



Ancient Places

Archaeology and history on the N5 Westport
to Turlough road project, Co. Mayo

Kerri Cleary, Richard F Gillespie and Paul Clarke

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With contributions by

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Linda G Lynch, Ellen OCarroll, Jerry O'Sullivan, Ian Riddler, Helen Roche, Ben Spillane, David
Stone, Angela Wallace and Ken Williams

TII Heritage 17

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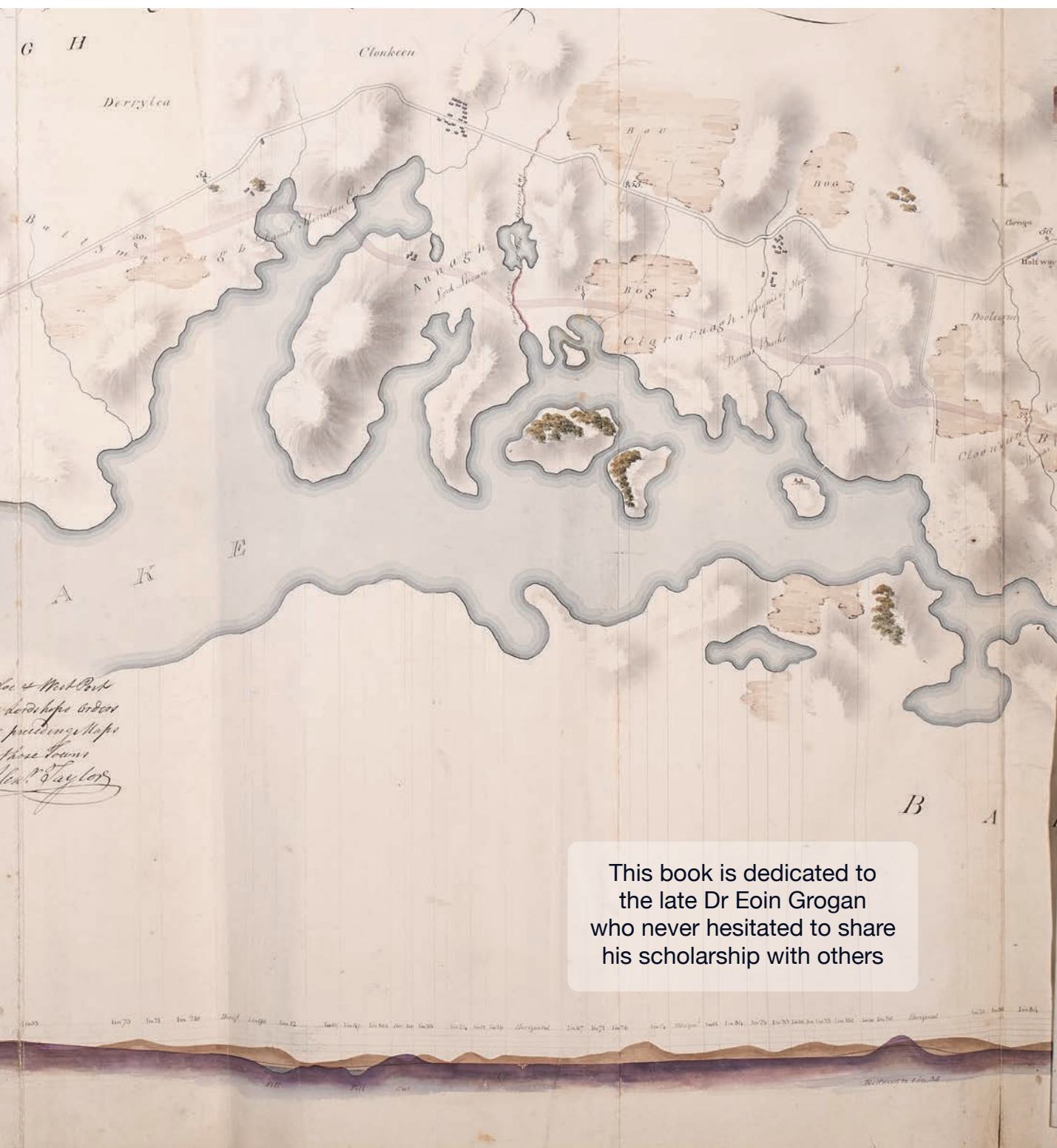
Front cover—Croagh Patrick, Co. Mayo, at sunset (Richard F Gillespie).

Page 257—Oblique aerial image of route of N5 road project during archaeological investigations, looking south-west towards Croagh Patrick (Firefly Photography for Mayo County Council).

Pages vi–vii and 258–259—Extracts from William Larkin's 1808 map of the *First Division of the Mail Coach Road from Ballinasloe to Westport* (National Library of Ireland).

