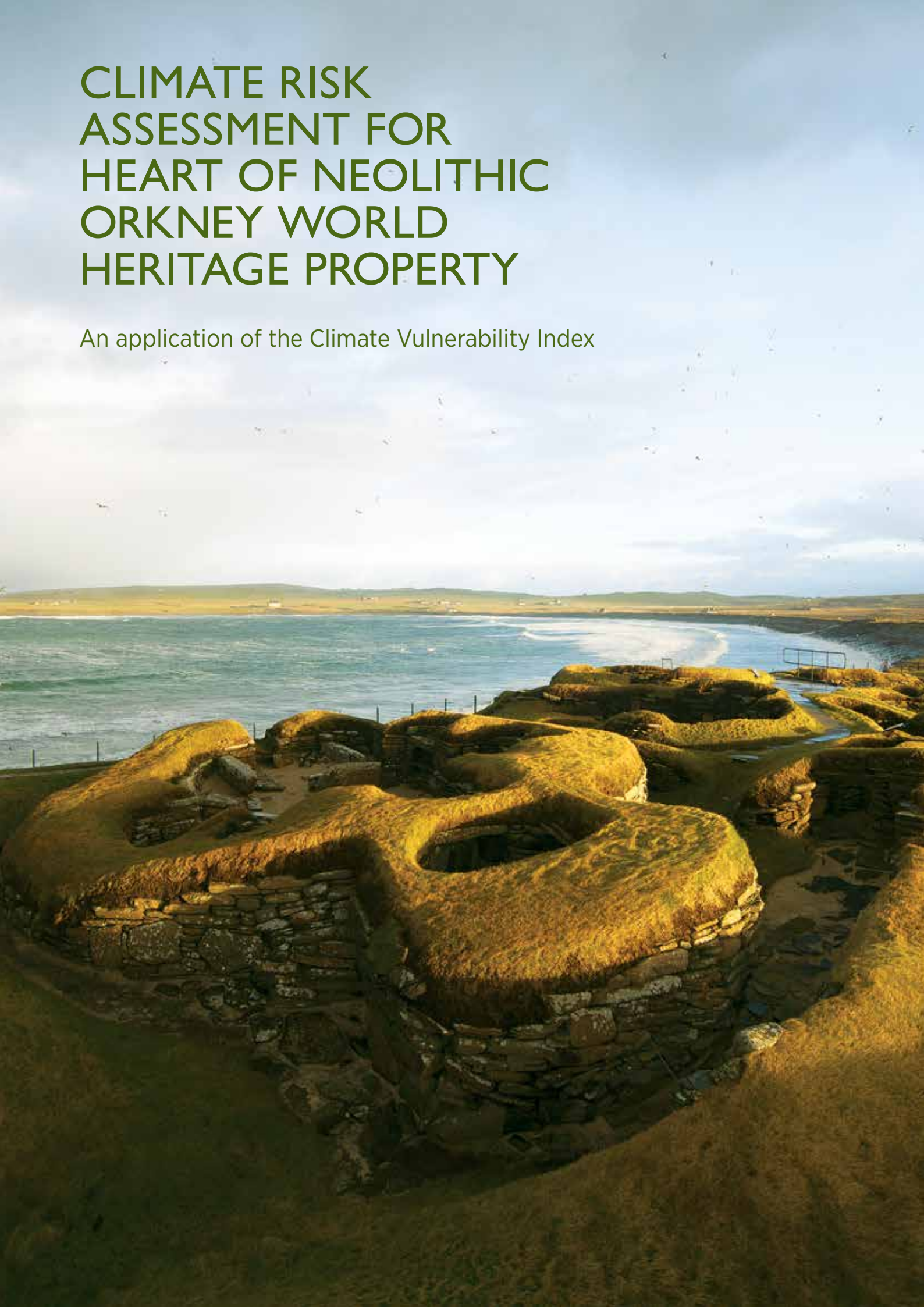
CLIMATE RISK ASSESSMENT FOR HEART OF NEOLITHIC ORKNEY WORLD HERITAGE PROPERTY

An application of the Climate Vulnerability Index



Authors
Jon C. Day[1], Scott F. Heron[2], Adam Markham[3,4], Jane Downes[4,5], Julie Gibson[5,6], Ewan Hyslop[7], Rebecca Jones[7], Alice Lyall[7]

Affiliations
[1] ARC Centre of Excellence for Coral Reef Studies, James Cook University, Townsville Q4811, Australia
[2] Physics, College of Science and Engineering, James Cook University, Townsville Q4811, Australia
[3] Union of Concerned Scientists, Cambridge, Massachusetts, USA
[4] ICOMOS Climate Change and Heritage Working Group
[5] University of the Highlands and Islands, Scotland, United Kingdom
[6] Orkney Islands Council, Scotland, United Kingdom
[7] Historic Environment Scotland, Longmore House, Salisbury Place, Edinburgh EH9 1SH, United Kingdom

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Contact
Enquiries regarding this report should be addressed to: Historic Environment Scotland, Longmore House, Salisbury Place, Edinburgh EH9 1SH, United Kingdom

Cover Skara Brae.

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EXECUTIVE SUMMARY

Maeshowe Chambered Cairn

Climate change is the fastest growing global threat to World Heritage (WH). Many WH properties around the world are already experiencing significant negative impacts, damage and degradation. These and many others are vulnerable to climate impacts, including from rising temperatures, sea level rise, extreme precipitation, flooding, coastal erosion, drought, worsening wildfires, and human displacement, and will be at risk in the future. Recently observed trends are expected to continue and accelerate as climate change intensifies.

This report describes outcomes from a workshop in Orkney, Scotland (April 2019) to apply the Climate Vulnerability Index (CVI). The CVI is a new methodology developed to rapidly assess climate impacts – both to Outstanding Universal Value (OUV) and the associated 'community' (local, domestic and international) – for all types of WH properties (natural, cultural or mixed). In its first application to a cultural WH property, the CVI process was undertaken for the 'Heart of Neolithic Orkney' (HONO).

HONO is comprised of four sites, among the most important Neolithic monuments in northern Europe, and was inscribed on the UNESCO WH List in 1999. Today these monuments remain dominant in a rural landscape, providing a unique testimony to ceremonial, funerary and domestic components of cultural traditions which flourished between 3000 BC and 2000 BC.

The CVI workshop for HONO:

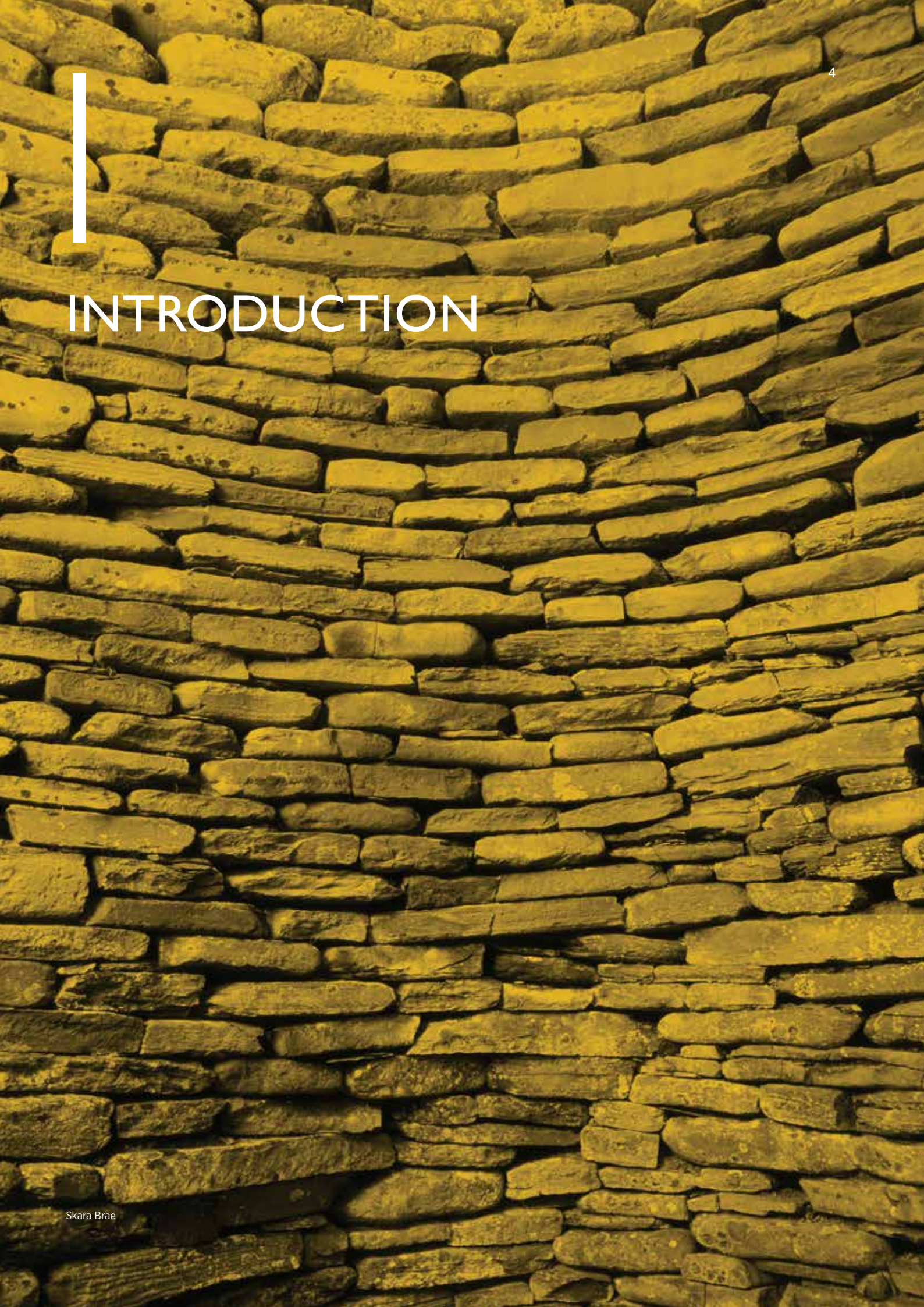
- involved site managers, academics, responsible management agencies, businesses, the local community and other stakeholders
- identified the three key climate drivers that present the greatest threat – Precipitation Change, Sea Level Change, and Storm Intensity and Frequency – considered over a time scale to c. 2050
- determined that the OUV Vulnerability was in the highest category (High), indicating the potential for major loss or substantial alteration of the majority of the values that comprise the OUV
- assessed Community Vulnerability to be in the middle category (Moderate), acknowledging the high level of adaptive capacity within the community
- concluded that climate impacts are increasingly likely to add to a wide range of compounding pressures including growing tourism numbers, infrastructure development and changing agricultural practices, which collectively are impacting the islands, Orkney's heritage and its cultural resources.

While the CVI methodology is currently in a pilot phase, the Orkney workshop highlighted the value of a transparent and repeatable framework for rapid assessment of climate impacts on heritage properties. Historic Environment Scotland will integrate the findings from the CVI workshop into the 2019 Management Plan revision and has recommended that the CVI process be repeated for HONO on a five-yearly cycle as part of the management review cycle.

There are currently six WH properties in Scotland and climate change has been identified as a current or potential risk to all; a full CVI assessment would be a valuable contribution to understanding climate impacts on these properties. There is also scope to employ the CVI methodology to inform the development of future WH nominations in Scotland and beyond.

Additional pilot CVI workshops involving different types of heritage at other WH properties around the world are planned to help further test, improve and refine the CVI methodology.

INTRODUCTION



Skara Brae

1.1 Background to this report

Climate change is the fastest growing global threat to World Heritage (WH) properties[1,2], many of which – natural, cultural and mixed – are already being impacted. The severity of current climate impacts on individual WH properties varies, as do the range of climate drivers causing those impacts (see Sections 4 and 5), and the rate at which they are occurring. In most cases, climate change impacts result in a degradation of the values that collectively comprise the Outstanding Universal Value (OUV) for WH properties (see Table 2.1 and Appendix 1).

"... climate change has become one of the most significant and fastest growing threats to people and their heritage worldwide ...".
(ICOMOS 2017)[1]

"Climate change is the fastest growing threat to ... World Heritage ... the most significant potential threat and, for a number of sites, this threat is materialising, with tangible impacts on World Heritage values".
(IUCN 2017)[2]

"Climate change is fast becoming one of the most significant risks for World Heritage sites worldwide ... direct and indirect impacts of climate change may present a threat to their OUV, integrity and authenticity".
(Markham et al. 2016)[3]

Currently UNESCO's Operational Guidelines for the Implementation of the World Heritage Convention[4] (the documentation used for managing all WH properties) has limited 'tools' to deal with impacts on WH values. The primary tool in the Guidelines is WH In-Danger, which was developed to deal with local and regional threats that a State Party can resolve given sufficient capacity and the political will. Furthermore, many WH properties could realistically be considered as being potentially vulnerable to the impacts of climate change, but it would be unrealistic to consider placing all WH properties on the WH In-Danger list.

The Intergovernmental Panel on Climate Change (IPCC) has predicted with 'high confidence' that *"Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate"*.[5] The IPCC has therefore advised (again with high confidence) *"Climate-related risks for natural and human systems [will]... depend on the magnitude and rate of warming, geographic location, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options"*.[5]

1.2 Overview of the Climate Vulnerability Index (CVI)

The Climate Vulnerability Index (CVI) methodology (Appendix 2) has been developed as a rapid assessment tool to assess climate change impacts upon WH properties based on a risk assessment approach. In response to the WH Committee's decision to update the World Heritage Convention's 2007 climate policy (41COM7[6]), an expert meeting was co-convened by ICOMOS, IUCN, ICCROM, the World Heritage Centre and the German Federal Agency for Nature Conservation (BfN) on the Baltic island of Vilm in 2017. The concept of a CVI for WH properties was introduced to the workshop. One recommendation from the workshop[7] was to consider establishing a climate vulnerability index for all properties to complement the WH In-Danger list. The CVI differs from previous vulnerability assessments by evaluating both *OUV Vulnerability* and *Community Vulnerability* (the latter being based on the economic, social and cultural dependencies related to the WH property and the adaptive capacity to cope with climate change) that is applicable to all WH properties.

1.3 Why was Orkney chosen to trial the CVI?

The CVI methodology had its first trial in a natural WH property (Shark Bay WHA, Australia in September 2018[8]) and various locations were suggested to test the CVI at a cultural WH site. The 'Heart of Neolithic Orkney' (HONO) was among several sites proposed.

HONO refers to a group of four Neolithic sites that collectively comprise one of Scotland's six WH properties. Situated on the mainland of the Orkney islands, the name was adopted by UNESCO when it proclaimed these sites as World Heritage in 1999 (see Section 2 for more details). The Orkney islands sit in an exposed position off the north coast of Scotland, between the Atlantic Ocean and the North Sea, where climate change has the potential to have severe negative impacts on this 5,000-year-old site and the surrounding areas. A key component of HONO, Skara Brae, was itself discovered as the result of a storm in 1850, underlining the vulnerability of this site.

Historic Environment Scotland (HES) is the public body responsible for the care and promotion of HONO, whose component monuments are also amongst more than 300 'Properties in Care' of national importance for Scotland. In recent years, HES has built a strong global reputation for innovation and practice in managing historic properties in response to climate change. Working in collaboration (e.g. with other government agencies, heritage organisations, research institutions and universities), HES has undertaken works to increase understanding and minimise the impacts of climate change on historic properties throughout Scotland, including across Orkney.

A number of factors led to HONO being chosen as the first cultural WH property to be assessed using the CVI. These included:

+ the existing recognition of HONO's vulnerability to climate change impacts
+ HES leadership and innovation in addressing climate change and its heritage implications
+ the engagement of the Archaeology Institute at the University of the Highlands and Islands (UHI) in Orkney – a high quality international research institution
+ strong support within the ICOMOS Climate Change and Heritage Working Group (CCHWG), including Professor Jane Downes (UHI) and Adam Markham (Union of Concerned Scientists, UCS)
+ the active engagement of the Orkney community with their historic environment and archaeological activities
+ local availability of a diverse array of researchers, other experts and stakeholders
+ good climate change data and research, and recently updated regional climate scenarios.

The CVI workshop was conducted in Orkney in April 2019 (more details about the HONO workshop are in Appendices 3 and 4).

The workshop aims were to:

1. Understand the CVI framework and its application in Orkney
2. Understand the significant values that comprise the OUV for HONO plus the other significant local values for Orkney
3. Understand the likely future climate change scenarios facing Orkney
4. Assess the climate drivers impacting the values of Orkney and select key climate drivers
5. Evaluate the vulnerability of the OUV to the key climate drivers, considering exposure and sensitivity
6. Consider the economic, social and cultural dependencies (sensitivity) and adaptive capacity to determine the Community vulnerability
7. Summary, feedback and next steps

This report, together with the Shark Bay report[8], substantiates the value of the CVI process to other WH site managers and to the wider WH community. The CVI methodology is currently in a pilot phase, and the Orkney workshop and an international series of other pilot workshops planned for the next 18 months involving different types of heritage properties, will be used to help improve and refine this methodology.

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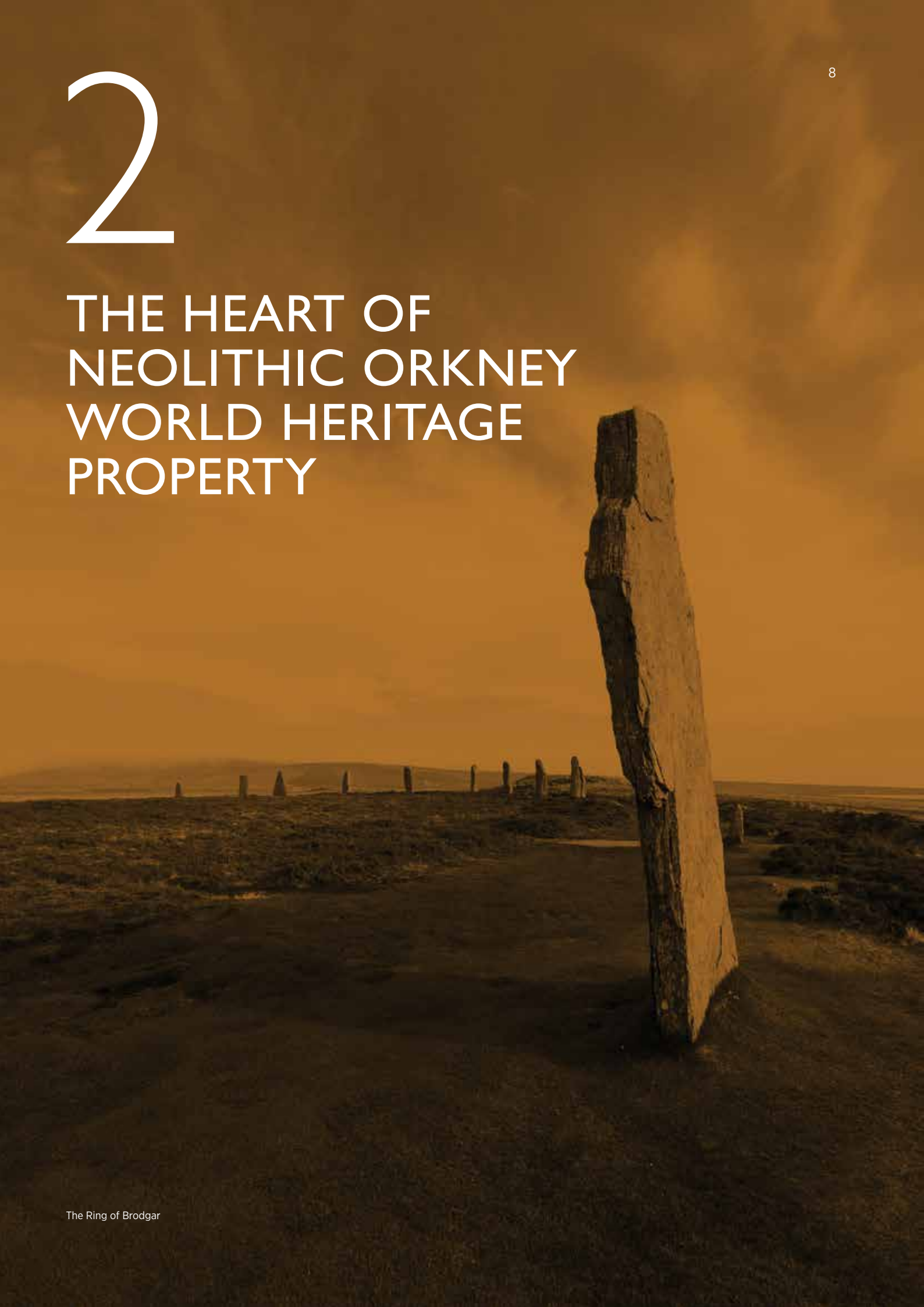
2

THE HEART OF NEOLITHIC ORKNEY WORLD HERITAGE PROPERTY



The Ring of Brodgar

2.1 Location

Orkney is an archipelago of about 70 islands lying 15 km off the north-eastern extremity of mainland Scotland where the North Atlantic meets the North Sea. The Heart of Neolithic Orkney World Heritage property is located in the west of Mainland, the largest island of the archipelago (Fig. 2.1).

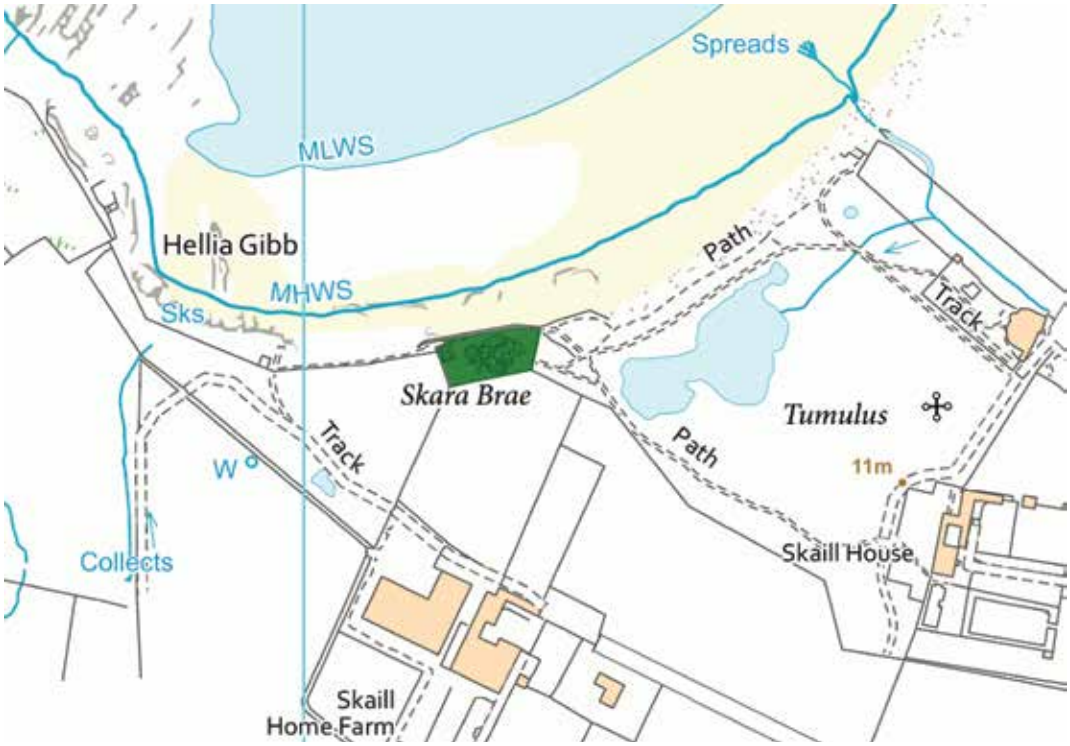
The WH property comprises four sites:

+ **Skara Brae** settlement: located on the Bay of Skaill, a pocket beach on the north-west coast of Mainland
+ **Maeshowe** chambered tomb and the associated **Barnhouse Stone**: located to the east of the southern tip of the Loch of Harray in central West Mainland
+ **The Stones of Stenness** and the associated **Watch Stone**: located near the shore of the Loch of Stenness on the peninsula at the south end of the Loch of Harray
+ **The Ring of Brodgar** and associated monuments: located on a peninsula that divides the Loch of Harray from the Loch of Stenness, joined to the Stenness peninsula to the south by a causeway bridge.

All sites are 'Properties in Care' managed by Historic Environment Scotland on behalf of Scottish Ministers. The World Heritage property boundary is tightly drawn and replicates the boundaries of the Properties in Care (Figs. 2.2 & 2.3) that define the limits of the four main monuments and the two associated standing stones. Surrounding the World Heritage properties is a much large Buffer Zone (Fig. 2.1). This is in two parts, one centred on Skara Brae on the north-west coast and one centred approximately 7 km to the south-east on the grouping of Maeshowe, Stones of Stenness and Ring of Brodgar. Many other sites dating from the Neolithic and later periods are located within the Buffer Zone, but do not form part of the inscribed World Heritage property. These include the Ness of Brodgar, discovered in 2003, and 23 Scheduled Monuments (recognised as being of national importance).

Figure 2.1 West Mainland of Orkney showing locations of the World Heritage monuments and the two-part Buffer Zone.

Figure 2.2 Location map of Skara Brae.



World Heritage Site

0 20 40 60 80 m

Figure 2.3 Map showing location of the Ring of Brodgar, Stones of Stenness and the Watch Stone, Maeshowe and the Barnhouse Stone.

World Heritage Site

0 0.1 0.2 0.3 0.4 km

2.2 The World Heritage Property

Inscribed on the World Heritage List in 1999, the combination of ceremonial, funerary and domestic sites that comprise the Heart of Neolithic Orkney bear "a unique testimony to a cultural tradition which flourished between about 3000 BC and 2000 BC" (Appendix 1). These Neolithic sites represent different facets of a dynamic and accomplished society: from domestic life at an extremely well-preserved settlement site through ceremonial expression at two monumental stone circle and henge sites, to beliefs and practices associated with death at a great chambered tomb. Individually the sites are masterpieces of Neolithic construction, and together they comprise one of the richest surviving Neolithic landscapes in western Europe. For a full description of the WH property, see the 1998 Nomination Document[1] submitted to the UNESCO World Heritage Committee.

i. Skara Brae

Skara Brae (Fig. 2.4) is a Neolithic settlement site occupied from c. 3100 to 2500 BC. Located today on the very edge of the Bay of Skaill and facing into the North Atlantic, it was discovered in 1850 when a storm stripped back the dune that had concealed it. The drystone construction and subsequent burial of the site in sand after abandonment allowed for exceptional preservation of domestic structures and interiors.

Evidence suggests that in the Neolithic, the settlement was c. 1 km from the sea and separated from it by a dune system and freshwater loch. Later in prehistory, the sea breached the dunes, creating the Bay of Skaill. The northern part of the settlement had been lost to the sea before discovery, and the first sea wall was constructed in 1925-26 to protect the site from further loss.

Vere Gordon Childe excavated the site in the late 1920s, initially believing it to be an Iron Age Pictish settlement, but this was later challenged. Further excavation in the 1970s by David Clarke confirmed the Neolithic date. There were two main phases of occupation: a first village of roughly square freestanding buildings with bed recesses, central hearths, stone-built 'dressers' and wall cupboards was followed on the same site by slightly larger houses, partially buried and connected by narrow, stone-slab roofed passages.

The later houses were similar in plan to the previous phase but contained freestanding stone slab 'box beds'. Geophysical survey suggests that further remains of settlement survive to the south-east of the areas revealed by 20th century excavations.

ii. Ring of Brodgar and associated monuments

The Ring of Brodgar (Fig. 2.5) is one of the finest and best-preserved prehistoric monuments in the British Isles. Laid out on almost a perfect circle, 123 m in diameter, it was probably built sometime after 2500 BC. Today there are 21 stones standing of 36 still visible, and there may once have been as many as 60, though it is not clear how many ever stood at one time. The stones may be from up to seven different sources, including one locality identified at Vestra Fiold 10 km to the north-west. The stone circle is surrounded by a monumental rock-cut ditch, now filled with peat but originally 10 m wide and almost 4 m deep. Two opposing causeways give access to the interior.

The Ring was carefully located by its builders, occupying the centre of a natural bowl or amphitheatre, surrounded by the water of the lochs and beyond this the low hills of Mainland and to the south-west the hills on the island of Hoy.

Sections of the ditch were excavated in 1973 and again in 2008. Otherwise, there has been no archaeological excavation of the Ring itself. Though known as a henge, the Ring of Brodgar lacks the external bank typical of these sites and excavations found no evidence for one. No artefacts were recovered from the ditch.

Around the Ring and forming part of the inscribed WH property lie at least 13 Neolithic and Bronze Age mounds and a stone setting, evidence that it remained a focus of activity for at least a thousand years. Antiquarian excavations in the 18th and 19th centuries have left limited evidence. The largest mound, Salt Knowe, may have had some sort of ceremonial function. The Comet Stone is situated on a mound to the south-east of the Ring and may have formed part of a stone setting.

Figure 2.4 Skara Brae

Figure 2.5 The Ring of Brodgar

iii. Stones of Stenness and the Watch Stone

The Stones of Stenness (Fig. 2.6) is a particularly early example of a stone circle, dating to 3100-2900 BC. Four great stone uprights remain out of an original 11 or 12 laid out on an elliptical plan c. 30 m in diameter and surrounded by a henge. The tallest of the surviving stones is over 5.7 m high. Two were re-erected in the early 1900s. The henge consisted of a ditch 6 m wide and about 2.3 m deep, though now mostly filled in, and an outer bank now much reduced by past ploughing. On the north side of the ring a single wide causeway crosses the ditch. The ditch may have considerable archaeological potential, including waterlogged deposits.

Excavations in 1973 revealed that a wooden post once stood in the centre of the ring. This was later replaced by a 2 m square setting of stone slabs. Pottery, cremated bone and evidence of fire were found inside this likely hearth. Evidence for a stone-built structure was located between the hearth and the causeway and it was likely that stones from this structure were re-used in 1908 when a 'dolmen' was erected on site – since taken down. Pits containing Iron Age pottery were found around the inside of the ring of stones, pointing to the ceremonial re-use of this Neolithic structure 2500 to 3000 years after it was first built.

The Watch Stone, a nearby monolith over 5.6 m in height, stands at the south end of the causeway between the Lochs of Harray and Stenness. It seems to have been one of a pair, as a socket for another standing stone was found to the south-south-west during roadworks in 1930.

iv. Maeshowe and the Barnhouse Stone

Maeshowe is a large chambered tomb built around 3000 BC (Fig. 2.7). The mound is 35 m in diameter and over 7 m high and was built on top of a partly artificial platform. A ditch, originally 14 m wide and 2 m deep, extends around the platform. The bank outside is predominantly modern but parts overlie the remains of a substantial prehistoric wall. Some of the stone slabs used in the construction weigh up to 30 tonnes.

A low 11 m long passageway opens into the 4.6 m square central chamber, flanked by three raised side cells. Neolithic carvings are inscribed on the masonry. A large blocking-stone in the passageway can only be pulled across the passage from the inside. During the midwinter sunset the setting sun aligns with the Barnhouse Stone and the entrance, and a beam of light shines along the passageway onto the back wall of the main chamber.

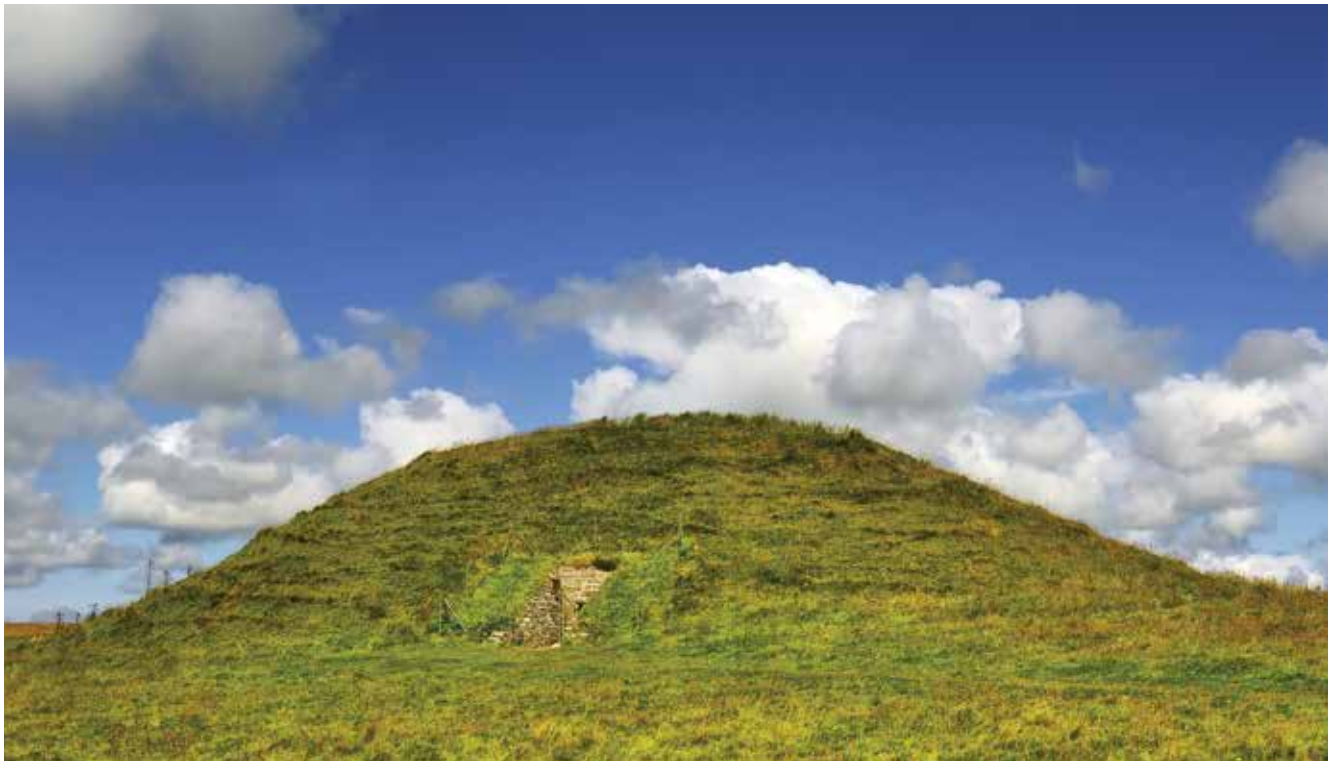
In the 12th century AD, Norse visitors broke into the mound. They may have removed burial remains and artefacts, as none are known, but they left behind the largest collection of Norse runes to be found in one monument outside Scandinavia.

Maeshowe has been subject to a series of excavations since 1861, and later evidence suggests there was activity at the site from the early Neolithic. A socket for a very large standing stone was been found in the platform below the mound, and in 1991 excavations revealed the presence of an earlier structure on the site, possibly a house.

The Barnhouse Stone is a monolith about 3 m tall which stands about 0.8 km south-west of Maeshowe. It stands in a line with the entrance to Maeshowe and the direction of the midwinter sunset and is visible when looking down the passageway from inside the chamber.

Figure 2.6 Stones of Stenness © Shutterstock

Figure 2.7 Maeshowe © Shutterstock



2.3 Implications of World Heritage Status

The 1972 World Heritage Convention[2] deals with the identification, protection and preservation of cultural and natural heritage around the world that is of outstanding value to all of humanity. The Convention has now been ratified by 193 governments, and in 2018 there were 1092 sites on the World Heritage List.

Inscription of a site on the World Heritage List obligates the relevant State Party to ensure the protection, preservation and transmission of its Outstanding Universal Value (OUV) to future generations. The Convention also describes the shared duty of the international community of signatories to protect all WH properties. Each property has a Statement of OUV which is the principal reference for protection and management of the property and a baseline for monitoring and reporting.

The Operational Guidelines for the Implementation of the World Heritage Convention[3] define ten criteria defined for OUV – six cultural and four natural.

HONO fulfills criteria (i) to (iv):

+ **Criterion (i)** to represent a masterpiece of human creative genius
+ **Criterion (ii)** to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design
+ **Criterion (iii)** to bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared
+ **Criterion (iv)** to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history.

All World Heritage properties must also demonstrate that they possess integrity: this requires assessing if the WH property is of sufficient size, and if its components are sufficiently complete, to show OUV; and assessing what pressures threaten the site and if they can be addressed.

For properties like HONO inscribed under any of the six cultural criteria, the Operational Guidelines have further requirements for integrity, including that "the physical fabric of the property and/or its significant features should be in good condition, and the impact of deterioration processes controlled. A significant proportion of the elements necessary to convey the totality of the value conveyed by the property should be included".

In addition to meeting the relevant criteria, cultural WH properties must also demonstrate authenticity. This condition is met where cultural values are expressed through their attributes, both tangible and intangible. The Operational Guidelines identifies attributes as including "form and design; materials and substance; use and function; traditions, techniques and management systems; location and setting; language, and other forms of intangible heritage; spirit and feeling; other internal and external factors". While attributes like spirit and feeling can be difficult to define and apply, these can be important indicators of character and sense of place.

In addition to its OUV, HONO has a range of other important values of national, regional and local significance. The Operational Guidelines make it clear that heritage should have a function in the life of the community, and that access and facilities for visitors appropriate to the protection and management needs of the property should be provided. However, management must ensure that sustainable use or any other change does not impact adversely on the OUV. This has implications for prioritisation and decision making in management and protection of the property.

The vulnerability of HONO to the impacts of climate change has previously been highlighted by the management partners as a key concern. Delivering on Convention commitments to preserve and transmit the WH property to future generations requires ensuring the continuing integrity of the site as a whole, maintaining the attributes that express authenticity, and managing impacts on the key values that combine to give the site OUV. Piloting the Climate Vulnerability Index for cultural WH properties is an important step in identifying the potential impacts, adaptive capacity, and vulnerability of the OUV.

2.4 Identifying the Values of the World Heritage Property

A retrospective Statement of Outstanding Universal Value (SOUV) for HONO was drafted in 2010 and adopted by UNESCO World Heritage Committee at the 37th session in Phnom Penh, Cambodia, June 2013. The full text of the HONO SOUV is reproduced in Appendix 1.

Prior to the CVI process commencing, the key excerpts from the HONO SOUV were identified and grouped together in a tabular form (see Table 2.1). These eight 'key values' were the basis for the assessments made throughout the CVI process. Other aspects of the SOUV were identified and related to the management of the property (Vulnerabilities and Management) (see Table 2.2).

Table. 2.1 Key values for HONO, derived from excerpts (shown) of the Statement of OUV (Appendix 1), together with their assessed current condition and trend (based on change since inscription in 1999).

Key values	Excerpts taken directly from the Statement of OUV	Current Condition and trend
	+ a major prehistoric cultural landscape which gives a graphic depiction of life in this remote archipelago in the far north of Scotland some 5,000 years ago + major relict cultural landscape graphically depicting life five thousand years ago	↘
Well-preserved prehistoric settlement	+ remarkably well-preserved settlement + state of preservation of Skara Brae is unparalleled amongst Neolithic settlement sites in northern Europe + Skara Brae is unparalleled for a prehistoric settlement in northern Europe + the sophisticated settlement of Skara Brae with its stone built houses connected by narrow roofed passages	↘

Good
The site's values are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.

Good with some concerns
While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained over the long-term.

Significant concerns
The site's values are threatened and/or may be showing signs of deterioration. Significant additional conservation measures are needed to maintian and/or restore values over the medium to long-term.

Critical
The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed to maintain and/or restore the site's values over the short to medium-term or the values may be lost.

→ **Stable**

↗ **Improving**

↘ **Deteriorating**

Table. 2.1 cont'd...

Key values	Excerpts taken directly from the Statement of OUV	Current Condition and trend
	+ a large chambered tomb (Maeshowe) + two stone circles with surrounding henges (the Stones of Stenness and the Ring of Brodgar) + a number of associated burial and ceremonial sites	↘
	+ among the most important Neolithic sites in Western Europe + the monuments remain largely in-situ	→
	+ monuments form and design are well-preserved + monuments remain dominant features in the rural landscape	↘
Architecture	+ highest sophistication in architectural accomplishment + technologically ingenious and monumental masterpieces + outstanding example of an architectural ensemble + an important interchange of human values during the development of the architecture of major ceremonial complexes in the British Isles, Ireland and northwest Europe	→
	+ exceptional evidence of the material and spiritual standards + exceptional evidence of beliefs and social structures of this dynamic period of prehistory + illustrates the material standards, social structures and ways of life of this dynamic period of prehistory + a paradigm of the megalithic culture of north-western Europe that is unparalleled	↗
Societal activities	+ characteristic of the farming culture prevalent from before 4000 BC in northwest Europe	→
	+ deliberately situated within a vast topographic bowl formed by a series of visually interconnected ridgelines visually linked to other contemporary and later monuments + form a fundamental part of a wider, highly complex archaeological landscape + wealth of contemporary burial and occupation sites in the buffer zone constitute an exceptional relict cultural landscape that supports the value of the main sites + archaeological landscape that illustrate a significant stage of human history when the first large ceremonial monuments were built	→
	+ current, open and comparatively undeveloped landscape around the monuments allows an understanding of the apparently formal connections between the monuments and their natural settings	→

Table. 2.2 Other important excerpts from SOUV (Appendix 1) associated with key values (Table 2.1).

	Excerpts taken directly from the Statement of OUV
Vulnerabilities	+ the boundaries are tightly drawn and do not encompass the wider landscape setting of the monuments that provides their essential context, nor other monuments that can be seen to support the Outstanding Universal Value + this fragile landscape is vulnerable to incremental change + physical threats to the monuments include visitor footfall and coastal erosion + prevent development that would have an adverse impact on its Outstanding Universal Value + Outstanding Universal Value is potentially at risk from change and development in the countryside
Management	+ identifying a series of key issues and devising specific objectives or actions to address these issues + strategy for future maintenance and conservation + management of tourism in and around the World Heritage property seeks to recognise its value to the local economy, and to develop sustainable approaches to tourism

2.5 Managing the World Heritage Property

The World Heritage property boundary is very tightly drawn to coincide with the Properties in Care, as noted above. HES has direct management responsibility for all the individual monuments that comprise the HONO WH property. However, the WH property as a concept, including its relationships, and access and infrastructure within the Buffer Zone and between the monuments is managed in partnership. This is done through a Management Plan which provides the framework for the preservation of the OUV. The Management Plan is a collaborative document developed and delivered by the partners, who are critical for integrated management of the WHS as a whole.

The Management Plan partners for the 2014-19 Management Plan are HES, Orkney Islands Council, Scottish Natural Heritage (SNH) and the Royal Society for the Protection of Birds (RSPB). A wide variety of stakeholders also have important roles in enabling the management and protection of the WH property and its Buffer Zone.

The current WH property Management Plan[4] covers the period 2014-19 and HES and its HONO management partners will be undertaking its complete review as part of the creation of a new plan for 2020-25. For a fuller discussion of management of the HONO WH property see Appendix 7.

At present there are no threats to HONO's OUV of an immediate nature that would require a Reactive Monitoring Report (Paragraph 172 Notification) to be submitted to the World Heritage Centre. However, one of the reasons for the development of the CVI rapid assessment tool is the acknowledgement by UNESCO of the urgent need for improved guidance and an appropriate tool to deal with climate change and its effects on World Heritage values over different timescales.

Figure 2.8 Examples of management pressures and conservation actions at HONO sites: Increased visitor numbers in recent years is adding to pressures on pedestrian surfaces at Ring of Brodgar (top); Increasing erosion of the soft dune coastline immediately adjacent to the protective sea wall around the Skara Brae site (bottom).

Figure 2.9 Examples of management pressures and conservation actions at HONO sites: Damage to footpath at Ring of Brodgar resulting from higher visitor numbers and increased rainfall levels (top); Installation of engineered surfaces to improve footpath resilience (bottom).

HES monitors the physical condition of the monuments across the WH property on a regular basis, including an Annual Conservation Audit at each of the component sites. Specific ongoing monitoring at the HONO sites includes:

- periodic recording of the runic inscriptions within Maeshowe since 2008, in order to ensure that these are not deteriorating
- environmental monitoring within House 7 at Skara Brae to measure the effectiveness of the replacement solid roof in protecting the fragile interior stonework
- increased staff presence to manage visitor movements and installation of automated visitor counters at Ring of Brodgar in order to more effectively monitor visitor numbers
- regular monitoring of the condition of the sea wall and immediate coastline at Skara Brae including terrestrial laser scanning every two years in order to identify and movement including loss or gain of coastal and beach material.

Ongoing conservation of the WH property monuments currently includes (Fig. 2.8 & 2.9):

- periodic stone conservation works at Skara Brae, Ring of Brodgar and Stones of Stenness
- improvements to pedestrian surfaces at Skara Brae to reduce erosion and enhance access and improve visitor flow around the site
- various approaches to improve the resilience of pedestrian areas at Ring of Brodgar through installation of engineered surfaces beneath modern turf layers
- repairs to the mound structure at Maeshowe in order to prevent water penetration to the interior resulting from increasing rainfall
- a long-term programme of repair and extensive targeted improvement works on the sea wall that protects Skara Brae.

Management of the site has had to adapt to large increases in visitor numbers in Orkney over the past decade. There have also been important shifts in patterns of visitation, including a large rise in the number of visitors from cruise ships (an increase from 36,000 in 2011 to 113,000 in 2017). The Ring of Brodgar received 142,000 visitors in 2018, and increased footfall is interacting with changes in precipitation patterns – primarily increased precipitation but also periods of very dry weather – which has led to serious and increasing footfall erosion. This threatens the fabric of the site and degrades the visitor experience for tourists and local residents. Over the last few years an extensive programme has seen installation of new turf surfaces over an engineered porous subsurface drainage layer to create more resilient surfaces for visitors (Fig. 2.9). Balancing access at the Ring of Brodgar, especially to the inner Ring, with conservation is now a key issue for site management, with periods of partial site closure required to allow areas of footpath to recover. The redirection of visitors to the outside of the Ring during these periods is resulting in further issues emerging in new locations as footfall on other parts of the site increases. For example, there are now footfall erosion issues on the prehistoric mounds associated with Ring of Brodgar, compounded by animal burrow damage.

In 2017, HES published a baseline Climate Change Risk Assessment for all its Properties in Care[5], including the HONO monuments. This desk-based exercise used existing Geographic Information Systems datasets to assess the risks from six identified hazards: fluvial, pluvial, groundwater and coastal flooding, slope instability and coastal erosion. However, it should be noted that the results of this report are strictly limited to impacts to the physical fabric and cultural significance within the Property in Care boundaries - risks just beyond these boundaries were not included. The report also identifies the limitations of the datasets used, for example the flooding datasets were not originally created for property-level assessments.

At the Ring of Brodgar, fluvial flooding, slope instability, and groundwater flooding were rated as a medium risk; at Skara Brae, groundwater flooding and slope instability as a high risk; slope instability and groundwater flooding were rated as a medium risk for Stones of Stenness; and for Maeshowe, groundwater flooding was identified as a high risk and slope instability as medium.

At Skara Brae, which recorded 112,000 visitors in 2018, management of footfall is also an increasing issue, although coastal erosion and rising sea levels (sea level change) remain the predominant threat to the survival of the site in the longer term. This is being addressed in the short and medium-term by periodic monitoring and ongoing sea wall maintenance and repair. There is potential for a single extreme coastal weather event to seriously damage the site, though at present the state of conservation is regarded as good.

In the past, the Stones of Stenness have proved resilient to visitor pressures, and the site had c. 80,000 visitors in 2018. However, with changes in visitation patterns across Orkney, and resolving parking infrastructure and access footpath issues, the site could potentially see increased footfall pressure bring issues similar to those at Ring of Brodgar.

At Maeshowe, visitor numbers are limited as access is by timed tours, with c. 28,000 visitors to the site in 2018. Monitoring reveals that runic and Neolithic carvings on the interior stonework appear stable. However, there are potential impacts to the structure of the monument from changes to wetting/drying cycles and more groundwater flooding that are not well understood at present.

An additional issue is that of changes over time to the landscape of the Buffer Zone driven by changes to the climate with potentially negative impact on the atmosphere of the sites. For example, loss of some species, increases in invasive species, changes to vegetative cover and changes to farming practice may alter the landscape and affect the 'sense of place'.

2.6 Evaluation of current condition and trend of the key World Heritage Values

CVI Workshop evaluation: As recorded in Table 2.1 above, the workshop participants identified the key values that make up the OUV for HONO. The workshop then identified the main climate drivers impacting the OUV and conducted a rapid assessment of the current condition and trend of these key values (Table 2.1). Section 5 provides a full description of the CVI process and results for HONO.

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3 THE CONTEXT FOR HONO

Stone Neolithic figurine known as the 'Westray Wife'

3.1 Physical geography and landscape

The archipelago of Orkney consists of about 18 inhabited islands plus approximately 70 small islands and holms (Fig. 3.1). It is situated at 59°N just off the north coast of Scotland, between the Atlantic Ocean and the North Sea and separated from Scotland by the swift flowing currents of the Pentland Firth. The Mainland of Orkney is the biggest island of the group. Its landscape is mainly one of low and gentle relief, with many lochs and bogs. Windswept, treeless hillsides are divided into squared pasture fields, and the Atlantic facing cliffs are generally topped by open areas of heath, scoured at the edges by spray, rain and wind[1].

It is probable that, in the last Ice Age, when Scotland was heavily glaciated and sea-levels 40 m lower than present, Orkney was one island. Isostatic rebound in Orkney has not kept up with natural sea-level rise and has led to the separation into the many islands seen today. The last 5 m of sea level rise has occurred in the last 5,000 years (since the creation of the HONO monuments). One effect of this was the marine inundation of the previously freshwater lochs of Stenness and the connected Harray loch, which surround the Ring of Brodgar. The last 1,000 years have seen this natural background sea-level rise continue slowly – at least 20 cm in the last 600 years[2].

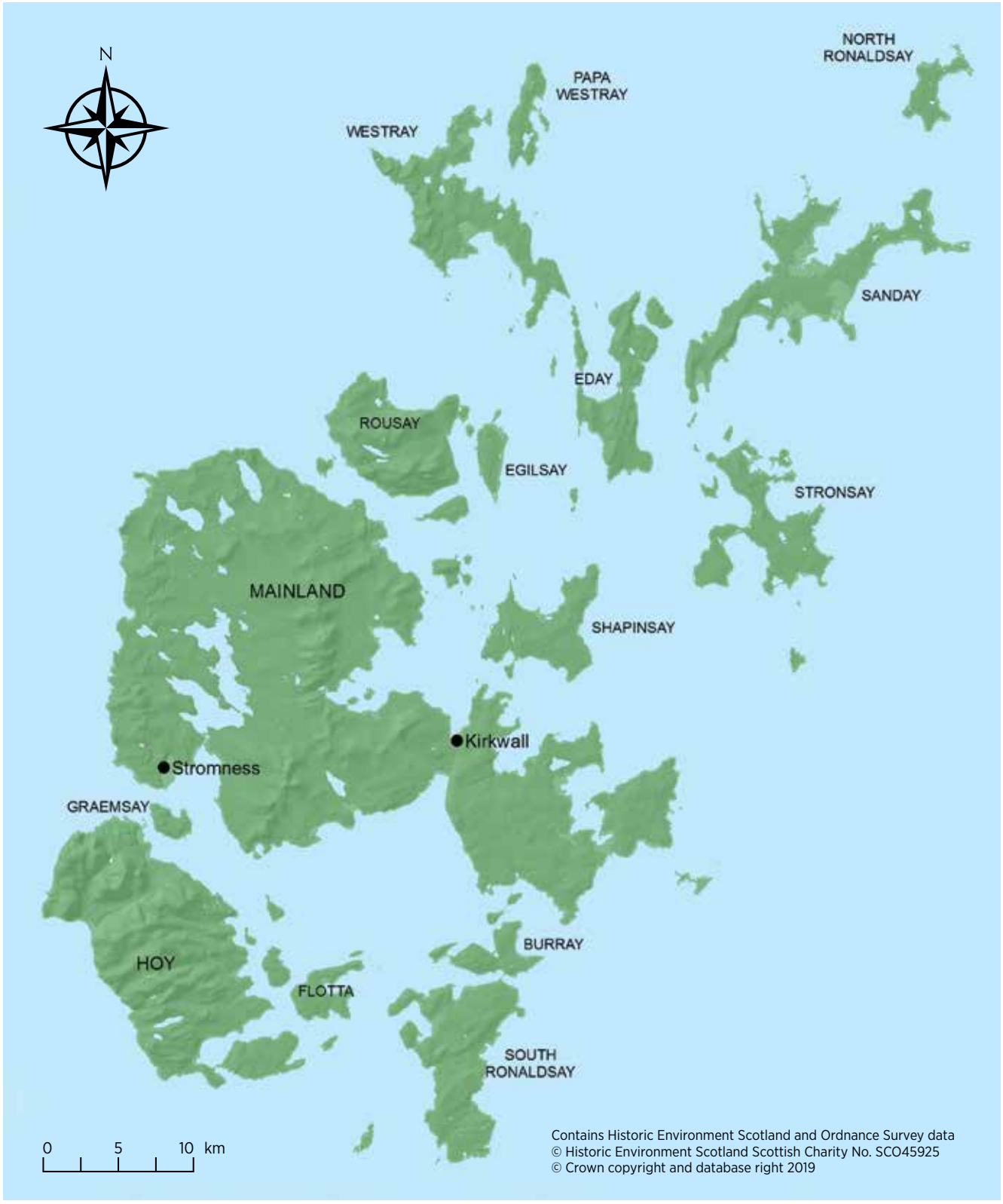
The coastline of West Mainland, in which the World Heritage property is situated, is characterised by high cliffs, interspersed with bays, including the Bay of Skaill (the location of Skara Brae). The Skara Brae village was founded on a thin line of glacial boulder clay that tops the Old Red Sandstone, at about 1 m above today's high tides, and was swamped by sand about 4,000 years ago. It is likely that an ayre originally protected a freshwater loch behind which was the Neolithic village, and that the current bay was formed by the seas breaking through that original barrier. Today the sandy Bay of Skaill faces northwest taking the full force of the Atlantic seas.

3.2 Ecology and agriculture

The ecology of Orkney is sensitive and significant[3]. A large proportion of the islands of Mainland and Hoy is designated as a National Scenic Area (extending to about 15,000 hectares). On Mainland alone, there are 14 nationally important Sites of Special Scientific Interest (SSSI) covering nearly 7,500 hectares: (i) over 4,500 hectares lie in two classified Special Protection Areas that are internationally important for birds; (ii) over 1,500 hectares lie in two Special Protection Areas that add additional legislative protection for the WH property; and (iii) nearly 800 hectares lie in a candidate Special Area of Conservation with internationally-recognised habitats. In addition, there are over 100 other sites designated for their local nature conservation value extending to almost 4,000 hectares[3]. The HONO sites are close to several areas designated for their natural assets and which could be affected, positively or negatively, by climate impact and/or climate mitigation strategies.

The Orkney Local Biodiversity Action Plan divides the ecological landscape into four parts: Greenspace (next to, or within towns); Farmland; Peatland; and Marine Environment. These landscapes, loch basins, uplands and farmlands are influenced by land management, past and present. Farms in the islands mainly focus on grass crops for livestock, with some cultivation of barley or swedes, etc., mainly for animal feed. The mixed farming regime is good for biodiversity with small natural or semi natural areas providing 'corners and corridors' that are associated with smaller farms and lower stocking densities and are important places for wildlife that help maintain ecosystem services. National agencies and local government are working together to help farmers support this[4].

Figure 3.1 Map of the Orkney Islands



3.3 Economic context

Orkney is an area of low unemployment. Government (especially National Health Service and Orkney Islands Council), tourism, transport, renewables and higher education are all significant employers. The traditional industry of agriculture is still the most widespread industry in both economic and landscape terms across the archipelago with 2,000 people employed. About £17 million was received in EU-supported agricultural subsidies in 2016-17, which was vital to the continuation of the industry in Orkney. Following the outcome of the European referendum in 2016, the long-term future of direct agricultural support remains unknown. By contrast, less than 300 people are reported to be fishermen; the total value of fish catch for 2017 was approximately £16 million.

The economic value of tourism was estimated at £77.5 million in 2017[5] (Table 3.1), with tourism activities concentrated in Mainland. 40% of visitors selected archaeology as the main reason for choosing to visit and 69% actually visited an archaeological site. Among these, HONO was joint top of the list of visited places. Excavations adjacent to the WH property have been televised and are responsible for an associated surge of tourism interest in Orkney[6].

Visitors to Orkney come predominantly by cruise ship (which has resulted in heavy recent investment in the Harbours of Orkney) or as individuals/families whose expenditure is possibly wider spread.

Imagery related to HONO is frequently used in branding and advertising of food and drink. For example, the branding of Orkney cheese features the Ring of Brodgar as the main image reinforced by a logo depicting the Maeshowe dragon (Fig. 3.2).

Orkney's investment in renewable energy, mainly wind power followed by tidal generation, has grown in recent years, such that Orkney produced over 120% of its electricity needs by 2017. In contrast, Orkney's fuel poverty is one of the highest in the UK with 49% of the population in fuel poverty in the West Mainland and 73% in the outer islands (2015 data[7]). Specific Planning Guidance protects the WH property against negative impacts on its setting, with tall developments required to be located behind and below sensitive ridge lines[8].

Table 3.1 Economic value of tourism to industry sectors in Orkney[5]

Sector	2015		2014	
	£ (in millions)	% of total distribution	£ (in millions)	% of total distribution
Transport	15.4	23.5	13.85	23.4
Accommodation	13.77	21.0	12.72	21.49
Shopping	12.51	19.1	11.25	19.0
Indirect	11.9	18.2	10.75	18.16
Food and drink	7.909	12.1	7.118	12.02
Recreation	4.044	6.2	3.488	5.89
Total	**65.53**	-	**59.18**	-

Figure 3.2 Orkney cheese labels showing the Ring of Brodgar and depicting the Maeshowe dragon in the logo.[9]

3.3 Social and Cultural context

Orkney's population in 2017 was estimated at 22,000, of whom nearly all were white and UK born[10]. About half of the population live in Kirkwall, the main town. The population is ageing and it is forecast that by 2026 over 40% of the population will be over 75. The population in most of the outer islands is falling.

Orkney's past is highly relevant to the identity of today's islanders, serving to provide or reinforce a strong Orcadian identity. This reveals itself in multiple ways:

+ Orkneyinga Saga is an Icelandic saga telling the story of the Earls of Orkney between the 10th and 13th centuries and is a powerful influence locally in respect of Orkney's Scandinavian past. Evidence for this can be seen, for example, in the continuing popularity of Saga names for Orcadian boys.
+ Extensive museums' collections relate to all periods. Orkney Islands Council has a policy for bidding for all archaeological material that is excavated or found in the islands to be allocated to the Orkney Museum. This is home to a Recognised Collection of national significance under the Scottish Government's Recognised Collections Scheme run by Museums Galleries Scotland. Orkney Museums in turn recognise very local aspirations, returning some items back to smaller communities (e.g. returning carved stones to the small islands of Westray and Sanday). This Orcadian identification with the past, including the Neolithic, is widely known, and HES have responded by returning the 'Westray Wife' a stone Neolithic figurine, to Westray, on long term loan prior to its allocation through the Treasure Trove system.

+ The recent UHI Archaeology Institute excavations at the Ness of Brodgar are a source of much local pride, and are seen to be helping to counter colonialist narratives of the spread of culture from south to north in the UK. These excavations have brought the prehistory of Orkney into national and international media, and the Orcadian Newspaper has a long tradition of reporting archaeological news. Reports of the CVI meeting and visits to coastal sites were welcomed by local landowners as evidence of worldwide interest in both the archaeology of the islands and its challenges. The cultural importance of the Ring of Brodgar and the Stones of Stenness, which are parts of HONO, is emphasised as both are used as wedding venues, either for photographs alone or increasingly for the ceremony itself. In addition, cremation ashes are scattered or deposited in these places, attesting to the significance of the monuments in the life of the deceased and their family.

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4

CLIMATE AND ITS INFLUENCE ON HONO

Stones of Stenness © Shutterstock

4.1 Current Climate

Orkney has a cool temperate maritime climate that is moderated by the Gulf Stream and so is relatively mild for its northerly latitude (59°N). Temperature extremes are rare, and frosts uncommon. Characteristically windy, the islands are highly exposed to very strong prevailing southwesterly winds and to incoming Atlantic storms and gales which are quite frequent. Rain and sea-haar (fog) are common. The islands experience strong tidal flows and, during storms, some of the largest wave heights in the UK. The mixing of North Sea and Atlantic waters causes localised extreme currents. The culture and physical infrastructure of Orkney is strongly influenced by and reflects its weather conditions.

Orkney's average annual temperature is 8.1°C. The average temperature for the warmest month (July) is 13°C, and the coldest month (January) is 4°C. Average winter night temperature is 2.3°C.

The average annual rainfall is 1038.5 mm (79 mm per month), and there are on average 188 days per year with more than 1.0 mm precipitation (i.e. it rains on about 16 days per month). The wettest months are typically October and November that record, on average, 126 mm of rainfall. The driest month is typically May with an average of 48 mm precipitation. Orkney typically has <20 snow days per year, and receives less total snow than much of the Highland region of Scotland.

Average annual relative humidity is 81.3%, and the average monthly relative humidity ranges from 75% in April to 86% in November. Average hours of sunshine per year are 1204 (an average of just over 3 hours per day). It is typically sunny for 27.5% of daylight hours, with the remaining 72.5% of daylight hours cloudy or with shade, haze or low sun intensity.

Winds are a key feature of the Orkney climate, and even in summer there are almost constant breezes (average 10-16 mph). In winter, there are frequent strong winds (average 25-31 mph), with around 52 hours of gales recorded annually.

Orkney's exposed position off the northern tip of Scotland results in high wave energy, with recorded average significant wave heights of 2-3 metres, reaching extremes of up to 19 metres. For west Orkney wave power is high, 31 kW/m reducing to 22 kW/m nearshore. There is strong seasonal variability and wave energy is strongly correlated to the North Atlantic Oscillation. The tidal range recorded for Kirkwall is 1.10 metres (Neap) to 2.26 metres (Spring), with strong localised tidal flows.

Details of Orkney's current climate are available from the UK Met Office Climate Averages table for Kirkwall, covering the period 1981 to 2010[1].

4.2 Observed Climate trends

The last century has been a period of rapid climate change across Scotland[2]. In particular, records show that over the last few decades temperatures have increased, with the last decade the warmest ever recorded. Rainfall patterns have also changed, with increased rainfall and more heavy downpours. Sea-level rise is accelerating; and there are fewer days with frost and snow cover.

Orkney is included within the North of Scotland region as defined by the UK Met Office. Trends over the period 1961-2004 show a series of significant changes for many climate indicators. These include:

- Increase in average temperature of 1.03 °C
- Average precipitation has increased by 21% with a 68.9% increase in winter, and 7% increase in summer. Rainfall shows a large variability from year to year
- Growing season has increased by 31 days
- Air frost has decreased by 21%; and ground frost decreased by 31.8%
- Snow cover days have reduced by 28.8%
- Days of heavy rain have increased by 8.2%.

There are no clear trends for wind speed or days of gales per year; nor in sunshine hours or cloud cover.

A number of significant changes in extremes of temperature and rainfall are observed for the North Scotland region when comparing weather data for the period 1961-1990 with the period 1981-2010 and most-recent decade, 2008-2017[3]:

+ **Temperature:** Compared to the period 1961-1990, the decade 2008-2017 shows an increase of 85% in warm periods of over 6 days duration. Over this decade there has been reduction in icing days (days with minimum temp below zero) from 9.2 to 7.3. Lowest recorded temperature has decreased from -10.6°C to -8.3°C
+ **Precipitation:** Compared to the period 1961-1990 the decades between 1981 and 2017 show increases of 19% for rainfall amounts on extreme wet days, and a 16% increase for the highest value of rainfall over a 5-day period.

Since the beginning of the 20th century global average sea levels have risen by around 16 to 21 cm, with rates accelerating since 2000[4]. Land uplift in Scotland continues from post-glacial times with much of the coast rising at rates close to 1 mm/yr.

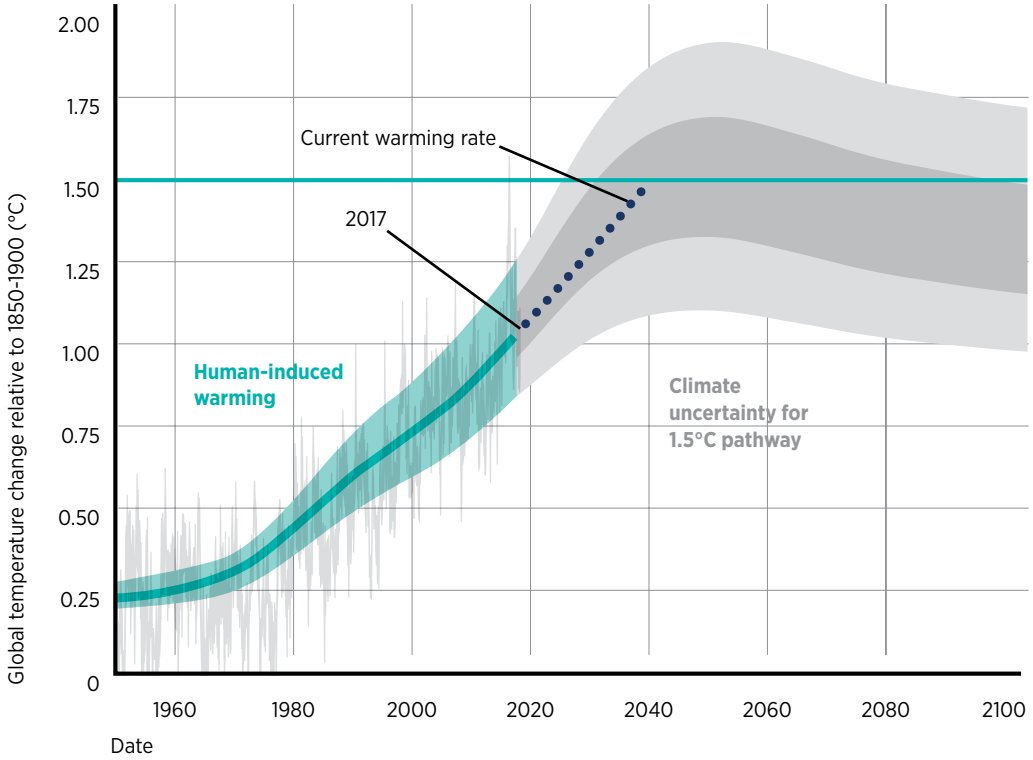
In recent decades this has become outstripped by global sea level rise, with an average rate of c. 3 mm/yr relative sea level rise noted by tide gauges on all Scottish coasts[5]. On the north coast of Scotland (Wick) data shows an increase of 5.54 mm/yr from 1992-2007 and 3.06 mm/yr from 1992 to 2013.

4.3 Anticipated climate change

i. Global climate change and the Paris Agreement

The 2015 Paris Agreement signed by 195 countries under the auspices of the UN Framework Convention on Climate Change (UNFCCC) seeks to keep global temperature rise well below 2°C from pre-industrial levels, and to pursue efforts to limit it to 1.5°C. According to the Intergovernmental Panel on Climate Change (IPCC), we have already made the climate 1°C warmer since pre-industrial times. Warming is likely to reach 1.5°C around 2040 and 2°C by 2065 if emissions continue unchecked (Fig. 4.1).

Figure 4.1 At current emissions pathways global temperatures will reach 1.5°C around 2040 and 2°C by 2065[6]. Grey shaded area shows the effect of immediate emissions reduction to reach net zero by 2055



Globally, rising temperatures are accelerating sea level rise, driving more intense and frequent extreme weather events, worsening drought and wildfires, and causing more damaging coastal flooding and storm surges (Fig 4.2). Sea level rise is accelerating, but the rate of change we experience through the rest of this century will be determined by the rate and extent of loss of the Greenland and Antarctic ice sheets.

Current estimates of global sea level rise are variable due to a number of uncertainties, but typically range between 0.5 metres and 2.4 metres higher by 2100 compared to 2000 (Fig. 4.3). Warming oceans are causing coral bleaching and changes in the range and populations of fish species that hundreds of millions of people rely upon for food and income.

Figure 4.2 The strength of scientific evidence for some of the most significant impacts of climate change – ©Union of Concerned Scientists (UCS).

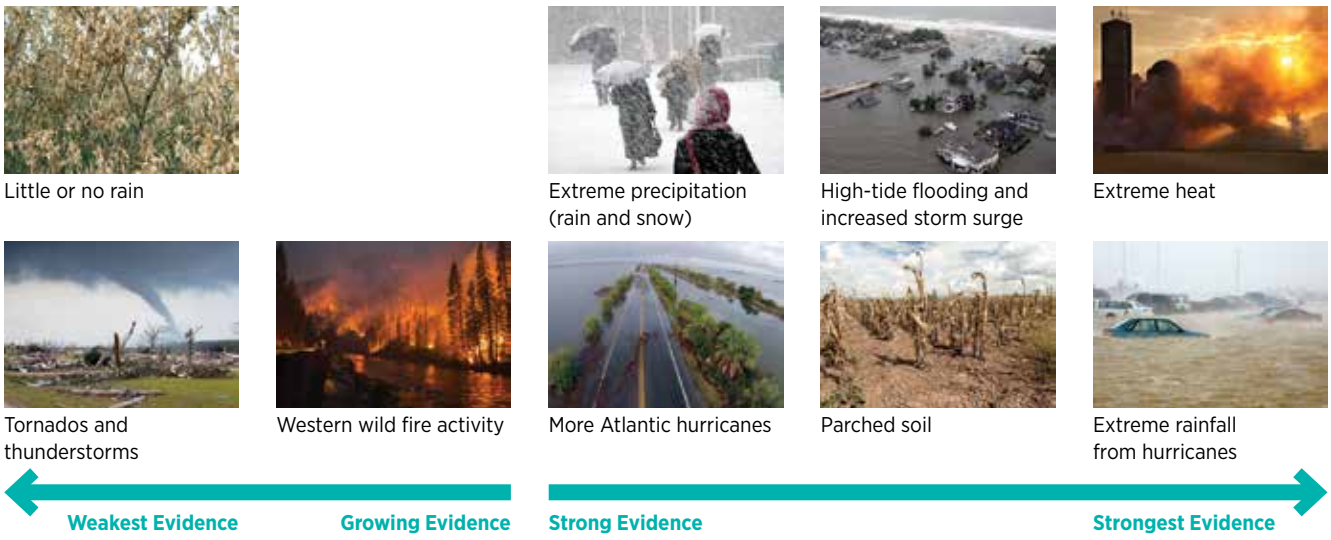
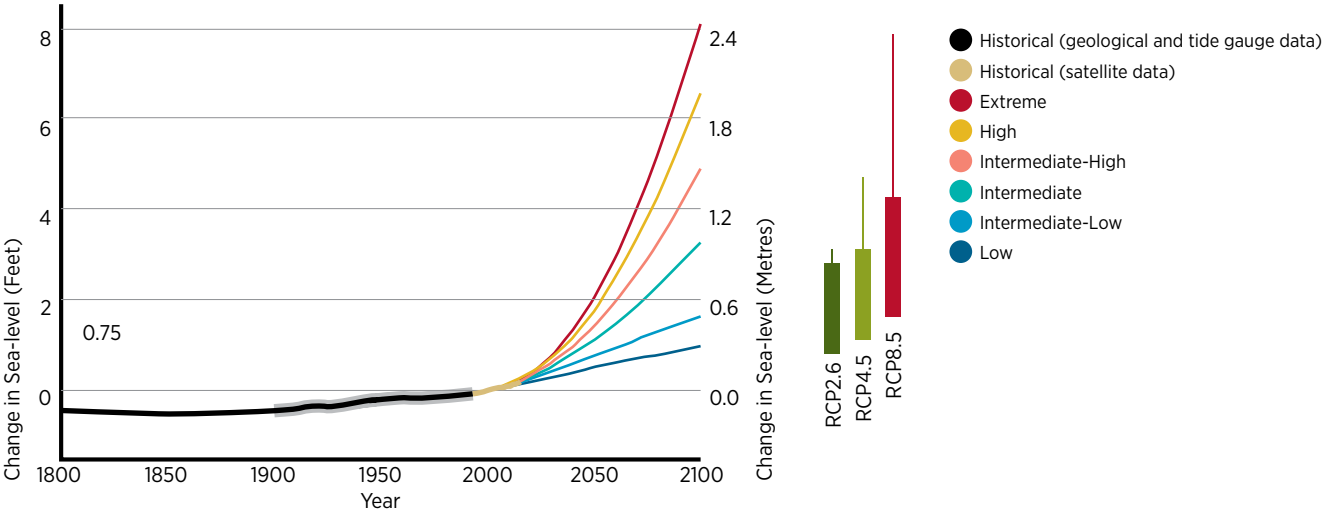


Figure 4.3 The latest estimates of global average sea-level rise, combining IPCC scenarios & more recent data on rates of Antarctic and Greenland ice loss[7].



ii. Climate projections for Orkney

Climate change projections for Scotland indicate continuation of the trends observed over recent decades. Across Scotland, on average, annual mean temperatures will continue to increase, with decreasing precipitation in summer and increasing precipitation in winter (Fig. 4.4).

Recently observed trends in Orkney's climate are expected to continue and accelerate as climate change intensifies[8], although some indicators differ from the average projections for Scotland due to Orkney's extreme geographical location. Under a future high-emissions scenario (RCP 8.5), by the 2050s Orkney is predicted to experience:

- An increase in mean annual temperature of between 0.3 °C to 2.2 °C
- An increase in mean winter temperature of between 0.1 °C and 2.9 °C
- An increase in mean summer temperature of between 0 °C and 2.4 °C
- A change in mean winter precipitation of between -7% drier to 42% wetter
- A change in mean summer precipitation of between -18% drier and 14% wetter.

The ranges given above are the 5th to 95th percentile ranges relative to a 1981 to 2000 baseline, under a future high-emissions scenario, and are specific to the Orkney and Shetlands 'river basin' spatial dataset produced as part of the newly published UKCP18 data[9].

Sea-level rise for the North of Scotland is expected to increase throughout the coming century. Current projections for Orkney show that sea-level rise is predicted to be in the region of 0.2 m to 0.4 m by 2050, relative to the 1981 to 2000 baseline, and 0.4 m to 1.00 m by 2100, under a future high-emissions scenario (RCP 8.5). The ranges given above are the 5th to 95th percentile ranges for Broch of Gurness, on Mainland Orkney (see Fig. 4.5). There is currently uncertainty about changes in wind direction and strength, storm frequency and intensity, and wave energy; although when storms do occur it is likely that their impact will be increased by other factors such as sea-level rise and related changes in coastal dynamics.

Figure 4.4 UKCP18 climate projections for Scotland showing change in mean temperature and precipitation from 1961 to 2100[10]. These are probabilistic projections: the dashed line is 50% central estimate; inner shading 25-75%; middle shading 10-90%; outer shading 5-95%. All values are compared to a 1981-2000 baseline average.

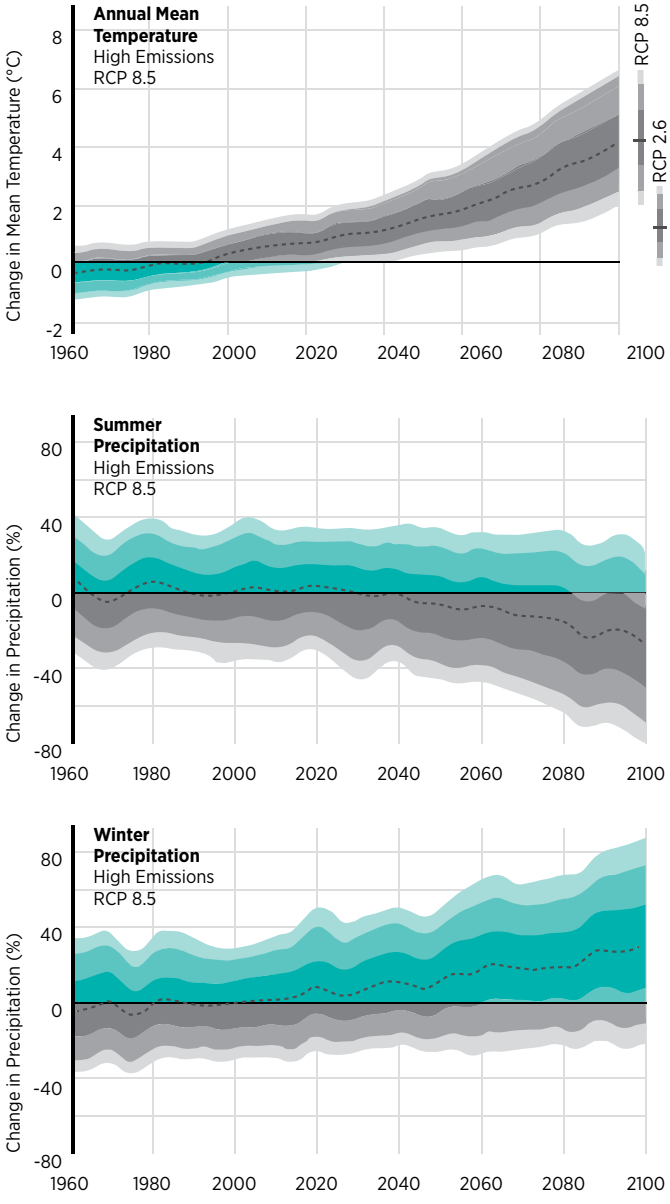
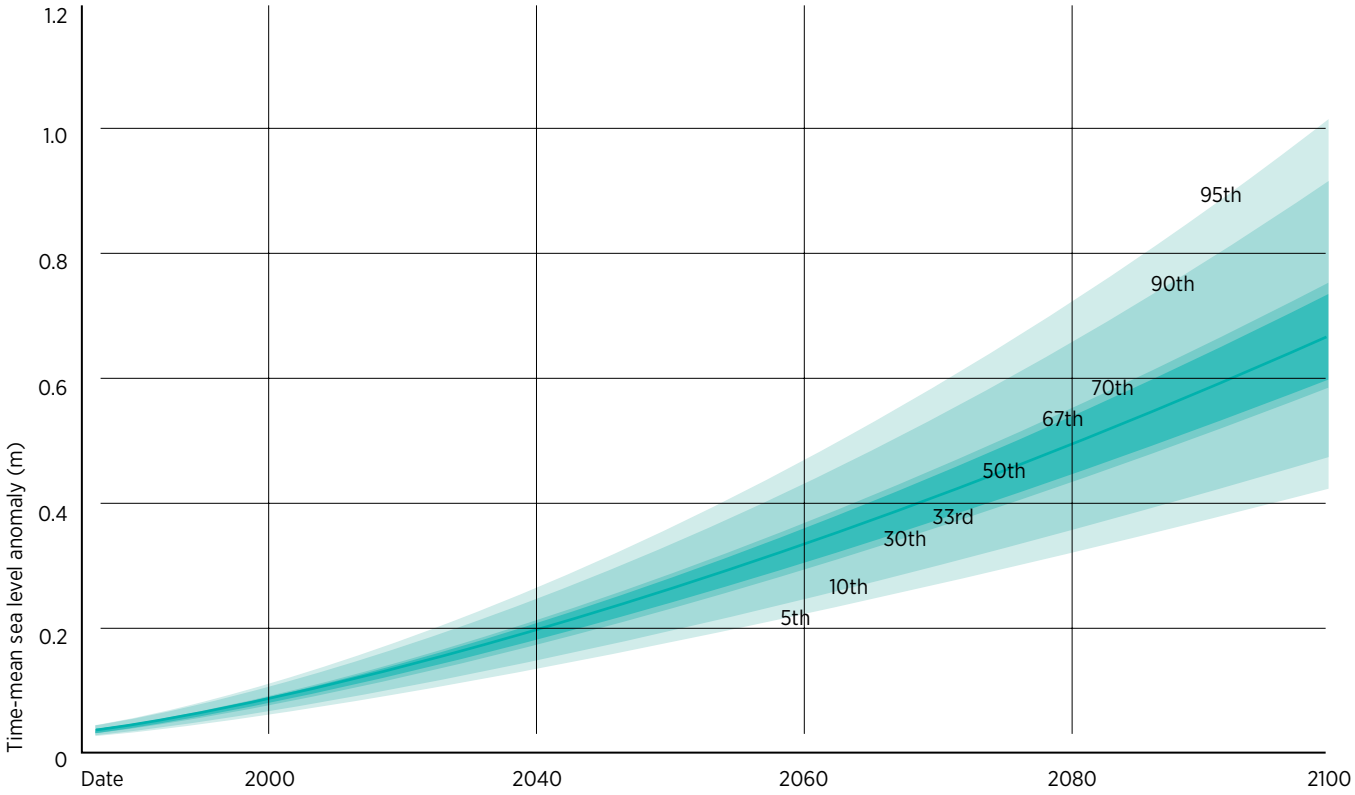


Figure 4.5 Projected changes in sea level for Orkney to 2100 under a high emissions (RCP 8.5) scenario. Data from UK Met Office Climate Change Projections UKCP18[11].



Climate changes in Orkney will translate into a wide range of compounding impacts for the islands, their heritage and cultural resources. In many cases, these impacts will interact with and exacerbate other pressures such as growing tourism numbers, infrastructure development and agricultural practices. These impacts are expected to include:

- Worsening coastal erosion, driven by sea-level rise and potential changes in storms – these are of particular concern for Orkney's historic environment, as are increases in extreme rainfall and flooding
- Changes in wind patterns including wind direction will have a major influence if they occur, although the projections are unclear
- Wetter winters, potentially drier summers and changes in seasonality will combine to have an impact on wildlife, plants and agriculture, as will the over-arching trend towards warmer temperatures.

In addition to the known risks to heritage from coastal erosion, rainfall extremes and flooding discussed in this report, a range of other significant climate impacts can be expected, with consequences that are hard to predict. For example:

- Warmer and drier conditions combined with changes in grazing patterns could result in increased risk of wildfires which could damage heritage assets or increase their exposure to erosion
- Changes in temperature, wind and relative humidity could change the pattern and species of biological growth, such as stable mosses and lichens on the monuments of Neolithic Orkney, with potential consequences for preservation of the stone
- Sea-level rise is already worsening storm-surge flooding, but it could also contribute to changes in marine habitats, for example degradation and loss of marine kelp fields, potentially changing current coastal systems, increasing exposure and exacerbating coastal erosion.

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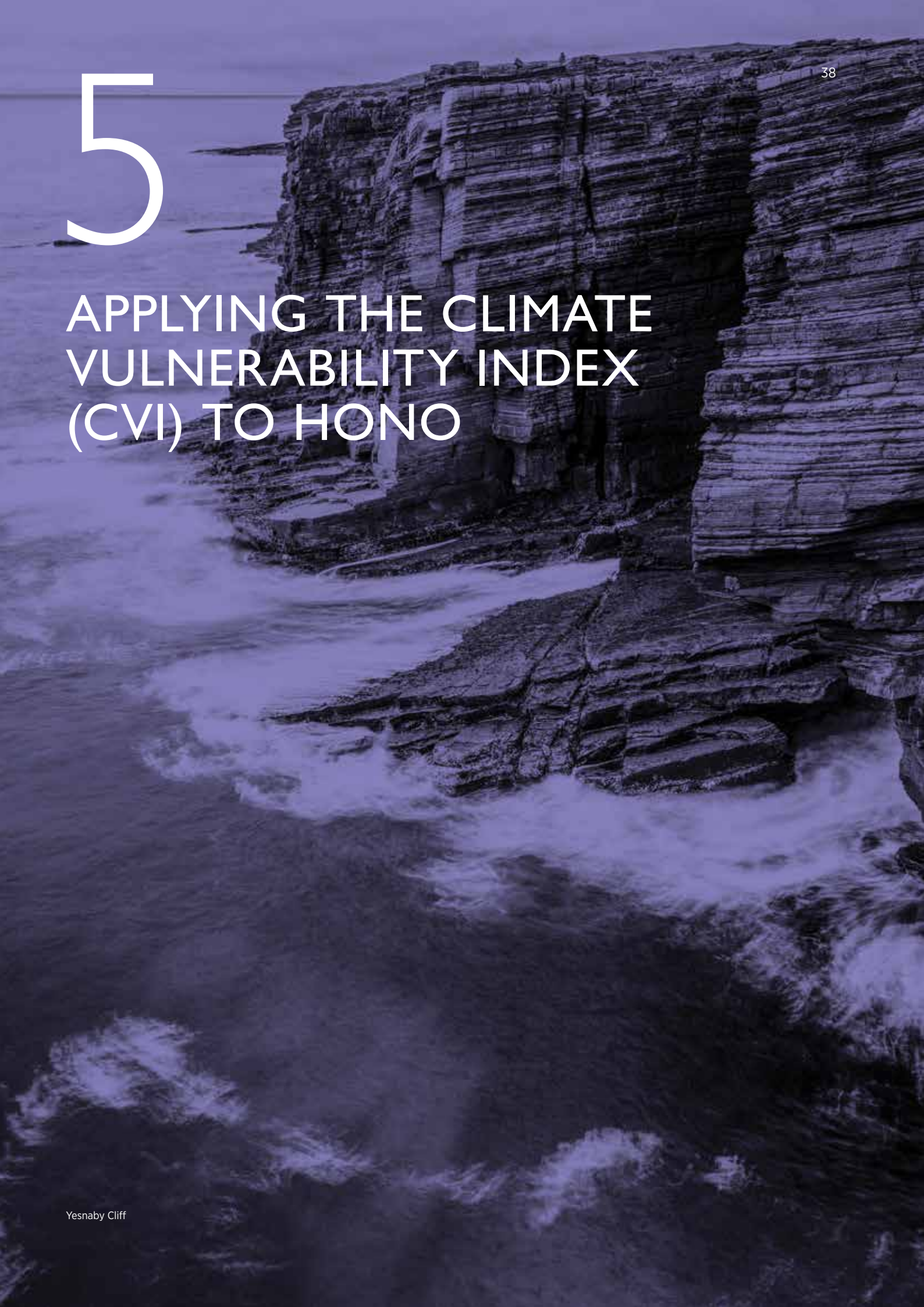
11 https://ukclimateprojections-ui.metoffice.gov.uk/

5

APPLYING THE CLIMATE VULNERABILITY INDEX (CVI) TO HONO



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The Climate Vulnerability Index (CVI) is a rapid assessment tool that has been specifically developed for application to World Heritage properties. The CVI framework builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)[1]. Vulnerability of OUV is determined by assessing the exposure, sensitivity and adaptive capacity with respect to determined climate drivers. The OUV Vulnerability becomes the exposure term to assess the vulnerability of the community associated with the property, combining with assessments of economic-social-cultural dependency (sensitivity) and adaptive capacity (Fig. 5.1). A customised spreadsheet-based worksheet is used to determine outcomes based on user inputs. A more detailed outline of the CVI methodology is provided in Appendix 2.

Workshop participants from a range of backgrounds, with around half based in the Orkney Islands, worked through the following foundational steps:

+ Determined the key values for HONO derived from the Statement of OUV and other significant local values (see Appendices 1 and 6)
+ Identified the three key climate drivers that would be most impactful on the HONO OUV (see Appendix 2)
+ Identified the current condition and trend of the key elements of OUV (see Table 2.1).

The following steps aligned with the CVI framework (Fig. 5.1) were then applied for the Orkney site:

1 Conducted a high-level risk assessment (**exposure** and **sensitivity**) to OUV of the chosen three key climate drivers within the agreed time frame (i.e. by 2050). This process also considered the influence of important **modifiers** that may vary these assessments.
2 Used the spreadsheet-based worksheet to identify the **potential impacts** of the top three potential climate drivers on the key WH values.
3 Considered the likely **adaptive capacity** of OUV in relation to the three key climate drivers.
4 Used the worksheet to determine the **OUV Vulnerability** to the three key climate drivers.
5 Considered, and assessed separately, the relevant **economic**, **social** and **cultural dependencies (ESC)** upon the WH property.
6 Used the worksheet to determine the **ESC potential impact** to the ESC dependencies upon the WH property.
7 Considered, and assessed separately, the level of **ESC adaptive capacity** for the same ESC components considered above.
8 Used the worksheet to determine the **Community Vulnerability**.

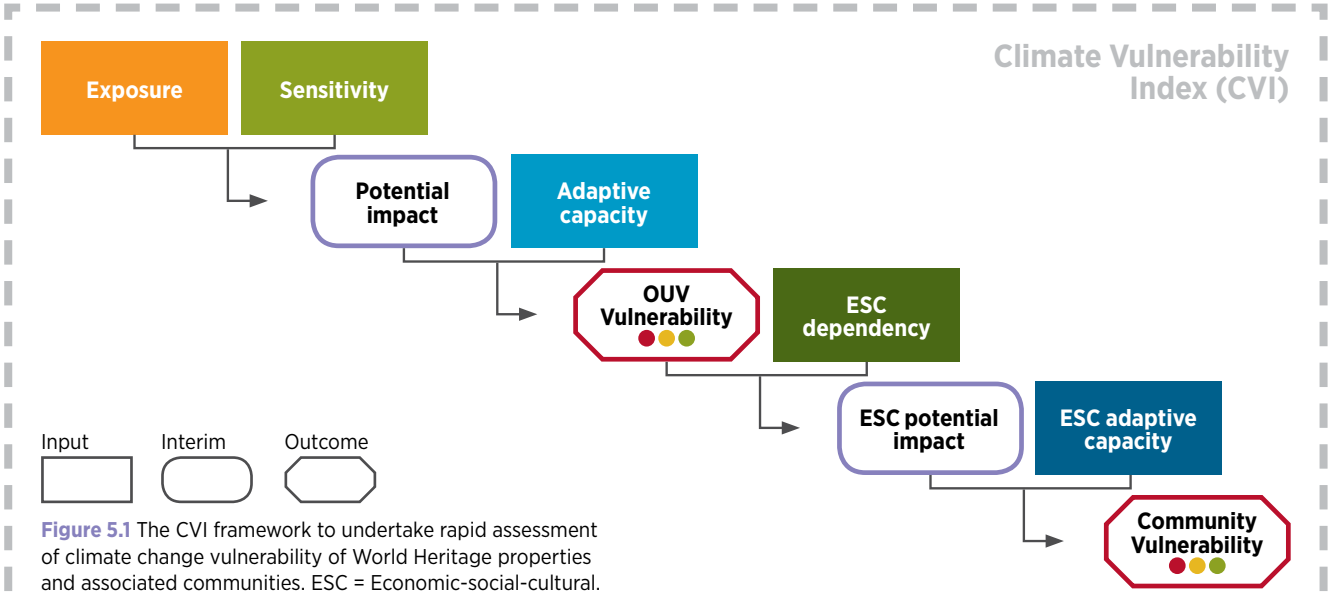


Figure 5.1 The CVI framework to undertake rapid assessment of climate change vulnerability of World Heritage properties and associated communities. ESC = Economic-social-cultural.

5.1 Preparatory steps

Excerpts from the Statement of OUV were compiled under eight headings representing the key values for the Orkney WH site (Table 2.1). These key values (and the excerpts from which they were derived) had been distributed to participants before the workshop; participants confirmed the summation to eight key values was appropriate during the workshop. Workshop participants considered which of the key values of OUV may be of greater importance or priority than others. The settlement and monuments (Skara Brae, Ring of Brodgar, Stones of Stenness and Maeshowe) were considered foundational to the other key values.

In addition to the values within the OUV, there are other local values of significance. Input to a list of significant local values was sought from participants prior to the workshop. These were compiled for discussion during the workshop and future reference (Appendix 6); however, no further analysis of these values was undertaken as the workshop focus was on the WH values.

From a list of 13 climate drivers (Appendix 2, Fig. A2-2), which had been provided before the workshop, the participants analysed which would be likely to have the most impact on each of the eight key values of OUV (Table 5.1). The time scale selected by the workshop to consider impacts was c. 2050. The climate drivers appearing in the top three for each value (including equal-third) were used to rank the drivers (Table 5.1, Fig. 5.2). From this, the three climate drivers likely to have greatest impact on the OUV were determined as:

+ Sea Level Change
+ Precipitation Change
+ Storm Intensity and Frequency.

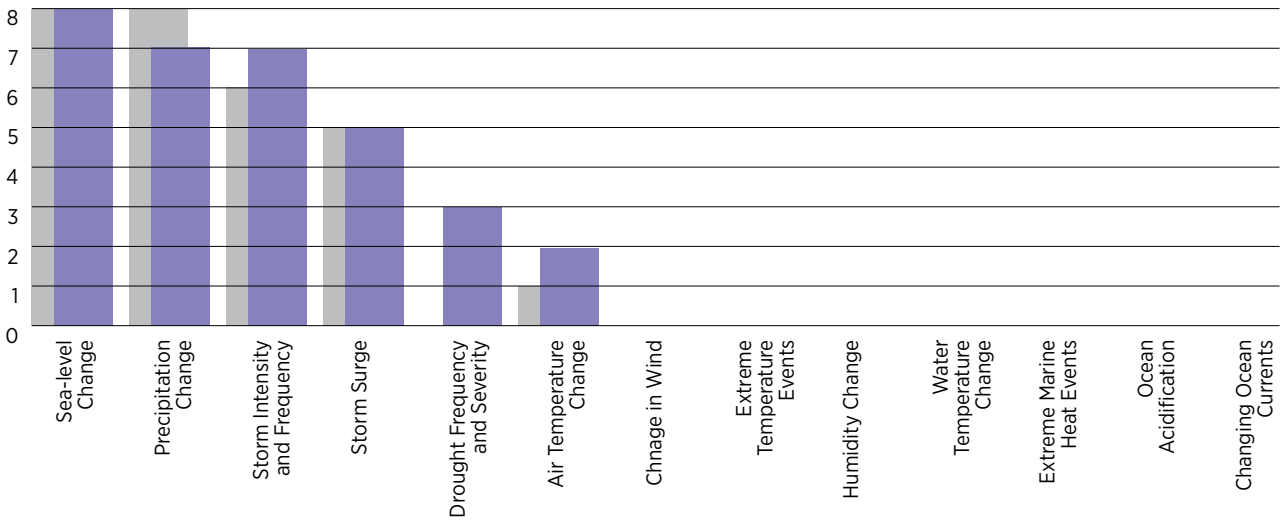
The same three key climate drivers had been identified as likely to have the most impact on the Orkney site in the pre-workshop responses (completed by just under half of the participants). Additionally, when considering the highest priority key values (settlement and monuments), participants confirmed these three drivers as most appropriate for analysis. The workshop participants decided the impacts of Storm Surge were encapsulated within the selections of Sea Level Change, and Storm Intensity and Frequency. Examples of impacts identified from these drivers were coastal erosion at Skara Brae, inundation of landscape elements (from rising water levels in lochs), rising of the water table, and increased rates of weathering (and associated reduced accessibility) from extreme precipitation.

There was a natural gap in the distribution of responses after the key climate drivers described above; all others were evaluated as impacting less than half of the eight grouped attributes of OUV (Table 5.1; Figure 5.2). However, the workshop considered that future analysis of Air Temperature Change was a next priority after the key climate drivers (though this was outside the available time for the workshop). Within this, impacts such as resultant humidity change in the inner chamber of Maeshowe, changes to flora and fauna of the contemporary landscape, and changes to biological activity on the stone monuments were noted. There was recognition of potential gaps in knowledge regarding impacts from specific drivers, and that priorities may change in a future risk assessment.

Table 5.1 Climate drivers identified as likely to have the most impact for each of eight key values of OUV. Marked cells indicate that the climate driver was in the top three responses (including equal-third) for each key value. Driver impacts were assessed for c. 2050.

Key values of OUV	Climate drivers												
Prehistoric cultural landscape						X	X				X		
Well-preserved prehistoric settlement							X		X		X		
Neolithic monuments			X			X	X				X		
Architecture						X			X		X		
Social fabric and beliefs			X			X	X		X		X		
Societal activities			X			X	X		X		X		
Archaeological landscape	X					X	X		X		X		
Contemporary landscape	X					X	X				X		
Total	2	0	3	0	0	7	7	0	5	0	8	0	0

Figure 5.2 Histogram of impacts on eight grouped attributes of OUV from 13 climate drivers whose impacts were assessed for c. 2050. Pre-workshop responses in grey; final workshop outcomes coloured.



5.2 OUV Vulnerability

For the identified three key climate drivers, assessments of **exposure** and **sensitivity** of the OUV system to each driver were undertaken using a five-point categorical scale (Table 5.2; see Appendix 2 for details). Modifiers were applied to the initial assessments to include effects of temporal scale and trend (for exposure), and spatial scale and compounding factors (for sensitivity). These assessments were undertaken in small breakout groups, which provided the potential for a range of responses.

Exposure to Sea Level Change and Precipitation Change was determined as very likely (>90%), and to Storm Intensity and Frequency was likely (67-90%). Sensitivity of OUV to all three drivers was determined as very high, indicating potential for major loss or substantial alteration of the majority of values comprising OUV.

The **potential impact**, derived from exposure and sensitivity, was determined as extreme (on a four-point scale, low to extreme) for all three key climate drivers.

Table 5.2 Rapid assessment of OUV Vulnerability to identified three key climate drivers. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and OUV Vulnerability. Colours refer to the elements of the CVI framework (Fig. 5.1).

Key climate drivers	Sea Level Change	Precipitation Change	Storm Intensity and Frequency
Exposure	Very likely	Very likely	Possible
Temporal scale	On-going	On-going	Frequent
Trend	Moderate increase	Moderate increase	Slow increase
Exposure	Very likely ○○○○●	Very likely ○○○○●	Likely ○○○●○
Sensitivity	High-Very high	High-Very high	High-Very high
Spatial scale	Extensive	Localised	Extensive
Compounding factors	Medium-High probability	High probability	Medium probability
Sensitivity	Very high ○○○○●	Very high ○○○○●	Very high ○○○○●
Potential Impact	Extreme ○○○●	Extreme ○○○●	Extreme ○○○●
Local management response	Moderate	Moderate	Moderate
Scientific/technical support	High	High	High
Effectiveness	Low	Medium	Low-Medium
Adaptive Capacity	Moderate ○●○	High ○○●	Moderate ○●○
OUV Vulnerability	High ○○●	Moderate ○●○	High ○○●
Combined OUV Vulnerability	High ○○●		

Adaptive capacity of the OUV system in the face of each key climate driver was assessed by considering the levels of local management response and scientific/technical support (four-point scale), as well as the effectiveness of these to address impacts from each driver (three-point scale). For Sea Level Change and Storm Intensity and Frequency, the adaptive capacity was determined to be moderate (three-point scale, low to high), and for Precipitation Change was high.

OUV Vulnerability (three-point scale, low to high) was determined to be high for both Sea Level Change and Storm Intensity and Frequency, whilst it was moderate for Precipitation Change (reflecting the higher level of adaptive capacity determined for this driver). The combined OUV vulnerability for the Orkney OUV was determined as high (Table 5.2).

5.3 Community Vulnerability

Vulnerability of the community associated with the World Heritage property was assessed by considering economic, social and cultural (ESC) components of **dependency** (i.e. the sensitivity term) and **adaptive capacity** (Table 5.3):

+ Dependency reflects the extent to which the key climate drivers will affect economic, social and cultural indicators in the future, using the previously defined time scale (i.e. c. 2050). Note that these effects may be positive or negative (four-point scale in each direction, high-negative to minimal-negative the minimal-positive to high-positive) in their nature (e.g. some business types may experience an increase in value under projected climate change).
+ Adaptive capacity reflects the current level of capacity within each component to adapt in the face of the key climate drivers (four-point scale, minimal to high). Note that adaptive capacity only has a positive directionality.

Assessments were undertaken in small breakout groups, which resulted in a spectrum of responses for each that was resolved in plenary.

Participants suggested the use of a specific scenario in which to consider the likely impacts of climate change on the economic, social and cultural aspects. After some discussion a scenario was determined to guide these assessments: Skara Brae having experienced physical impacts from coastal erosion; Maeshowe being impacted by rising groundwater table; and accessibility issues at the Ring of Brodgar (visitors unable to walk around it) due to extreme precipitation events.

The economic component includes only tangible (i.e. market or direct) economic effects on businesses that are directly dependent upon the World Heritage property. These were grouped into four business types for assessment: Tourism-related; Heritage Conservation (natural & cultural); Research & Education; and Goods & Services. Other groupings were considered during the assessment process but were ultimately considered to fall within these four groups. While assessments of economic dependency were undertaken for each group, recent data on economic valuation[2] indicated that the tourism-related businesses predominate, and this was taken into consideration for the final assessment. Economic dependency was assessed as moderate-negative, whilst the adaptive capacity was high (Table 5.3).

Intangible effects (e.g. social cohesion, aesthetics) were considered within the social and cultural components. An important distinction between these components is that social connections require a physical interaction with the property (i.e. visit), whereas cultural connections can exist without a physical interaction. For each component, three groupings of people were considered to assess dependency and adaptive capacity: local, domestic and international.

Social indicators used to inform the assessments can be considered within four categories: Human capital; Social capital; Natural capital; and Built capital (see Appendix 2 for full list of indicators and references). Social dependency was considered by the workshop to be predominated by local people and this was taken into consideration for the final assessment. Social dependency was assessed as high-negative, whilst the adaptive capacity was moderate (Table 5.3).

Cultural indicators can also be considered within four categories: Self-centric; People-centric; Environment-centric; and Pleasure-centric (see Appendix 2 for full list of indicators and references). Cultural dependency was considered by the workshop to be predominated by local people and this was taken into consideration for the final assessment. Cultural dependency was assessed as moderate-negative, whilst the adaptive capacity was high (Table 5.3).

Combining the three components, the overall ESC dependency was determined as moderate-negative, which, combined with the OUV Vulnerability (as the exposure term), resulted in the ESC potential impact being assessed as high (three-point scale, low to high; Table 5.3). The combined ESC adaptive capacity was assessed as high (three-point scale, low to high), reflecting the capabilities of the community to persevere and transform through climate-driven disturbance and shift.

These outcomes determined the Community Vulnerability as moderate (three-point scale, low to high; Table 5.3).

It is of note that the CVI process biases the analysis toward the greatest level of impacts, such as through selecting the three climate drivers considered to be most impactful. This is appropriate as the loss of integrity and/or authenticity of one component of OUV is contrary to the tenets of World Heritage, to preserve and maintain the site for the values described in the Statement of OUV. Furthermore, there will always be uncertainties in future impacts of projected climate change, and especially in how interactions between impacts may occur (synergistically, antagonistically, independently). Given both the high standard required within World Heritage and the uncertainty of future impacts, the described bias within the CVI process is consistent with the precautionary principle[3].

Table 5.3 Rapid assessment of Community Vulnerability to identified three key climate drivers. Assessed values of seconomic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC potential impact and Community Vulnerability.

Economic	Moderate-negative
Social	High-negative
Cultural	Moderate-negative
ESC dependency	[-] ○●○○ Moderate-negative ○○○○ [+]
ESC potential impact	High ○○●
Economic	High
Social	Moderate
Cultural	High
ESC adaptive capacity	High ○○●
Community Vulnerability	Moderate ○●○

5.4 Summary

Precipitation Change, Sea Level Change, and Storm Intensity and Frequency (where the latter two also include impacts from Storm Surge) were identified as the three climate drivers likely to most impact the Orkney WH site. Potential impact from each of these key drivers was scored in the highest category (Extreme). Despite adaptive capacity to mitigate impacts being assessed as moderate-to-high, the OUV Vulnerability was nevertheless determined to be in the highest category (High). Impacts from the key climate drivers were judged as likely to lead to a negative future impact at a moderate level on the economic, social and cultural aspects of the community surrounding the Orkney WH site, resulting in a high level of potential impact on the community. However, as the adaptive capacity of the community was determined to currently be at a high level, the overall Community Vulnerability was assessed to be in the middle category (Moderate).

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6

NEXT STEPS

Stones of Stenness © Shutterstock

6.1 Findings from the CVI Process

The HONO WH property was determined to be **extremely vulnerable** to the impacts of the three key climate drivers identified by the workshop participants. By 2050, there is the potential for major loss or substantial alteration of the majority of the values that comprise the OUV of the WH property.

The three key climate drivers which were identified and analysed for HONO are:

+ Sea Level Change
+ Precipitation Change
+ Storm Intensity and Frequency.

Storm Surge was determined to be better considered as a component of both Sea Level Change and Storm Intensity and Frequency rather than a separate driver. A fourth key driver – Air Temperature Change – though not ranked in the three most important drivers, was nonetheless identified as likely to be an important driver in the future. As such, it should be considered for incorporation in future iterations of the CVI process for HONO.

i. Sea Level Change

The potential impact of Sea Level Change (rise) was considered particularly acute at Skara Brae. The sea wall, first built in the 1920s, has been repaired, extended and improved in recent decades, and is now monitored through a biennial programme of laser scanning and visual survey. Impacts of sea level change at Skara Brae are likely to be exacerbated by combination with changes in Storm Intensity and Frequency. There may also be, in the longer-term, increased risk of impacts at the Stones of Stenness and Watch Stone and to the physical connection between Ring of Brodgar and other west Mainland WH property components due to the Loch of Stenness being connected to the sea at the Brig o' Waithe.

ii. Precipitation Change

Climate trends for north Scotland show average precipitation has increased by around 21% annually between 1961 and 2004 with increases in winter rainfall of around 69% (see Section 4) and an increase in extreme rainfall events. Combined with an increase in visitor numbers, particularly peak-time surges in numbers from volume tourism (i.e. coach parties from cruise ships and the short sea crossings), this increased wetness has led to significant footfall erosion issues at the Ring of Brodgar. If planned infrastructure improvements (e.g. upgraded car parking; new footpath access) enable larger number of visitors at the Stones of Stenness, similar issues could arise there. Potential impacts of this driver on other monuments are less well understood, but there is potential for increased groundwater flooding at Maeshowe; changes in the wetting and drying cycle there and at the other sites could impact subsurface features and affect structural integrity, as well as potentially increasing rates of weathering including stone decay.

iii. Storm Intensity and Frequency

Though the data for trends and changes to Storm Intensity and Frequency are not as clear as for the other two drivers, the potential impact of Storm Intensity and Frequency across all four component parts of the WH property was considered to be high. As noted above, this driver would operate in combination with Sea Level Change at Skara Brae. There exists the potential for a single extreme event destroying part of Skara Brae, with serious impact on OUV. Storm Intensity and Frequency was also discussed as a compounding/connected factor with regard to Precipitation Change. Past storm events have impacted elements of the WH property, such as a 1980 lightning strike which split and toppled a stone in the Ring of Brodgar. Potential impacts of this driver on other monuments are less well understood.

iv. Economic, Social and Cultural Issues

The historic environment of Orkney is a key economic driver for the archipelago. Tourism is a significant employer and makes a substantial contribution to the islands' economy. Orkney's cultural heritage has great significance for the island communities, who are extremely engaged with their heritage and in addressing the pressures of changing tourism patterns and climate change. Around half the workshop participants were Orkney residents and the public seminar held at Orkney College UHI at the conclusion of the workshop was well attended by an audience who were highly engaged with these issues.

Whilst the workshop assessment determined that the potential impact of climate change was high for the local community, the process also identified their high adaptive capacity. Despite the acknowledged importance of heritage, overall the community was judged to be only moderately vulnerable to climate change impacts on the OUV of HONO, in part due to the range and depth of engagement with the broader cultural heritage beyond the WH property itself.

6.2 Gaps Identified

i. Research gaps

The workshop participants represented an excellent mix of specialists from differing fields, with about half of these living on Orkney and aware of the climate vulnerabilities of the islands on a daily basis, and the other attendees from farther afield bringing additional knowledge and expertise. Despite this, it is recognised that knowledge and understanding will evolve over time and as more research into different aspects of climate change takes place. For example, the workshop participants noted that not enough was known about the effect of Air Temperature Change on various aspects of the WH property and Buffer Zone, and suggested that further research in this area could potentially elevate this to one of the key three drivers when the HONO CVI assessment is repeated. Research needs have yet to be formally evaluated but clearly include increasing understanding of relevant climate drivers and their impacts on HONO, compounding socio-economic issues, and the impacts of OUV degradation on local communities and the Orkney economy.

As knowledge and understanding of the various factors improve over time a future CVI assessment process may well result in a different outcome.

ii. Policy and guidance gaps

As observed in Section 1, climate change is the fastest growing global threat to WH property. The rigidity of the narrative around OUV may create some problems for management of sites which are at risk of rapid change as a result of climate drivers. Climate change may affect the physical fabric of some WH properties but their OUV may nonetheless be retained. However, Statements of OUV are currently not subject to periodic review and update: this seems particularly relevant for the section of each Statement of OUV that outlines the Protection and Management requirements for the Site. Recognising that the OUV itself is fixed at the time of inscription, it seems that a mechanism for reviewing the narrative statement describing OUV would nonetheless be useful. Further discussion regarding the potential to develop policies and guidance that would enable the World Heritage Committee to accept revised Statements of OUV for sites subject to significant climate change impacts is necessary.

6.3 Lessons for other Properties

i. Lessons for Scottish WH properties

There are currently six WH properties in Scotland: Heart of Neolithic Orkney; the Forth Bridge; Frontiers of the Roman Empire: The Antonine Wall; New Lanark; Old and New Towns of Edinburgh; and St Kilda. All six properties are inscribed for cultural values, with St Kilda also inscribed for its natural heritage. While the physical fabric of each is very different – from the extensive linear earthwork monument of the Antonine Wall to the monumental steel engineering construction of the Forth Bridge – climate change has been identified as a current or potential risk to all (see the WH property Management Plans for each location[1]). For example, St Kilda is an island archipelago 64 km west of the Western Isles of Scotland, and known to be vulnerable to coastal erosion and storm damage for cultural heritage values, while sea temperature changes are already seriously impacting the seabird population.

A full CVI assessment of St Kilda would be a valuable contribution to understanding climate driven risks to the OUV of the site and the potential for adaptation. At other sites the climate vulnerabilities may be more subtle: for example, changes in precipitation are known to be affecting historic buildings across Scotland and this is a clear concern for the Old and New Towns of Edinburgh and New Lanark. Understanding the economic-social-cultural impacts and the adaptive capacities of associated communities and groups will be key to developing management strategies to preserve OUV in a changing climate and the CVI approach offers a well-documented and repeatable method to do this.

Two sites in Scotland are currently on the UK Tentative List for World Heritage: the Flow Country and the Crucible of Iron Age Shetland. HES provide advice to Scottish sites developing World Heritage nominations, and there is clear scope to employ the CVI methodology to inform the development of the nominations for these and future proposed WH properties, particularly given the current focus of the World Heritage Committee on community engagement and involvement.

ii. Lessons for non-WH sites across Orkney

In 2017, the Scottish Coastal Archaeology and the Problem of Erosion (SCAPE) Trust produced a Review of Heritage at Risk from Coastal Processes in Scotland[2], the result of their Scottish Coastal Heritage at Risk project. This was based on a review and survey by volunteers to update information from the earlier Coastal Zone Assessment Surveys, carried out for Orkney in the late 1990s (note that not all the islands were surveyed). The results highlighted specific concerns for sites across the archipelago, and more high-priority sites were identified in Orkney than in any other area of Scotland. Of some 3,000 identified terrestrial heritage sites in Orkney, c. 1000 are on the coast and either already being damaged by coastal erosion or under threat. Whole classes of sites, for example boat nousts and Iron Age brochs, are imperilled. As an archipelago with a very extensive coastline, Orkney is and was a maritime cultural landscape[3]. Where the impact of climate drivers is high and cannot be directly reduced, adaptation – economic, social and cultural – will be key.

The climate influences and trends presented in Section 4 are largely applicable across Orkney. The three key drivers – Sea Level Change; Precipitation Change; Storm Intensity and Frequency – are likely to be the significant drivers throughout much of Orkney, as may the fourth driver highlighted as of potential concern by participants – Air Temperature Change.

The CVI process has highlighted the potential value of a transparent and repeatable framework for rapid assessment of sites. More robust rapid assessment approaches alongside archaeological information will be critical in making decisions regarding threatened coastal heritage in the face of climate impacts: for example, changes in management, focused investment in conservation or protection measures, managed retreat, or rescue excavation.

iii. Lessons for other sites across Scotland

As noted above for sites across Orkney, the CVI process has highlighted the potential value of a repeatable framework for rapid assessment of heritage sites. This will also be widely applicable across Scotland, not only in coastal areas, though the key climate drivers are likely to differ regionally given the variability of some climate aspects across geographical areas (e.g. marked differences in precipitation between north, east and south Scotland). Robust, transparent and repeatable assessment approaches drawing on the CVI methodology will again be critical in decision-making for management of threatened heritage in the face of climate impacts, and will build on the existing body of work in this field by HES and others. Questions of social, cultural and economic adaptation by communities will be central. This ties in with existing work currently underway in Scotland on principles for prioritisation for the built and historic environment[4].

6.4 Recommendations for Scottish World Heritage Properties

The Climate Change (Scotland) Act 2009[5] and Climate Ready Scotland: Scottish Climate Change Adaptation Programme[6] place duties on public bodies such as HES to integrate climate change actions into their operations. One stage of this was the production of a Climate Change Risk Assessment Report for Properties in the Care of Scottish Ministers[7], which includes the four component sites of the HONO WH property.

HES has a direct management role at, and leads on WH property coordination for, HONO and the Antonine Wall WH property, and is a partner in management for the other four WH properties. HES will propose that the CVI process be embedded in the management plan review cycles for all Scottish WH properties. The Site management plans are typically reviewed every five years and the CVI process would repeat on the same timetable as proposed for HONO (see below, Revisiting the CVI Process). The results of the CVI process for all six sites will then also inform the next UNESCO Periodic Reporting cycle.

The Frontiers of the Roman Empire: the Antonine Wall forms part of a transnational WH property with Hadrian's Wall in England and the Upper German-Raetian *Limes* in Germany. A proposed Antonine Wall CVI workshop in 2020 would include representatives of these national and international partners. This will enable a common approach, despite likely regional differences in climate drivers and impacts across the whole WH property.

6.5 Revisiting the CVI Process

The review of the HONO Management Plan began in 2019 and the CVI workshop has been extremely timely. The workshop results will inform the review process and resultant new Management Plan: it has already been recognised that this iteration of the HONO Management Plan must ensure that addressing climate change mitigation and adaptation is a theme that runs throughout the whole Plan rather than being a stand-alone objective.

We recommend that the CVI process is repeated for HONO WH property on a 5-yearly cycle, in parallel with the management review cycle. The next review will therefore take place in 2024-25 prior to the inception of the 2025 Management Plan review process. In order to ensure that trends and results are easily comparable, we propose that the 2024-25 CVI workshop apply the same methodology, but include a systematic review of the 2019 workshop assumptions.

6.6 Wider Applications

It is noted that the application of the CVI methodology and process will be of interest and relevance to those managing other heritage sites across the Orkney Islands. In addition, other WH properties across the UK and Ireland may find this report particularly useful due to similarities in climate. However, the process is flexible and rigorous enough for much wider application and it is anticipated that others will find the format and process useful when considering the key values and climate change challenges at heritage sites worldwide.

Cited references

1 The six Management Plans are available via: https://www.historicenvironment.scot/

2 Hambly, J. SCAPE Trust (2017). Review of Heritage at Risk from Coastal Processes in Scotland: Results from the Scotland's Coastal Heritage at Risk Project 2012-2016. Available at: http://scharp.co.uk/media/medialibrary/2017/12/Review_of_Coastal_Heritage_at_Risk.pdf

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4 Built Environment Forum Scotland (2019) Principles for Prioritisation, Version 2. Available at: https://www.befs.org.uk/wp-content/uploads/2019/03/Principles-of-Prioritisation-V2.pdf

5 Climate Change (Scotland) Act 2009. Available at: https://www.legislation.gov.uk/asp/2009/12/contents

6 Climate Ready Scotland: Scottish Climate Change Adaptation Programme (2014). Available at: https://www.gov.scot/publications/climate-ready-scotland-scottish-climate-change-adaptation-programme/

7 HES 2018. Screening for Natural Hazards to inform a Climate Change Risk Assessment of the Properties in Care of Historic Environment Scotland. Available at: https://www.historicenvironment.scot/

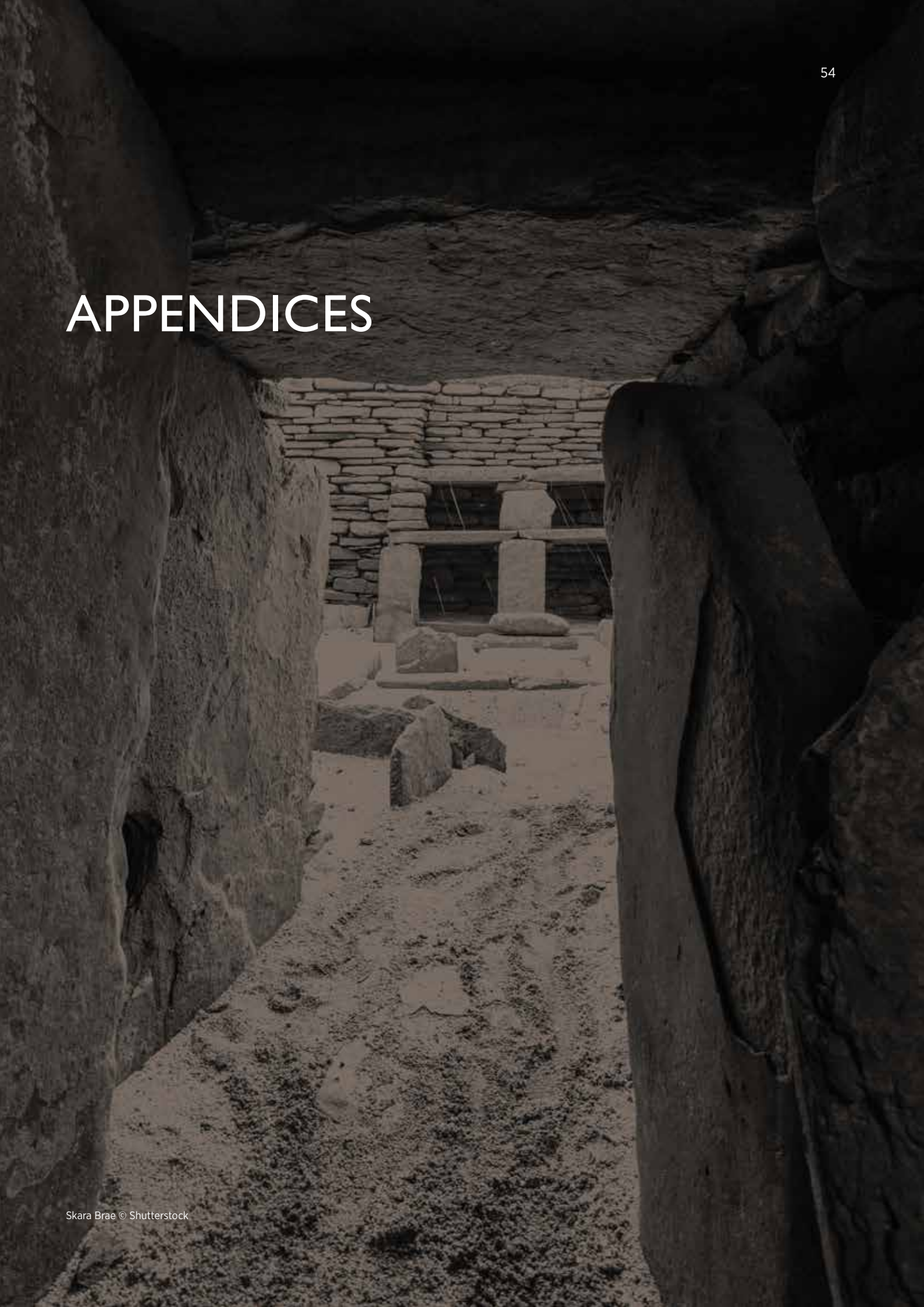
ACKNOWLEDGEMENTS

Adam Markham being interviewed by BBC Scotland

Many people contributed to the success of the CVI workshop in Orkney:

- Adam Markham, Union of Concerned Scientists (UCS) proposed the idea of trialling the CVI in Orkney and initially discussed his proposition with Prof. Jane Downes, Director of the Archaeology Institute at the University of Highlands and Islands (UHI), who together with Julie Gibson (County Archaeologist for Orkney Council and lecturer at UHI) supported Adam's proposition
- Ewan Hyslop, Rebecca Jones and Alice Lyall were contacted as representatives of Historic Environment Scotland (HES - the managing organisation for the HONO World Heritage property) and were then invited to be part of the group organising the workshop
- A workshop Steering Committee was formed comprising the above key personnel, along with the two developers of the CVI framework from James Cook University, Australia (Jon Day and Scott Heron)
- The pre-workshop webinar (10th April) was coordinated and introduced by Adam Markham, Union of Concerned Scientists (UCS) and was presented by:
  - Brenda Ekwurzel (UCS)
  - Joe Hagg, (Adaptation Scotland) with additional input from Alistair Rennie (Scottish Natural Heritage)
  - Ewan Hyslop (Historic Environment Scotland)
- The pre-workshop information requested from the workshop participants was compiled by Chloe Ames (UCS)
- Five students from the Archaeology Institute at the University of Highlands and Islands (UHI) were chosen to assist with the workshop; they played an important role in organising many aspects of the workshop and the public event, including recording notes during the workshop, so thanks to Naomi Bouche, Alanis Carag Buhat, Euan Cohen, Marion Ratier and Farrah Skimani
- Claire Mullaney (Senior Communications Officer, HES) and Sean Page (Marketing Officer, UHI) both played significant roles in coordinating media and communications, during and following the workshop
- All the participants listed in Appendix 5 gave their time and expertise to the workshop which greatly benefited from the diverse range of perspectives and views about Orkney
- The workshop was conducted in the meeting facilities at the Stromness library, and the public outreach event was hosted at the Kirkwall campus of the University of Highlands and Islands. Thanks to those in the Orkney community who attended the public outreach event at UHI; many local community members were also excellent hosts during the workshop
- Frank Thomas (HES) produced the maps in Figures 2.1, 2.2 & 3.1
- Report design coordinated by Rory Cameron of HES, with Stand Agency, Glasgow.

APPENDICES



Skara Brae © Shutterstock

APPENDIX I

Statement of Outstanding Universal Value for the World Heritage-listed 'Heart of Neolithic Orkney'

This retrospective Statement of Outstanding Universal Value (SOUV) for HONO was drafted in 2010 and adopted by UNESCO World Heritage Committee in June 2013. The text shown in **bold** below was used to develop the table of key WH values (Table 2.1 as shown in Section 2).

Summary
The group of Neolithic monuments on Orkney consists of a large chambered tomb (Maeshowe), two ceremonial stone circles (the Stones of Stenness and the Ring of Brodgar) and a settlement (Skara Brae), together with a number of unexcavated burial, ceremonial and settlement sites. The group constitutes **a major prehistoric cultural landscape which gives a graphic depiction of life in this remote archipelago in the far north of Scotland some 5,000 years ago**.

Brief synthesis
The Orkney Islands lie 15km north of the coast of Scotland. The monuments are in two areas, some 6.6 km apart on the island of Mainland, the largest in the archipelago.

The group of monuments that make up the Heart of Neolithic Orkney consists of a **remarkably well-preserved settlement**, **a large chambered tomb**, and **two stone circles with surrounding henges**, together with **a number of associated burial and ceremonial sites**. The group constitutes a **major relict cultural landscape graphically depicting life five thousand years ago** in this remote archipelago.

The four monuments that make up the Heart of Neolithic Orkney are unquestionably **among the most important Neolithic sites in Western Europe**. These are the Ring of Brodgar, Stones of Stenness, Maeshowe and Skara Brae. They provide **exceptional evidence of the material and spiritual standards as well as the beliefs and social structures of this dynamic period of prehistory**.

The four main monuments, consisting of the four substantial surviving standing stones of the elliptical Stones of Stenness and the surrounding ditch and bank of the henge, the thirty-six surviving stones of the circular Ring of Brodgar with the thirteen Neolithic and Bronze Age mounds that are found around it and the stone setting known as the Comet Stone, the large stone chambered tomb of Maeshowe, whose passage points close to midwinter sunset, and **the sophisticated settlement of Skara Brae with its stone built houses connected by narrow roofed passages**, together with the Barnhouse Stone and the Watch Stone, serve as a **paradigm of the megalithic culture of north-western Europe that is unparalleled**.

The property is **characteristic of the farming culture prevalent from before 4000 BC in northwest Europe**. It provides **exceptional evidence of, and demonstrates with exceptional completeness, the domestic, ceremonial, and burial practices of a now vanished 5000-year-old culture** and **illustrates the material standards, social structures and ways of life of this dynamic period of prehistory**, which gave rise to Avebury and Stonehenge (England), Bend of the Boyne (Ireland) and Carnac (France).

The monuments on the Brodgar and Stenness peninsulas were **deliberately situated within a vast topographic bowl formed by a series of visually interconnected ridgelines** stretching from Hoy to Greeny Hill and back. They are also **visually linked to other contemporary and later monuments** around the lochs. They thus **form a fundamental part of a wider, highly complex archaeological landscape**, which stretches over much of Orkney. The **current, open and comparatively undeveloped landscape around the monuments allows an understanding of the apparently formal connections between the monuments and their natural settings**. The **wealth of contemporary burial and occupation sites in the buffer zone constitute an exceptional relict cultural landscape that supports the value of the main sites**.

Criterion (i): The major monuments of the Stones of Stenness, the Ring of Brodgar, the chambered tomb of Maeshowe, and the settlement of Skara Brae display the **highest sophistication in architectural accomplishment**; they are **technologically ingenious and monumental masterpieces**.

Criterion (ii): The Heart of Neolithic Orkney exhibits an **important interchange of human values during the development of the architecture of major ceremonial complexes in the British Isles, Ireland and northwest Europe**.

Criterion (iii): Through the **combination of ceremonial, funerary and domestic sites**, the Heart of Neolithic Orkney **bears a unique testimony to a cultural tradition that flourished between about 3000 BC and 2000 BC**. The **state of preservation of Skara Brae is unparalleled amongst Neolithic settlement sites in northern Europe**.

Criterion (iv): The Heart of Neolithic Orkney is **an outstanding example of an architectural ensemble and archaeological landscape that illustrate a significant stage of human history when the first large ceremonial monuments were built**.

Integrity

All the monuments lie within the designated boundaries of the property. However, the boundaries are tightly drawn and do not encompass the wider landscape setting of the monuments that provides their essential context, nor other monuments that can be seen to support the Outstanding Universal Value of the property. Part of the landscape is covered by a two part buffer zone, centred on Skara Brae in the west and on the Mainland monuments in the central west.
This fragile landscape is vulnerable to incremental change. Physical threats to the monuments include visitor footfall and coastal erosion.

Authenticity

The level of authenticity in the Heart of Neolithic Orkney is high. The state of preservation at **Skara Brae is unparalleled for a prehistoric settlement in northern Europe**. Where parts of the site have been lost or reconstructed during early excavations, there is sufficient information to identify and interpret the extent of such works.

Interventions at Maeshowe have been antiquarian and archaeological in nature; the monument is mostly in-situ and the passageway retains its alignment on the winter solstice sunset.

Re-erection of some fallen stones at Stones of Stenness and Ring of Brodgar took place in the 19th and early 20th century, and works at Stenness also involved the erection of a 'dolmen', now reconfigured. There are, however, many antiquarian views of the monuments attesting to their prior appearance, and it is clear that **they remain largely in-situ**.

The central west Mainland monuments remain **dominant features in the rural landscape**. Their **form and design are well-preserved** and **visitors are easily able to appreciate their location, setting and interrelationships with one another, with contemporary monuments situated outside the designated property, and with their geographical setting**. This **relationship with the wider topographic landscape helps define the modern experience of the property and seems to have been inextricably linked to the reasons for its development and use in prehistory**.

Protection and management requirements

World Heritage properties in Scotland are protected through the following pieces of legislation. The Town and Country Planning (Scotland) Act 1997 and The Planning etc. (Scotland) Act 2006 provide a framework for local and regional planning policy and act as the principal pieces of primary legislation guiding planning and development in Scotland. Additionally, individual buildings, monuments and areas of special archaeological or historical interest are designated and protected under The Planning (Listed Building and Conservation Areas) (Scotland) Act 1997 and the 1979 Ancient Monuments and Archaeological Areas Act.

The Scottish Historic Environment Policy (SHEP)[1] is the primary policy guidance on the protection and management of the historic environment in Scotland. Scottish Planning Policy (SPP) sits alongside the SHEP and is the Government's national planning policy on the historic environment. It provides for the protection of World Heritage properties by considering the impact of development on their Outstanding Universal Value, authenticity and integrity.

Orkney Islands Council prepared the Local Development Plan that sets out the Council's policy for assessing planning applications and proposals for the allocation of land for development.

The Plan contains policies that address the need to put an appropriate level of protection in place for the property and its setting. Supplementary Planning Guidance for the World Heritage Site has also been produced. These policies and guidance establish a general commitment to preserving the integrity and authenticity of the property. They also seek to manage the impact of development on the wider landscape setting, and to prevent development that would have an adverse impact on its Outstanding Universal Value through the designation of Inner Sensitive Zones, aligned with the two parts of the buffer zone and the identification of sensitive ridgelines outside this area. The Rural Conservation Area at Brodgar includes Maeshowe, the Stones of Stenness and the Ring of Brodgar, and it is envisaged to establish a Rural Conservation Area at the Bay of Skaill.

The property is in the care of Historic Scotland[2] on behalf of Scottish Ministers. A Management Plan has been prepared by Historic Scotland in consultation with the Partners who share responsibility for managing the sites and access to them: Orkney Islands Council, Scottish Natural Heritage, and the Royal Society for the Protection of Birds. The Management Plan is a framework document, and sets out how the Partners will manage the property for the five years of the Plan period, together with longer-term aims and the Vision to protect, conserve, enhance and enjoy the property to support its Outstanding Universal Value. It does so by identifying a series of key issues and devising specific objectives or actions to address these issues. The Steering Group responsible for implementing the Management Plan comprises representatives of the Partners. Stakeholders drawn from the tourist industry, local landowners and the archaeological community participate in Delivery Groups reporting to the Steering Group with responsibilities for access and interpretation, research and education, conservation and protection, and tourism and marketing.

Condition surveys have been completed for each of the monuments. These documents record previous interventions and include a strategy for future maintenance and conservation. Conservation and maintenance programmes require detailed knowledge of the sites, and are managed and monitored by suitably experienced and qualified professionals.

Conservation work undertaken at the sites follows national and international policy and seeks to balance minimum intervention with public accessibility to the monuments. Any intervention is given careful consideration and will only occur following detailed and rigorous analysis of potential consequences. In conservation work, local materials have been used where appropriate.

Management of tourism in and around the World Heritage property seeks to recognise its value to the local economy, and to develop sustainable approaches to tourism. Key approaches include improved dispersal of visitors around the monuments that comprise the property and other sites in the wider area. A World Heritage Ranger Service supports this approach and allows for on-the-ground education about the issues affecting the site.

The **relationships and linkages between the monuments and the wider open, almost treeless landscape, and between the monuments that comprise the property and those in the area outside** it that support the Outstanding Universal Value are potentially at risk from change and development in the countryside. The long-term need to protect the key relationships between the monuments and their landscape settings and between the property and other related monuments is kept under review by the Steering Group. Policy HE1 as well as The Heart of Neolithic Orkney World Heritage Site in the Local Development Plan and the associated Supplementary Guidance require that developments have no significant negative impact on either the Outstanding Universal Value or the setting of the World Heritage property.

Notes

1 Since this statement was finalised in 2013, there have been some changes in the legislative and policy context in Scotland.

2 Historic Scotland is now known as Historic Environment Scotland (HES).

APPENDIX 2

Overview of the methodology for the Climate Vulnerability Index (CVI)

The Climate Vulnerability Index (CVI) methodology is a rapid assessment tool that has been specifically developed for application in World Heritage (WH) properties.

The CVI framework builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)[1]. However, the CVI differs from many vulnerability assessments because it comprises two distinct stages (see Figure A2-1) and it can be applied across all types of WH properties, assessing:

+ the OUV Vulnerability (OUV = Outstanding Universal Value, the central concept for World Heritage[2]); this assesses the exposure, sensitivity and adaptive capacity of the key WH values that collectively comprise the OUV, assessing how they will be impacted by three key climate drivers chosen to be the most relevant for that WH property
+ the Community Vulnerability based on the economic, social and cultural dependencies upon the WH property, and the adaptive capacity of these to cope with climate change.

The OUV Vulnerability is an important outcome of the CVI process, as is the final outcome, the Community Vulnerability, which is rarely considered in other assessments of climate impacts. Both outcomes are, however, highly relevant for many groups including the site managers, the responsible management agencies, the industries that are dependent on the property and the local communities.

Prior to commencing assessment of the CVI, there are three key foundational steps:

+ Determine the key WH values derived from the Statement of Outstanding Universal Value for the relevant WH property (see Section 2 for an example) and identify other significant local values (see Appendix 6)
+ Choose the three key climate drivers most likely to impact the WH values within a defined and agreed timeframe (e.g. by 2050); drivers to be chosen from the list in Figure A2-2
+ Undertake a preliminary assessment of the current condition and trend of the key WH values of the property.

Once these three foundational steps are completed, then the CVI process involves systematically undertaking the following eight key steps:

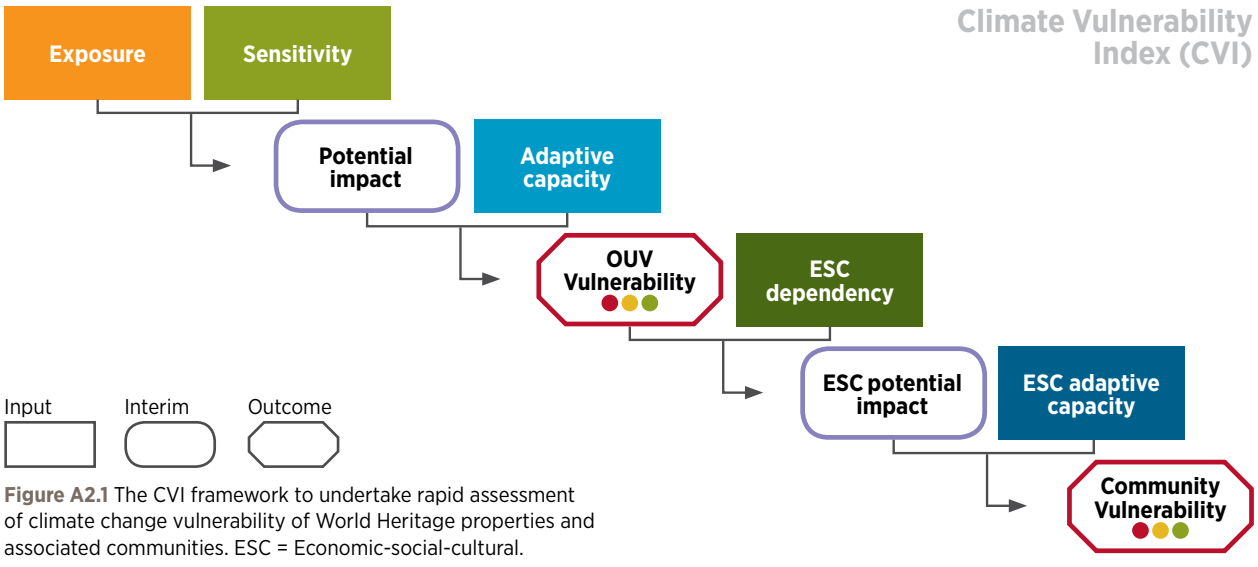


Figure A2.1 The CVI framework to undertake rapid assessment of climate change vulnerability of World Heritage properties and associated communities. ESC = Economic-social-cultural.

1 Conduct a high-level risk assessment (exposure and sensitivity) of OUV from the chosen three key climate drivers within the agreed time frame (e.g. by 2050). This process also considers some important modifiers that may vary these assessments
2 Use the spreadsheet-based worksheet to identify the potential impacts of the key climate drivers on the key WH values
3 Consider the likely adaptive capacity of OUV in relation to the key climate drivers
4 Use the worksheet to determine the OUV Vulnerability to the key climate drivers
5 Consider, and assess separately, the relevant economic, social and cultural (ESC) dependencies upon the WH property
6 Use the worksheet to determine the ESC potential impact to the ESC dependencies
7 Consider, and assess separately, the level of ESC adaptive capacity for the same ESC components considered above
8 Use the worksheet to determine the Community Vulnerability

The CVI approach should be undertaken by managers, academics, local residents and other stakeholders who know the relevant WH property and who understand the drivers likely to impact the property. Experience has shown the most comprehensive CVI assessments will result if a diverse group of stakeholders, managers, local community and agency representatives collectively participate in the workshop bringing together a range of views/perspectives.

Figure A2.2 List of the 13 climate drivers used in the CVI.

Driver	Synonyms and Associated Terms	Timeframe
Atmospheric		
Air temperature change	Warming; hotter average weather; increased evaporation; desiccation	Chronic
Change in wind	Gale; gusts; change in wind direction	Chronic
Drought frequency and severity	Aridity; dehydration; below average rainfall; prolonged water shortage	Chronic
Extreme temperature events	Heatwaves, bleaching; hot spell; desiccation	Acute
Humidity change	Evaporation; moisture content; oppressiveness; condensation; clamminess; sweatiness	Chronic
Precipitation change	Rainfall; rainstorms; showers; drizzle; heavy dew; hailstorms; sleet; snow	Chronic
Storm intensity and frequency	Cyclone; hurricane; typhoon; blizzard; tornado; storminess; extreme rainfall; lightning strikes	Acute
Marine		
Water temperature change	SST; warming	Chronic
Storm surge	Storm floods; storm tides; coastal flooding; cyclones; hurricanes	Acute
Extreme marine heat events	Heatwaves, bleaching; hot spell; desiccation	Acute
Sea level change	Sea level rise; flooding; subsidence; post-glacial rebound; coastal vulnerability	Chronic
Ocean acidification	OA; pH change; acidity; calcification rate; chemical reaction	Chronic
Changing ocean currents	Ocean circulation; ocean dynamics; ocean conveyor-belt	Chronic

The eight key steps of the CVI outlined above are explained in more detail below:

1. **Conduct a high-level risk assessment (exposure and sensitivity) of OUV from the chosen three key climate drivers within the agreed time frame (e.g. by 2050).**

The level of exposure (i.e. the nature, magnitude and rate of climatic and associated changes) of the key WH values to the three key climate drivers are assessed using the following scale (Table A2.1).

Similarly, the measure of the sensitivity or consequence (i.e. the degree to which the OUV is affected, either adversely or beneficially, by climate variability or change) of the key WH values to the three chosen climate drivers are assessed using the following scale (Table A2.2).

Applying modifiers to exposure and sensitivity

The CVI applies modifiers to both exposure and sensitivity to account for temporal scale and trend (exposure), as well as the spatial scale and compounding factors (sensitivity).

The effect of the modifiers above Level 1 is to amplify the exposure and/or sensitivity (scaling by 1.0–1.3 in increments of 0.1 for each level), and thus increase the assessed risk. Modifiers are applied using the following scales (Table A2.3, Table A2.4).

A compounding factor may be relevant when a WH property is already being or will be stressed by other factors; for example, a property may be already be subjected to non-climate stressors, such as increasing decay of materials (e.g. rot, insect attack, mould, mildew, fungal attack, acid rain, etc.); destabilisation of structures (e.g. earthquakes, subsidence, armed conflict); or the cumulative impacts on the site due to increasing tourism.

2. **Use the spreadsheet-based worksheet to identify the potential impacts of the key climate drivers on the key WH values.**

The modified exposure and modified sensitivity scores are entered into the risk matrix as shown below (Table A2.5) to determine the level of potential impact.

Table A2.1 Categorical levels for exposure, based on IPCC[1] definitions.

Exposure % based on IPCC[1,4]	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Very unlikely <10%	**Unlikely** 10–33%	**Possible** 34–66%	**Likely** 67–90%	**Very likely** >90%

Table A2.2 Categorical levels for sensitivity, based on IUCN[3] definitions

Sensitivity based on IUCN[3]	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
	Very low All key WH values will remain essentially intact; overall condition of property is stable or improving	**Low** Some loss or alteration of a few of the key WH values will occur, but not causing persistent or lasting effects on OUV	**Moderate** Some loss or alteration of some of the key WH values will occur, but not causing a significant reduction of OUV	**High** Loss or alteration of many key WH values will occur, leading to a significant reduction of OUV	**Very high** Potential for major loss or substantial alteration of majority of key WH values, leading to substantial reduction of OUV

Table A2.3 Modifiers to assessed exposure

Modifier	Level 0	Level 1	Level 2	Level 3
Exposure				
Temporal scale The frequency of event exposure	Intermittent (<1 event/ decade)	Occasional (1-5 events/ decade)	Frequent (5-10 events/ decade)	On-going
Trend The recent trend of the key climate driver	Decrease/static	Slow increase	Moderate increase	Rapid increase

Table A2.4 Modifiers to assessed sensitivity.

Modifier	Level 0	Level 1	Level 2	Level 3
Sensitivity				
Spatial scale Extent (%) of WH property affected by climate driver at any one time	Restricted <10%	Localised 11–50%	Extensive 51–90%	Very widespread 91–100%
Compounding factors Is climate change likely to influence or interact with other non-climate stressors (e.g. invasive species) in the near future?	Very unlikely/ unknown	Low probability	Medium probability	High probability

Table A2.5 Risk matrix to assess potential impact from exposure and sensitivity.

Modified Exposure	Modified Sensitivity				
	Very low	**Low**	**Moderate**	**High**	**Very high**
Very unlikely	Low	Low	Low	Low	Low
Unlikely	Low	Low	Moderate	Moderate	Moderate
Possible	Low	Moderate	Moderate	High	High
Likely	Low	Moderate	High	High	Extreme
Very likely	Low	Moderate	High	Extreme	Extreme

3. Consider the likely **adaptive capacity** of OUV in relation to the key climate drivers

Adaptive capacity describes the potential, capability or ability of a World Heritage property to adjust to climate change, to moderate potential damage, to take advantage of opportunities, or respond to the consequences[4].

In the CVI framework, adaptive capacity is considered in terms of:

a the local management response,
b the level of scientific and/or technical support, and
c the effectiveness of these to address the climate stressor being considered.

The following matrix (Table A2.6) shows the levels for these three aspects of adaptive capacity. In a situation where the resources available or technical knowledge provide no effect to address the climate stressor, any identified adaptive capacity is nullified; where there is an effect, the adaptive capacity can mitigate the risk of potential impact.

4. Use the worksheet to determine the **OUV Vulnerability** to the key climate drivers

The *OUV Vulnerability* is first key outcome of the CVI approach and is determined from the risk matrix (Table A2.7) derived from the potential impact and the adaptive capacity. Where the adaptive capacity does have an effect, it serves to mitigate the vulnerability of OUV.

The *OUV Vulnerability* (i.e. the level of vulnerability of the key WH values that collectively comprise the OUV) is an important outcome of the CVI. However, the implications of this for the surrounding community who depend upon the WH site (either economically, socially or culturally) are also very significant. The subsequent assessment (i.e. of the *Community Vulnerability*) is an important aspect rarely assessed in most other assessments of climate impacts. The CVI framework evaluates Community Vulnerability by considering the economic, social and cultural dependencies of the community associated with the property – noting that 'the community' comprises local, domestic and international aspects – and the community's adaptive capacity to cope with climate change.

Table A2.6 Categorical levels for components of adaptive capacity; local management capacity and scientific/technical support only contribute to the overall adaptive capacity in the CVI process if they are assessed to be effective (lower section) in addressing the relevant key climate driver.

	Level 1	Level 2	Level 3	Level 4
Local Management Capacity (i.e. resources, budget, knowledge) for management to respond at local level	No capacity and/or resources	Low capacity	Moderate capacity	High capacity
Scientific/Technical Support for management at local level	No support and/or scientific understanding	Low level of support	Moderate level of support	High level of support
Effectiveness to address the climate driver Extent to which adaptive capacity will effectively address the driver	Very low/ negligible level of effectiveness	Low level of effectiveness	Moderate level of effectiveness	High level of effectiveness

Table A2.7 Risk matrix to assess OUV Vulnerability from potential impact and adaptive capacity.

Potential Impact	Adaptive Capacity		
	High	**Moderate**	**Low**
Low	Low	Low	Low
Moderate	Low	Moderate	Moderate
High	Moderate	Moderate	High
Extreme	Moderate	High	High

5. **Consider, and assess separately, the relevant economic, social and cultural (ESC) dependencies upon the WH property.**

Economic dependency: This is the estimated future change in tangible (i.e. market or direct) economic value of all businesses directly dependent upon the WH property, due to climate change. Note that the assessment of businesses should be undertaken at the level of broad business types (e.g. day-tourism operations, multi-day tourism trips, resorts, cruise ships, commercial fishing, fishing tours, educational excursions, etc) rather than for every individual business (e.g. Joe Brown's Beach Hire Service). Consequently, having identified the main business types that are directly dependent upon the WH property (e.g. operating inside the World Heritage boundary or within the buffer region), the extent to which the key climate drivers will change the direct economic value is assessed as [MINIMAL, LOW, MODERATE, or HIGH]. Change in the direct economic value may be negative or positive for each identified business type, designated 'x' and '+', respectively, in the CVI worksheet. Intangible effects (e.g. social cohesion, aesthetics) were considered within the social and cultural components.

Social dependency: Social dependence requires physical interaction with the property; i.e. individuals must have visited or use the property. This assessment considers separately the extent to which the key climate drivers will affect society in the future; and considers locals, domestic visitors and international visitors separately, with each group's dependency being assessed as [MINIMAL, LOW, MODERATE, or HIGH]. Societal effects may be negative or positive for each identified people group, designated 'x' and '+', respectively, in the CVI worksheet.

In making this assessment, the CVI workshop participants may find it helpful to consider the following examples of social indicators[5]:

a **Societal:** relating to community (networks and norms that facilitate co-operative action, security, social cohesion)
b **Human resources:** relating to people (the knowledge and information stored in our brains, as well as our labour; considers age, education level, gender, health, life satisfaction)
c **Manufactured assets:** relating to infrastructure (manufactured goods such as tools, equipment, buildings, and the consumption of economic resources)
d **Natural capital:** relating to the environment (the renewable and non-renewable goods and services provided by ecosystems including culture and leisure, local environment, recreational opportunities).

Cultural dependency: Cultural dependence does not require a physical interaction with the property; i.e. individuals need not have visited or use the property to have an affinity toward it. This assessment also considers separately the extent to which the key climate drivers will affect local, domestic and international people separately, with each group's dependency being assessed as [MINIMAL, LOW, MODERATE, or HIGH]. Cultural effects may be negative or positive for each identified people group, designated 'x' and '+', respectively, in the CVI worksheet.

In making this assessment, the CVI workshop participants may find it helpful to consider the following examples of cultural indicators[6,7]:

a **Self-centric:** self and self-interest (health and well-being, personal identity, lifestyle, personal wealth, way of life)
b **People-centric:** the welfare of other humans (attachment to place, pride in place, icon value, Traditional Owner heritage, bequest value)
c **Enviro-centric:** non-human species (appreciation of biodiversity, existence value)
d **Pleasure-centric:** intangible personal pleasures derived through spiritual, artistic and aesthetic opportunities (spirituality, nature appreciation, cultural opportunities).

Having undertaken their assessments for the elements of economic (i.e. business types), social and cultural (i.e. people groups) components, the participants are then asked to consider which, if any, of the outcomes may need to be revised in the light of a holistic overview. The CVI worksheet equally weights each element, which may not best reflect the situation. For example, (i) for economic dependency, there may be certain business types that are of far greater economic importance; (ii) for social dependency, one group, such as the locals, may be of far more significance than the others. This opportunity for high-level revision ensures the final outcome does reflect the levels of dependency for the community associated with the WH property.

6. **Use the worksheet to determine the ESC potential impact to the ESC dependencies.**

The level of ESC potential impact is determined using the risk matrix, shown below (Table A2.8) based on the OUV Vulnerability and the combined ESC dependency.

Table A2.8 Risk matrix to assess ESC potential impact from OUV Vulnerability and ESC dependency.

OUV Vulnerability	ESC Dependency			
	Positive or minimal-negative	Low-negative	Moderate-negative	High-negative
Low	Low	Low	Low	Moderate
Moderate	Low	Low	Moderate	High
High	Low	Moderate	High	High

7. Consider, and assess separately, the level of **ESC adaptive capacity** of the same ESC components considered above.

ESC adaptive capacity describes the potential, capability or ability of the community associated with a World Heritage property to adjust to climate change. In contrast to ESC dependency, the ESC adaptive capacity only has a positive direction in the analysis. In evaluating ESC adaptive capacity, the same business types and social/cultural indicators used for the ESC dependency should be considered. The CVI process considers separately, then combines, the adaptive capacities of these same three ESC components:

Economic adaptive capacity: the extent or ability of each business type directly dependent upon the World Heritage property to adapt now to the key climate drivers. Considerations should include the ability of business types to adapt; e.g. (i) How flexible are operations? (ii) How realistic are alternative locations? (iii) What is the level of adaptability and uncertainty for each business type? (iv) How transferable are the skill sets of current business types? Each business type should be assessed as having [MINIMAL, LOW, MODERATE, or HIGH] adaptive capacity, designated '+' in the CVI worksheet.

Social adaptive capacity: the capacity now that locals, domestic visitors and international visitors each have to adapt socially in the face of the key climate drivers.

When making this assessment, consider the ability and capacity of the broad social indicators shown previously to adapt; e.g. (i) How adaptable is the local community? (ii) Are the human resources and manufactured assets easily adapted? (iii) Would visitors (domestic or international) know if changes occurred to how ecosystem services are used? (iv) Is the current natural capital available elsewhere or replaceable? Each people group should be assessed separately as having [MINIMAL, LOW, MODERATE, or HIGH] adaptive capacity, designated '+' in the CVI worksheet.

Cultural adaptive capacity: the capacity now that local, domestic and international people each have to adapt culturally in the face of the key climate drivers. When making this assessment, consider such aspects as: (i) the extent to which the existing level of cultural connection might be adapted (or not)? (ii) What are the implications for a loss of cultural identity or cultural links? (iii) Is there any ability to assimilate a loss of culture? Each people group should be assessed separately as having [MINIMAL, LOW, MODERATE, or HIGH] adaptive capacity, designated '+' in the CVI worksheet.

8. Use the worksheet to determine the **Community Vulnerability**

Having assessed the ESC adaptive capacity in the context of ESC potential impacts, the level of Community Vulnerability is determined based on these using the risk matrix, shown below (Table A2.9).

Table A2.9 Risk matrix to assess Community Vulnerability from ESC potential impact and ESC adaptive capacity

Potential Impact	ESC Adaptive Capacity			
	High	Moderate	Low	Minimal
Low	Low	Low	Moderate	Moderate
Moderate	Low	Moderate	Moderate	High
High	Low	Moderate	High	High

This determination of the Community Vulnerability is the final outcome from the CVI process, and its assessment distinguishes the CVI from most other assessments of climate impacts. If there is a significant level of adaptive capacity across the economic, social and cultural aspects, this can mitigate the identified potential impacts on the associated community. However, if the ESC adaptive capacity is low or minimal, the Community Vulnerability may even be greater than the assessed ESC potential impacts. Both the OUV Vulnerability and Community Vulnerability are highly relevant for many groups including the site managers, the responsible management agencies, the business that are dependent on the property and the local community.

It is important to note that the intention of the CVI-assessed vulnerabilities is to identify the risk to a property, but is not for comparison with other properties. The variabilities between different property types (e.g., natural and cultural, marine and terrestrial) are such that a ranking of properties based on vulnerability would not be appropriate. However, assessments of OUV Vulnerability within a thematic group (e.g., montane rainforests, mud architecture) can provide a foundation for assessments of other properties within that same thematic group. Note that the potential for broad variability in ESC characteristics of properties, even within a thematic group, would preclude a similar expectation for the Community Vulnerability.

Benefits of the CVI

Application of the CVI to date has demonstrated it to be:

+ a **rapid assessment tool**, that works for, and is able to be consistently applied to, a very wide range of WH properties (natural, cultural and mixed)
+ able to rapidly assess the physical and ecological impacts of climate change on OUV, but also provide a high-level **assessment of the economic, social and cultural consequences** of climate change for an individual WH property
+ **systematic and comprehensive** yet not overly complex (climate change itself is a complex issue, so the CVI needs to balance scientific robustness and political credibility with a level of practicality which enables it to be undertaken with all stakeholder groups at the WH property level)
+ **repeatable**, allowing for repeat assessments over time to assess trends (in the current era of rapidly changing climate, the ability to re-assess vulnerability at periodic intervals can guide updates of management actions)
+ enabling others to see exactly how the assessment was derived
+ able to **put climate change into context** – climate change is becoming a dominant threat to many WH values, but climate change is only one of many cumulative pressures impacting on WH properties and be **proactive** (not waiting for climate change impacts to become manifest, or for long-term trends to be confirmed)
+ provides opportunity to **identify adaptation strategies** in the face of potential impacts, with a consistent methodology that supports applications for funds and other resources to undertake identified activities
+ assist in **better understanding by local and indigenous communities and users**, of climate change and its impacts on WH properties (therefore is a key engagement tool)
+ **assist other WH properties with similar values** but less expertise to benefit from pre-existing assessments
+ **standardised** enough that it can ultimately become part of WH processes (such as State of Conservation reports, periodic reporting and WH nominations).

Supporting organisations and further application of the CVI

The ICOMOS Climate Change and Heritage Working Group (CCHWG) has included the development of the CVI in its current workplan, as have the IUCN Protected Areas Climate Change Specialist Group and the Union of Concerned Scientists; the UNESCO World Heritage Centre is also supportive of the CVI. Various other WH properties (e.g. Ningaloo, Wadden Sea, Vega Archipelago, Belize Barrier Reef, Gondwana Rainforests, Sydney Opera House, Frontiers of the Roman Empire: the Antonine Wall, St Kilda) are now part of a growing interest from WH properties across the globe in the CVI approach.

It is expected that CVI assessments will also be undertaken at a broad thematic level (as distinct from the individual WH property level); this approach is currently being trialled. Within a broad thematic group, exemplar WH properties may be used to assist other WH properties with similar values when they undertake their own assessments.

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APPENDIX 3

Overview of the CVI workshop in Orkney

As outlined in the Introduction, the Orkney workshop was the first time the CVI had been applied in a cultural WH site, and the first time the full CVI, including the economic, social and cultural aspects, had been tested anywhere.

Once the decision was made to hold the workshop in Orkney, a Steering Committee was formed which then liaised regularly via Skype/Zoom prior to the workshop to address various matters outlined below. The Committee members (identified in the list of participants at Appendix 5) comprised representatives of:

+ Historic Environment Scotland (HES)
+ Archaeology Institute at the University of the Highlands and Islands (UHI)
+ Orkney Islands Council (OIC)
+ Union of Concerned Scientists (UCS)
+ CVI developers from James Cook University

Participants – the aim was for 25-30 participants, but given the high level of interest, 31 experts (plus five UHI students) participated; however, several were unable to stay throughout.

+ A decision was made to limit workshop numbers to ensure the small groups were manageable while ensuring diversity of backgrounds and expertise. The final workshop included archaeologists, site managers, planners, climate experts, scientists, renewable energy experts, tourism representatives, local and international NGOs and agency representatives (see full list at Appendix 5)
+ Two-thirds of the participants were from Scotland, as well as senior heritage experts from England, Ireland, Norway and the USA, along with the CVI developers from Australia
+ Experience, from the two CVI workshops and elsewhere, demonstrates that more effective and realistic assessments result if a diverse group of stakeholders, managers, local community and agency representatives collectively participate in the workshop, bringing together a range of expertise and perspectives.

Workshop programme – the workshop ran for 2.2 days (i.e. 0.5 day familiarisation, 0.5 day field trip, 1 full day on the CVI assessment and 0.2 day summary/ evaluation - see Appendix 4 and Fig. A3.1). An outline of the agenda was distributed to participants before the workshop; the actual program comprised a mixture of:

+ Plenary sessions
+ Four small group sessions undertaking assessments and then reporting back to plenary sessions. The make-up of the small groups was deliberately chosen to, as far as possible, ensure a similar mix across each group of background, experience and agency representation.

Workshop location – a large meeting room in Stromness Library was used for the plenary sessions, with two additional breakout rooms also used for the small group sessions. Kirkwall (UHI campus) was chosen for the public talk (see below).

Pre-workshop tasks – prior to the workshop, a worksheet requested all participants to:

+ Read the Statement of OUV and understand how the breakdown of values was developed from that Statement
+ Identify what they considered were the main climate drivers impacting those values
+ Identify significant local values (while these may not 'meet the bar' of OUV, they do have local, regional or national significance)
+ Identify the key economic activities dependent upon the WH property.

Pre-workshop webinar – to provide a basic grounding for all participants, a webinar was organised addressing key background material (i.e. a global overview of climate change; a Scotland/Orkney perspective on climate and climate change projections; an overview of coastal erosion around Orkney; HES management responses to climate change on Orkney). The webinar is available online: https://www.youtube.com/watch?v=kvAC5-Q4XFQ&feature=youtu.be

Field trips – a half-day field trip (to Skara Brae and Ring of Brodgar) was conducted during the workshop, which was invaluable to provide context to workshop participants particularly through the discussions held on-site; a second optional field trip to two sites in Deerness (outside HONO) threatened by climate change occurred after the workshop concluded.

Assistance from university students – the UHI staff arranged for five students to assist during the workshop; they were scribes for both the plenary and small group sessions, organised the public event (i.e. developed posters; ensured publicity); organised catering for the workshop and undertook general logistics (e.g. registration of participants; photocopying when required, etc).

Communications/media – Significant media coverage occurred in Scotland. There were four pieces of broadcast coverage across television and radio, including BBC Reporting Scotland, Scottish TV news, BBC Radio Scotland *Good Morning Scotland* and BBC Radio Orkney. Printed media included items in seven national and regional print and online outlets: BBC News online, The Scotsman, The National, the Press and Journal, The Orcadian, The Orkney News and Scottish Field. The online reach was 614 million and print reach was 3,400. There were two blogs:

+ HES: https://www.historicenvironment.scot/about-us/news/orkney-hosts-international-workshop-on-climate-change-threat-to-world-heritage-sites/
+ UHI: https://archaeologyorkney.com/2019/04/24/orkney-hosts-international-workshop-on-climate-change-threat-to-world-heritage-sites/

Social media: Many tweets arose from the workshop (search #CVIOrkney). The UHI Archaeology Facebook page had 15,439 people look at posts during the 3 days of the workshop, as well as 23,000 impressions on Twitter. 4,600 people viewed the blog page, with 200 people sharing in the first 3 days. Social media share was 1,100.

+ The Scottish Government Cabinet Secretary for Culture, Tourism and External Affairs, Fiona Hyslop MSP, tweeted about the workshop.

Public talk/open event – on the Thurs evening, four presenters from the workshop addressed a public outreach event at the Kirkwall campus of UHI which was then followed by Q&A; the 1.5 hour event was very successful, with more than 60 people attending (standing-room-only).

Post-workshop write-up – following the workshop, the Steering Committee spent a day debriefing about the workshop and drafting sections of this report.

Main outcomes from the workshop:

+ Successfully tested the full CVI methodology and completed the CVI assessment for HONO (see Section 5 for details)
+ Following the workshop, very useful feedback was provided on ways to strengthen and improve the methodology for future CVI workshops (e.g. improved definitions; more targeted info prior to the workshop; simplifying some of the info provided for the economic, social and cultural assessments; choosing an agreed climate change scenario so everyone uses the same basis for assessments)
+ HES agreed to publish the workshop report, co-branded with the other partners
+ HES will report on the success of the workshop at the Sea Change: Coastal Heritage and Climate Change conference in Blackpool, UK, in September 2019.

Success factors identified

The success of this workshop can be attributed to many things, including:

+ The international steering committee worked to establish a rapport and met by video-conference call weekly for nearly two months to facilitate workshop organisation/logistics etc.
+ The considerable level of effort prior to the workshop:
  - The pre-workshop webinar was available to all participants, allowing them all to obtain a similar background prior to the workshop
  - The pre-workshop tasks provided information which was analysed before the workshop and then used during the workshop

- The small group break-out sessions worked well as did having additional information on worksheets, and stimulated lively discussion in plenary
- The CVI developers acted as independent facilitators to maintain momentum throughout the workshop
- The inclusion of the students from UHI was an unexpected bonus – while they assisted with a lot of the logistics, they also learned a lot and appreciated the opportunity to be involved
- The students took minutes of the break-out groups as well as the plenary sessions
- The high level of media interest was due to a concerted effort by HES and UHI media/ communication teams, with input from UCS
- While the 'open-door public event' on the Thursday night was not an essential part of the CVI workshop process, it provided an important opportunity to raise local awareness and to receive additional input from the community (including those who did not attend the workshop).

Follow-up after the workshop

- The outcomes from the workshop will be presented at the 2019 WH Committee meeting (43COM) in Baku, Azerbaijan including during a side-event of the meeting, to the Site Managers Forum, and as part of the World Heritage Watch forum
- HES will integrate the workshop findings into the new Management Plan review process and document for the HONO WHS, beginning summer 2019
- There were commitments from HES and Historic England (the statutory agency responsible for heritage management in England) to use the CVI methodology at other UK sites, and strong interest from the national heritage agencies in Ireland and Norway
- The CVI project team – led by James Cook University – will follow-up with other WH properties and national agencies that are interested in hosting CVI workshops, including the Wadden Sea (Netherlands/Germany/Denmark), Ningaloo and the Sydney Opera House (Australia), Vega Archipelago (Norway), Belize, New Zealand, Nigeria and Colombia
- It is recommended that this report should act as a template for future CVI reports.

Figure A3.1 Images showing the CVI workshop including plenary and breakout discussion sessions and site visits.

APPENDIX 4

Outline of the CVI workshop in Stromness, Orkney 23rd-25th April

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Tuesday 23rd April
12.00-18.00
A working lunch was provided when the workshop participants first arrived

1 Overview of workshop aims, introductions, use of plenary and small-group sessions, logistics (toilets, coffee-breaks, etc.) – presentation (~40 min)

AIM 1: Understand the Climate Vulnerability Index (CVI) framework and its application in Orkney

2 Provide full overview of CVI concept, followed by discussion – presentation (~45 min)

AIM 2: Understand the significant values that comprise the OUV plus the other significant values (i.e. Significant Local Values = SLVs) for Orkney

3 Ensure all participants are aware of the Statement of OUV for Orkney and how the Table of key values was derived from the SOUV – interactive (~30 mins)

4 Ensure everyone understands the distinction between OUV and Significant Local Values (SLVs) – interactive (~15 mins)

AIM 3: Understand future climate change scenarios facing Orkney.

5 Provide overview of climate change scenarios, differences in projected impacts from scenarios including timescales, and geographically-specific projections – presentation (~45 min)

AIM 4: Assess the climate drivers impacting the values of Orkney and select key climate drivers

6 Show list of climate drivers – check for (i) understanding? (ii) timescales? Do example together of brainstorming key climate drivers impacting ONE OUV attribute from Table 1 – presentation (~45 min)

7 Using the list of climate drivers as provided, ask small groups to brainstorm what are the key climate drivers impacting the OUV attributes – interactive (~60 min)

Wednesday 24th April
08.30-12.30
Field trip to Heart of Neolithic Orkney sites (Skara Brae and Ring of Brodgar)

Wednesday 24th April
13.00-18.00

AIM 4 (cont.):

8 Bring outputs from #7 back to plenary and ensure all participants agree on which climate drivers are impacting the attributes of OUV – interactive (~30 min)

AIM 5: Evaluate vulnerability of OUV to key climate drivers, considering exposure and sensitivity. Analyse one or two scenarios ('Business as Usual' and 'Paris Agreement').

9 Revisit process, including detail of thresholds, for exposure and sensitivity. Review the potential impact matrix that combines these. Revisit process for adaptive capacity and review the OUV vulnerability matrix that combines these – presentation (~45 min)

10 Participants in groups assess the exposure and sensitivity (thus determining potential impact) and adaptive capacity (thus determining OUV vulnerability) for the key climate drivers. Analyse one agreed scenario e.g. 'Business as Usual' – interactive (~90 min)

11 Bring outputs from #10 back to plenary and discuss any variation in assessments of exposure, sensitivity and adaptive capacity, and any effect on OUV vulnerability

12 Identify industries directly dependent upon WH property – interactive (~60 min)

Thursday 25th April
09.00-12.30

AIM 6: Consider economic, social and cultural dependencies (sensitivity) and adaptive capacity, to determine Community Vulnerability.

13 Revisit process for analysing economic, social and cultural dependency. Review the ESC potential impact matrix that combines these. Revisit process for analysing economic, social and cultural adaptive capacity – presentation (~40 min)

14 Participants in groups assess the economic, social and cultural dependency (thus determining ESC potential impact) and adaptive capacity (thus determining Community vulnerability) for the property – interactive (~75 min)

15 Bring outputs from #14 back to plenary and discuss any variation in assessments of economic, social and cultural dependency, and corresponding adaptive capacity. Examine any effect of these on Community vulnerability – interactive (~60 min)

Thursday 25th April
13.00-14.00

AIM 7: Summary, feedback and next steps – interactive (~60 min)

16 Summarise outcomes from workshop, following final analysis worksheet. Receive feedback on CVI framework and workshop process.

17 Recap on those items that had been 'parked' during the workshop.

18 Conduct workshop evaluations; other feedback from participants.

Workshop concluded at 14:00

Public Event
Thursday 25th April
19.30–21.00
University of Highlands and Islands,
Orkney College Campus, Kirkwall.

Facilitated by Prof. Jane Downes, with presenters:

- Adam Markham: Climate Change – the greatest global threat to cultural heritage
- Julie Gibson: Orkney's spectacularly threatened heritage: the World Heritage Site in context
- Ewan Hyslop: Managing the impact of climate change on Orkney's World Heritage sites
- Scott Heron: Climate Vulnerability of Orkney's World Heritage.

These presentations were then followed by Q & A.

APPENDIX 5

List of participants in the CVI workshop, Orkney (Steering Committee members indicated by *)

Participant	Title	Affiliation	Based
Elin Dalen	Senior Advisor, International Issues	Riksantikvaren – Directorate for Cultural Heritage (Norway)	Oslo, Norway
Gareth Davies	Managing Director	Aquatera	Orkney
Mairi Davies	Climate Change Manager	Historic Environment Scotland (HES)	Edinburgh
Tom Dawson	Director of SCAPE, and Principal Research Fellow, St. Andrews.	SCAPE Trust (Scottish Coastal Archaeology and the Problem of Erosion), & St. Andrews University	St. Andrews
Jon Day*	CVI Developer; a former Director with the Great Barrier Reef Marine Park Authority (now retired)	ARC Centre for Coral Reef Studies, James Cook University, Australia	Townsville, Australia
Pauline Gleeson	Senior Archaeologist	National Monuments Service of the Dept. of Culture, Heritage & Gaeltacht	Dublin, Ireland
Jane Downes*	Director, Archaeology Institute	University of the Highlands & Islands (UHI) Archaeology Institute	Orkney
Sian Evans	Islands & World Heritage Visitor Services Manager	Historic Environment Scotland (HES)	Orkney
Julie Gibson*	Orkney County Archaeologist; Lecturer, Archaeology Institute	Orkney Islands Council (OIC) & UHI Archaeology Institute	Orkney
Hannah Fluck	Head of Environmental Strategy	Historic England	Portsmouth, England
Anne Gascoigne	Committee member	Orkney Field Club	Orkney
Joe Hagg	Science & Skills Manager	Adaptation Scotland	Edinburgh
Scott Heron*	CVI Developer; Senior Lecturer in Physics (JCU); NOAA affiliate	James Cook University & NOAA Coral Reef Watch	Townsville, Australia
Ewan Hyslop*	Head of Technical Research & Science	Historic Environment Scotland (HES)	Edinburgh
Rebecca Jones*	Head of Archaeology & World Heritage	Historic Environment Scotland (HES)	Edinburgh
Rebecca Kavanagh	Planning Policy Support Officer (Development and Marine Planning)	Orkney Islands Council (OIC)	Orkney
Neil Kermode	Managing Director	European Marine Energy Centre (EMEC)	Orkney
Patricia Long	Chair	Orkney Tourist Guides Association (OTGA)	Orkney

Participant	Title	Affiliation	Based
Alice Lyall	Deputy Head of World Heritage; Coordinator for Heart of Neolithic Orkney	Historic Environment Scotland (HES)	Edinburgh
Adam Markham*	Deputy Director, Climate & Energy	Union of Concerned Scientists (UCS) & US-ICOMOS (International Council on Monuments and Sites)	Connecticut, USA
Kevin Murphy	Archaeologist	Western Isles Archaeology Service	Stornoway, Western Isles
Cath Parker	HES Field Officer for Orkney; Chair, Sanday Trust	Historic Environment Scotland (HES); Sanday Heritage Trust	Orkney
Andrew Potts	Climate Change & Heritage Working Group Coordinator	ICOMOS (International Council on Monuments and Sites)	Albany, NY, USA
Alistair Rennie	Coastal Erosion Coordination & Research Manager	Scottish Government	Inverness
Paul Sharman	Senior Projects Manager	UHI Orkney Research Centre for Archaeology (ORCA)	Orkney
Antonia Thomas	Lecturer in Archaeology	UHI Institute of Archaeology	Orkney
Shona Turnbull	Marine Environmental Planner	Orkney Islands Council	Orkney
Val Turner	Shetland Regional Archaeologist	Shetland Amenity Trust	Lerwick, Shetland
Stuart West	Planning & Marine Development Manager	Orkney Islands Council	Orkney
Caroline Wickham-Jones	Archaeological Researcher; OHS Board Member	Orkney Heritage Society (OHS)	Orkney
David Woolf	Associate Professor, School of Energy, Geoscience, Infrastructure and Society	Heriot Watt International Centre for Island Technology	Orkney
Naomi Bouche	Undergraduate student	UHI Institute of Archaeology	Orkney
Alanis Carag Buhat	Masters student	UHI Institute of Archaeology	Orkney
Euan Cohen	Undergraduate student	UHI Institute of Archaeology	Orkney
Marion Ratier	Masters student	UHI Institute of Archaeology	Orkney
Farrah Skimani	Masters student	UHI Institute of Archaeology	Orkney

APPENDIX 6

List of significant local values that are locally, regionally or nationally significant for Heart of Neolithic Orkney

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Intangible		+ Allows for recreation/re-creation and offers a sense of space. But to what degree this is an imagined/ideal landscape is contingent on individual response + Wide open landscape
	Tranquility	+ There are times when you cannot hear man-made sound (specifically traffic) + Local value – sense of connection with local surroundings. + The serenity and tranquility of these places, for many spirituality
	A focal point for activity	+ Locus and incentive for exercise, dog-walking, birdwatching, beach-combing, kayaking, botany, artistic pursuit
	Natural Soundscape	+ National value – location unique in UK + e.g. bird song and calls + The ways in which the landscape and seascape are experienced with non-visual senses, particularly important when thinking about the values of these places to those who are differently abled but also relevant to all + Soundscapes of wind, sea, water, birds
	Monuments featured in songs	
	Viability of traditional & ancient crops and plants	
	“Northern-ness”	+ The sites embody the regional northern otherness that sets Orkney (Shetland also) apart from the rest of Scotland and the U.K. (McClanahan 2013)
	Reuse of imagery	+ Motifs from sites found throughout the islands in contemporary life.
	Education	+ In addition to archaeological practice there is an educational value of the heritage of Orkney for all ages
	Placemaking	
	Artistic inspiration	+ For literary, visual and performance arts.
	Memory & identity of residents and visitors	+ Experience of past visits to sites important to many e.g. Sunday school picnics; trip of a lifetime for some visitors

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Heritage Practice		+ Association (e.g. Maeshowe) with solstice, I am not aware but there may be local traditions/ festivities associated with this or other events, summer fetes, winter wassail these sorts of festivals + Mid-winter illumination of Maeshowe and Pagan ritual use of the Stones of Stenness (e.g. equinoxes) + Solstice
	Traditional skills and activities	+ Dry stone walling, traditional building techniques, maintaining landscape (hedge laying, traditional crofting skills – I am not familiar with Orkney specific examples but imagine there are some) + Knitting/spinning + Fishing practices, farming practices + Crafts + Traditional practices that shape and remake the landscape and seascape. Every place has them and these are often integral to the values of the landscape and seascape of these places. There is a practicality in how these are transferred and continued and their loss, absence or change would/does have a fundamental impact upon the place as experienced + Local – Gift shops and artists use the architecture of sites like the Ring of Brodgar and the Stones of Stenness to design item + Heritage in products: The use of imagery and artwork from the sites throughout the island
		+ This is particularly important for this area – so many archaeologists are trained and taught in and around Orkney. There is also an intangible oral history of this training and practice that has and continues to shape archaeological practice + Excavation, survey, as test for new techniques, etc.
	Local myths, legends and stories, music, oral history	+ The practical and tangible frameworks associated with storytelling and music making/sharing – the when and where and how + Loss or damage to sites could reduce physical links to the stories + The folklore and story-telling associated with the heritage of Orkney
		+ Local- Pagan society uses sites for spiritual uses + The association of these places with the spirituality of contemporary people + In widest sense but also includes modern Pagan ceremonies incl. weddings held at Ring of Brodgar; specific (sometimes 'secular') spiritual experience of winter solstice at Maeshowe + Local pagan group holds events and rituals at primarily the Stones of Stenness and the Ring of Brodgar. Important religious events for some
	Social beliefs	+ Local, regional and national- researchers believe that the Heart of Neolithic Orkney represent the social beliefs of the time
		+ Early 20th century sea wall defences, local craftmanship, at Skara Brae are evidence of early and relatively pioneering form of heritage conservation. Local, regional and national. Sea wall defence at Midhowe on Rousay (traditional knowledge) and the cairns

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Biodiversity & Ecological		+ Many specific areas of the WH are examples of the 24 categories of terrestrial and marine/freshwater habitat as classified by national/ international Biodiversity Action Planning schema. Orkney LBAP 2018-2022 gives a full description of these and offers four broad themes, three of which (farmland, peatland and marine/freshwater habitat) are applicable to the Heart of Neolithic Orkney + littoral; marine; terrestrial; managed landscape; unmanaged landscape + The habitats that the Orkneys provide due to their geology, cultural and natural landscapes and seascapes – e.g. rockpools, grazing land, heath
	"Sanctuary" for species considered to be of conservation concern	+ As identified in Orkney LBAP: Short-eared owl, Curlew, Lapwing, Skylark, Twite, Linnet, Sand Martin, Otter, Orkney Vole, Brown Hare, Great Yellow bumblebee, Large Heath butterfly, Holy grass, + Nationally threatened bee. Lochs of Harray and Stenness are designated as a Site of Special Scientific Interest (SSSI) for flora, fauna and importance to wintering wildfowl
	Ecosystems and mutual dependencies	+ The relationships between flora and fauna that occupy particular places in the landscape
	Saline lagoon environment in Loch of Stenness	+ Loch of Stenness designated as a Special Area of Conservation (SAC) as a saline lagoon. This designation applies to rare, endangered or vulnerable habitats and species of community interest and plays a key role in ensuring they are either maintained at, or restored to, favourable conservation status
	Terrestrial Flora	+ The plants that grow on land, sea and shore + Lochs of Harray and Stenness are designated as a Site of Special Scientific Interest (SSSI) for flora, fauna and importance to wintering wildfowl + Wildflowers and crops
	Terrestrial Fauna	+ Other non-avian fauna, from invertebrates to mammals + Biodiversity: Local – Orkney and surrounding landscape is home to a wide variety of animals, including the Orkney Vole •+ Including farm animals and people
	Marine fauna and flora	+ Maerl; Marine seascape + Flame shells; Coastal protection + Kelp; Carbon reservoir + Sea grass + Grey seals: Marine Seascape + Harbour or common seals: For better or worse, major attractant to visitors + Orcas (very rarely but iconic): N.B. though internationally 'harbor seal' is classified with a conservation status of 'least concern', in north eastern Scotland, the local population has declined alarmingly and has been the leading environmental obstruction to marine renewable energy development + Otters (notably near Brig o' Waithe, various dolphins and porpoises)
	Avifauna	+ So many species! Essential adjunct to the landscape + Puffins: For better or worse, major attractant to visitors + Oyster Catchers + Curlews + Greylag Geese

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Heritage Practice	Social activities	+ Local, regional and national – Spotting native flora such as Scottish Primrose around the Heart of Neolithic Orkney, terrestrial fauna such as animal spotting, and bird watching at the Ness of Brodgar and other sites + Local, regional and national – Spotting native flora such as Scottish Primrose around the Heart of Neolithic Orkney + Nationally, regionally and locally - Animal spotting (e.g. Orkney Vole)
	Conservation	+ Local- Encourage pollination and attract Great Yellow Bumblebee + Local, regional and national – birds such as the curlew and short-eared owl have been sighted around the Heart of Neolithic Orkney
	Tourism	+ Local – Chance to spot native plants (500 native plants in total) + Local – The heart of Neolithic Orkney increases tourism to the mainland and subsequently also creates jobs + Local – Tours suited to bird spotting around the Heart of Neolithic Orkney
	Research	+ Local, regional and national – Research on plants surrounding the heart of Neolithic Orkney
	Landscape Setting	+ Local – Birds are a part of the Heart of Neolithic Orkney landscape + Local – Plants associated with the Heart of Neolithic Orkney landscape are part of the setting and experience + Local farmers tend to animals, such as sheep, which are located within the Heart of Neolithic Orkney landscape
	Management	+ Local – Encouraging birds to settle around the area will encourage tourism
	Hunting	+ Local and regional – Duck and geese shootings in and around the Heart of Neolithic Orkney
	Grazing	+ Local – Farming community use sites such as the Stones of Stenness for grazing
	Geologically interesting features esp. at Skaill	+ Bay of Skaill designated as an SSSI for its geological interest
Archaeological	Hidden	+ National significance – research and interest brings archaeologists from across the UK and further afield
	Visible	+ National significance – research and interest brings archaeologists from across the UK and further afield. + Local – The visible architecture has integrated into the landscape setting
	WH monuments	+ Locally, nationally, regionally important + Ness of Brodgar – Nationally/Internationally + Barnhouse – regionally + Standing stones/outliers – Nationally + Mounds – nationally/regionally
	Neolithic monuments	+ State of preservation
	Buried archaeology	+ Ness of Brodgar close to WH property + Those sites and features we cannot see and that have not yet been reveal through excavation or natural processes. Some will be predictable, others unknown

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Archaeological	Underwater/Marine archaeology	+ May be important underwater sites yet to discover, telling history of sea level rise + Those archaeological sites and deposits in the marine environment – some may be maritime, some will relate to terrestrial activities from the past that are now below sea level
	Orkney Islands Identity	+ As identified in Orkney LBAP: Short-eared owl, Curlew, Lapwing, Skylark, Twite, Linnet, Sand Martin, Otter, Orkney Vole, Brown Hare, Great Yellow Bumblebee, Large Heath butterfly, Holy grass + Nationally threatened bee. Lochs of Harray and Stenness are designated as a Site of Special Scientific Interest (SSSI) for flora, fauna and importance to wintering wildfowl
	Tourist attraction	+ Major reason for visitors to come. Revenue; support for local businesses + Local – The heart of Neolithic Orkney increases tourism to the mainland and subsequently also creates jobs
	Deposits	+ paleoenvironmental; cultural, stratigraphy and spatial distribution + The information contained within archaeological deposits – to do with past environments, past activities and the sequence of these that records changes through time and space
	littoral	+ The archaeology in the inter-tidal and shoreline – often revealed and concealed with changing tides and currents and weather. Often found and lost very rapidly
	Earthworks, structures	+ The visible heritage lumps and bumps and structures of past human activity
	Landscape setting	+ Local – The archaeological remains are part of the physical and cultural landscape
	Research	+ Local, regional and national – The sites have been influential in research surrounding Neolithic society and beliefs
	Employment	+ Local – The Skara Brae visitor centre creates jobs for people working in the tourism sector
	Media	+ Local and national – Media attention gives the Heart of Neolithic Orkney recognition across the country
	Diverse settlement	+ Neolithic/ Bronze Age/ Pictish/Norse: The juxtaposition of settlements from many periods is essential to the rich archaeological landscape of Orkney
	Vulnerability	+ Local – Sites like the Ring of Brodgar are under threat due to foot activity from tourism
Economic	Income Opportunities	+ National – growth of Scottish economy + Local farmers tend to animals, such as sheep, which are located within the Heart of Neolithic Orkney landscape
	Jobs	+ Local impact
	Conservation	+ Local and national

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Economic	Reputational/Presentation and accessibility	+ Local and national
	Management of sites	+ Local and national
	Tourism	
Scenery/ Landscape and Seascape (Aesthetics and Experience)	Monuments	
	Tourism	+ Local – Scenery including lochs are a popular attraction for tourists
	Sea Views	+ Beaches and bays + Always close to water
	Aesthetics	+ Instagram-worthy
	Media	+ Local and national – Pictures etc. taking of surrounding scenery are attractive to tourist and show natural landscape
	Landscape Setting	+ Historic Structures + Local – These human-made archaeological features have become part of the landscape + Sites/remains of WWI/II camps and defences + Relics of historical farming/land-use
	Contemporary landscape / Architecture	+ Local – Modern properties are located around the sites for the views and scenery
	Unique seascape and landscape character	+ The combination of features that give the unique seascape and landscape character of Orkney + National: Hoy & West Mainland National Scenic Area encompasses central West mainland sites and part of Buffer Zone + Land Use patters + Relationship between the monuments and the surrounding scapes are enjoyed. Imagery is used in photography and by heritage organisations + Views of surrounding hills, locks, footpaths, and farmland
	Legibility of landscape and seascape through time	+ How the landscape and seascape can be read and understood by those today and in future
	Geological	+ The geological character of the Orkney islands and the geological information within the rocks and deposits
	Conservation	+ Local – Wind mills are controversial in archaeology sites and highly debated in term of running the scenery
	Routeways – sea and land	+ Those routes between places, often very long history of use and associate folklore. The markers that indicate them, from land and sea
	Sensory Experiences	+ Changing light especially as year passes (extremes of daylight/ darkness) + Experiencing natural light from sites (view of the sun over the hills of Hoy from Stones of Stenness). The illumination of Maeshowe during mid-winter solstice

Broad groupings of values	Key values	Additional justification Why is the value significant? Locally, regionally or nationally?
Scenery/ Landscape and Seascape (Aesthetics and Experience)	Lochs	+ Loch of Stenness SSSI and SAC + Loch of Stenness is a peculiar brackish environment supporting wild fowl, worms, bivalves, marine algae + Loch of Harray primarily valued as an amenity (e.g. fishing) + Both lochs are an essential part of the landscape of west-central Mainland
	Conflicted site	+ A site that has been at the heart of contestations between pressure groups wanting to construct within the boundaries of the HONO WH property and those wanting to conserve its integrity – Local and regional
	Cultural features	+ Skaill House, historic manor house overlooking Skara Brae – Local
Natural systems	Representative Scottish and island habitats, including machair	+ Site of Special Scientific Interest
	Rare breeding species of bird & insect, rare plants	+ Site of Special Scientific Interest; RSPB reserves, etc.
	Access to paths and sites for walking/running/cycling	+ Locally significant to resident especially at Brodgar and Skaill
	Beach at Skaill	+ Popular sand beach; attractive; also popular with surfers (known across UK)
Recreational	Fishing in Harray Loch	
	Visiting sites/monuments with guests	
	Birdwatching	+ Orkney nationally known for birdwatching: key draw for some visitors. Drivers as for biodiversity
	Terrestrial Fauna Societal Activities	+ Nationally, regionally and locally – Animal spotting (e.g. Orkney Vole) + Local – Farming community use sites such as the Stones of Stenness for grazing

APPENDIX 7

The management planning process for the Heart Of Neolithic Orkney

States Parties that have ratified the 1972 World Heritage Convention have obligations to ensure that any WH property in their territory has an appropriate management system in place. Although formal management plans for WH properties are not a statutory requirement in Scotland, their use is regarded as best practice. These are working documents that are monitored during delivery and regularly reviewed and updated.

The central purpose of the Management Plan is to maintain the OUV of the property and ensure its effective protection, conservation, and presentation and its transmission to future generations. It also provides a framework to demonstrate to UNESCO that the property has appropriate management mechanisms in place to do this. The International Council on Monuments and Sites (ICOMOS) advises that management plans should be based on a strategic view over 30 years. In developing the 2014-19 Management Plan, the HONO partners developed a vision for the property for 2014-44 to guide this and future plans.

The vision states that:
"The Heart of Neolithic Orkney is a World Heritage Site that is effectively protected, conserved, enhanced and enjoyed in ways that safeguard its Outstanding Universal Value. Its global importance as an exceptional testimony to the cultural achievements of the Neolithic peoples of northern Europe and its status as a world-class visitor experience are widely recognised. It is a focus for achieving sustainable economic, social and environmental benefits for locals and visitors alike. It is a resource for inspiring research and learning and widening engagement through participation and discovery."

Six aims were derived from this, to prioritise and guide decision making:

1. Safeguard and enhance the OUV of the WH property by managing, conserving and protecting its cultural, archaeological, historical, and landscape values.
2. Promote awareness and understanding of the OUV to local, regional, national and global audiences by improving intellectual, social and physical accessibility.
3. Realise the WH property's full potential as a resource for education and learning, for skills development, and for sustainable tourism.
4. Build strong structural and organisational partnerships between local and national organisations and strengthen engagement with the local community and landowners.
5. Ensure the sustainable management of the WH property by balancing wider environmental, natural heritage, biodiversity, social, and economic concerns.
6. Encourage and broaden research opportunities and use this new research to underpin work to protect and promote the WH property.

Each aim has one or more associated Issues, outlining specific challenges. The aims and issues informed the development of specific objectives cross-referenced to the rest of the Management Plan as required.

The 2014-19 Management Plan and Climate Change
Climate change was recognised as a matter of concern when the current management plan was developed, but in line with the previous 2008-13 Management Plan it was not woven throughout the planning process. It was addressed under Aim 5: Ensure the sustainable management of the WH property. Issue 16: Impact of Climate Change stated that "[a]n emerging issue of concern for the cultural heritage sector is the impact of climate change on the management of the archaeological resource."

HONO is at significant risk from a variety of climate-related factors including: increases in storminess and sea level rise and consequent increases in coastal erosion; torrential rain and flooding; changes to wetting and drying cycles; changes to the water table; and changes to flora and fauna. The growth of renewable energy also has the potential to impact on the setting of the monument.

The Objectives derived from this were:

- Objective 5.4: Identify areas of the property at risk and ensure that they are appropriately monitored and that recommendations for mitigation and adaptation are integrated into the management of the WH property.
- Objective 5.5: Seek to improve sustainability and energy efficiency in relation to the property and visitor management.
- Objective 5.6: Ensure the mitigation commitments in the 2008 Strategic Environmental Assessment are taken forward as the Management Plan objectives are delivered.

There was a recognition that issues were interconnected. Issue 5 was explicitly linked to Issue 1: The HONO WH property and its Buffer Zone, and to Issue 3: Risk Preparedness, both located under Aim 1: Safeguard and enhance the OUV of the WH property. Issue 1 noted that, "[HES] safeguard and preserve the authenticity and integrity of the WH property through the conservation and maintenance of the physical fabric of the monuments. Detailed conservation strategies, monitoring regimes and regularly reviewed maintenance programmes are in place for each monument, ensuring the Site is conserved in accordance with national and international conservation charters." Issue 3 noted that, "Examples of physical risks include threats to the fabric of the monuments, particularly from erosion, potential impacts on setting from nearby development, and issues around managing visitor access to and around the WH property.

The surviving extent of the site at Skara Brae is vulnerable to coastal erosion which needs to be managed without exacerbating erosion elsewhere in Skaill Bay. This issue remains a threat to the long-term survival of the site."

The Objectives here were:

- Objective 1.1: Safeguard and preserve the authenticity and integrity and carry out the conservation and maintenance of the WHS monuments in accordance with national and international conservation charters.
- Objective 1.7: Develop a risk strategy and associated mitigation measures to address the risks associated with the Management Plan and objectives.
- Objective 1.8: Continue to monitor and review coastal erosion at the Bay of Skaill and review strategy for the protection of Skara Brae accordingly.

As seen above, it was determined during the management plan development process that the Strategic Environmental Assessment[1] commitments from the previous 2008-13 Plan could be carried forward with minimal revision into the new plan period. Commitment 3 explicitly addresses climate change, while 5 and 6 address climate impact related threats (Table A7-1).

Table A7.1 The Schedule of Commitments identified in by the Strategic Environmental Assessment of the 2008-13 Management Plan and revised for the 2014-19 Management Plan.

	Strategic Environmental Assessment: revised Schedule of Commitments
1	Any proposals to alter the WH property boundary following review to be developed in consultation with partners and undertake public consultation
2	Manage visitor numbers to avoid exacerbating problems at sensitive sites
3	Consider the implications of the predicted effects of climate change for the management of the WH property
4	Integrate environmental assessment into the development of any options for any new visitor facilities and car parks. Include consideration of sustainable urban drainage systems for any new developments
5	Include section on environmental risk in the Risk Strategy
6	Consider environmental implications of proposals to address coastal erosion at Skara Brae and seek early involvement of partners and SEPA
7	Include environmental interests in Conservation Strategies
8	Consider environmental sustainability issues when addressing carrying capacity problems
9	Proposals for archaeological research to consider possible environmental effects of the proposed work
10	Grant funding from HS [now HES] to incorporate environmental criteria into the evaluation of funding proposals
11	Include environmental sustainability questions in any programme of visitor studies
12	Include wider environmental issues in the Interpretation Plan and Access Strategy and integrate environmental sustainability principles into the review of public access
13	Improve general awareness of biodiversity duty
14	Implement the environmental measures that will be required to reduce our carbon footprint though Partners' organisational strategies e.g. Historic Scotland's [now HES] Climate Change Action Plan 2012-17 and Carbon Management Plan. Maintain links with the Green Tourism Business Scheme

Delivery and Governance

HES directly manages the monuments that comprise the WH property, but the wider management of the property and the Buffer Zone is currently carried out in partnership with Orkney Islands Council, Scottish Natural Heritage and Royal Society for the Protection of Birds. Representatives from the four partner organisations and Orkney College UHI Archaeology Institute together form a Steering Group that oversees strategic implementation of the Management Plan. Subgroups responsible for delivering on specific areas cover Conservation and Protection, Access and Interpretation, and Research and Education.
HES provides coordination via a dedicated WH Property Coordinator position, to support liaison between the partners, drive forward the implementation, monitoring and revision of the Plan, communicate OUV and the benefits of WH, promote awareness and understanding among partners, stakeholders and the wider public, and to serve as a central point for advice.

Reviewing the 2014-19 Management Plan

The WH Property Coordinator and Steering Group will lead the process of reviewing and revising the current management plan during 2019, with the next plan to be in place for 2020-25. The Steering Group partners have agreed that in light of increasing challenges to the management of the WH property, in particular from climate change and changes to tourism numbers and patterns, that a thorough review and revision is now required. This process will involve broad consultation with partners and stakeholders, including local resident communities and wider communities of interest.

Climate change impacts are recognised as a key issue for current management of the site and the future preservation and transmission of its OUV. As such, the findings of the CVI workshop will be used to inform the consultation and development process and to support decisions about prioritisation of resources. Climate change and its current and potential impacts will be a foundational consideration throughout, rather than an issue confined to a specific set of objectives.

Notes

[1] Public bodies and others are required to assess, consult on, and monitor the likely impacts their plans, programmes and strategies will have on the environment. This process is known as Strategic Environmental Assessment (SEA).

APPENDIX 8

Acronyms

AD	Anno Domini
BC	Before Christ
CC	Climate Change
CVI	Climate Vulnerability Index
ESC	Economic, social and cultural
EU	European Union
HES	Historic Environment Scotland
HONO	Heart of Neolithic Orkney
ICCROM	International Centre for the Study of the Preservation and Restoration of Cultural Policy
ICOMOS	International Council on Monuments and Sites
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LBAP	Local Biodiversity Action Plan
OIC	Orkney Islands Council
OUV	Outstanding Universal Value
RSPB	Royal Society for the Protection of Birds
SAC	Special Areas of Conservation
SCAPE	Scottish Coastal Archaeology and the Problem of Erosion
SNH	Scottish Natural Heritage
SOUV	Statement of Outstanding Universal Value
SSSI	Sites of Special Scientific Interest
UCS	Union of Concerned Scientists
UHI	University of the Highlands and Islands
UNESCO	United Nations Educational, Scientific & Cultural Organization
WH	World Heritage
WHA	World Heritage Area
WHS	World Heritage Site

Glossary

ayre	A ridge of sand or gravel formed by the sea; a sand spit
broch	An Iron Age round defended house, found mainly in the north and west of Scotland
fuel poverty	A household which, in order to maintain a satisfactory heating regime, is required to spend more than 10% of its income on all household fuel use
henge	A circular or sub-circular Neolithic enclosure defined by a ditch and external bank, usually with one or more entrances. May contain a variety of internal features, including stone and timber settings and hearths
holm	Old Norse term for small and rounded islet or island
noust	A place where a boat can be hauled up and kept ashore; specifically, a scooped-out trench at the edge of a beach surrounded by a shallow wall of stones

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University of the Highlands and Islands
Oilthigh na Gàidhealtachd agus nan Eilean

ICOMOS
international council on monuments and sites

JAMES COOK UNIVERSITY
AUSTRALIA

Union of Concerned Scientists

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