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This book is dedicated to
the late Dr Eoin Grogan
who never hesitated to share
his scholarship with others

Foreword

There is an early 19th-century map in the National Library of Ireland that shows a proposed ‘post road’ between Ballinasloe and Westport, designed by William Larkin, surveyor and engineer, in 1808. One of Larkin’s aims was to follow the most level gradient available, avoiding unnecessary strain on draught animals and people. Consequently, his route meandered around the hills, hollows and lakes that are typical of the drumlin landscape in the region. Larkin’s road was never built but, more than two centuries later, the N5 Westport to Turlough road was built in the same landscape, on a similar but more direct route.

The N5 Westport to Turlough project was designed with requirements and constraints unimaginable in Larkin’s day, including potential impacts on a cultural landscape of architectural heritage and archaeological sites and monuments. The project team at Mayo County Council chose routes that successfully avoided all previously known sites and monuments. But new archaeological sites are invariably discovered on major road projects, so extensive investigations were undertaken prior to construction.

The archaeological sites discovered along the N5 project route provide evidence for aspects of daily life in the region from the Neolithic period to the 19th century—farming and food processing; craftwork, industry and trade; domestic architecture; and, at the end of life, later prehistoric funerary practices. Some of the evidence was startlingly well preserved. Waterlogged hollows between the drumlins were favoured

for the Bronze Age burnt mound sites (*fulachtaí fia*) used to boil water in large pits or troughs. These watery places also provided ideal conditions for the survival of organic materials. The wooden planks, wickerwork and mosses lining the troughs looked fresh and new, though some were nearly 4,000 years old.

These ‘ancient places’ were identified by investigations that included a desk-based study of early maps and aerial photographs; geophysical surveys of sub-surface features using the magnetic gradiometry and electrical resistivity methods; and test-excavations throughout the route, using mechanical excavators under archaeological supervision. The sites were all fully recorded and excavated by hand, resulting in an intensive programme of post-excavation analyses of finds and samples, and detailed technical reporting.

This book is a distillation of that work. It aims to tell the story in plain language while maintaining the scientific integrity of the evidence. I am glad that it gives me this opportunity to thank everyone who worked on the road project. I particularly wish to congratulate the authors of *Ancient Places* on making the results of the work publicly available in the TII Heritage series, in an attractive and colourful format that we hope you will enjoy.

Lorcan O’Connor

Chief Executive

Transport Infrastructure Ireland

Acknowledgements

The archaeological excavations on the N5 Westport to Turlough road project were undertaken by Archaeological Consultancy Services Unit (ACSU) Ltd on behalf of Mayo County Council with funding from Transport Infrastructure Ireland (TII) (formerly the National Roads Authority). The archaeology, architectural and cultural heritage section of the Environmental Impact Statement for the project was compiled by Valerie J Keeley Ltd for Roughan & O'Donovan–Faber Maunsell Alliance. The consulting engineers to the Council at design and planning stage were Roughan & O'Donovan–AECOM. Roughan & O'Donovan were consulting engineers for the construction stage. The main contractors were Wills BAM Joint Venture, who retained Moore Environmental and Archaeological Services Ltd for the construction stage.

Paul Hyland was Senior Engineer at the National Roads Design Office in Mayo County Council. Marian McHugh was Project Manager for the Council and Michael Corley, Martin Lavelle and John O'Malley were the Project Engineers. Mary Deevy was Senior Archaeologist for TII, Richard F Gillespie was the Project Archaeologist for Mayo County Council, assisted by Paul Clarke, Mayo County Council Archaeologist, from fieldwork to publication; Michael MacDonagh, for the National Roads Authority (now TII), and Gerry Walsh, for Mayo County Council, were Project Archaeologists at the preliminary stages of the project. Mark Keegan was liaison archaeologist at the National Monuments Service. Dr Nessa O'Connor

provided support from the National Museum of Ireland.

Archaeological excavations were directed for ACSU Ltd by Siobhán McNamara, Leo Morahan, Donald Murphy, Joe Nunan and Ian Russell, assisted by excavation supervisors Robert Breen, Marcus Byrne, Arlene Coogan, Deirdre McCarthy, Alan McCombs, Will Ó Sioráin and Suzi Smith Tracey, and other fieldworkers including Caroline Cosgrove, Derek Gallagher, James McKee, Deirdre Murphy and Jon Stirland. Mechanical excavators were supplied and operated by Joe O'Brien and his team at Skm Contracts Ltd. Jon Stirland (ACSU Ltd) recorded a built heritage survey. Underwater surveys were by Dr Niall Brady and Rex Bangerter (ADCO Ltd). Archaeological geophysical surveys were by Dr James Bonsall and Heather Gimson (Earthsound Ltd). ACSU Ltd thanks all of the landowners along the route for facilitating all stages of our fieldwork.

At the post-excavation stage, specialist analyses of finds, samples and dating evidence were provided by Victor Buckley (clay pipes); Kieran Campbell (historic pottery); Arlene Coogan (faunal remains); Cecily Cropper (glass bead); Dr Killian Driscoll, Dr Bernard Gilhooly and Jon Stirland (chipped stone objects); Dr Julie Dunne, Dr Toby Gillard and Professor Richard P Evershed (organic residue analysis); Antoine Giacometti (glass); Dr Eoin Grogan and Helen Roche (prehistoric pottery); Dr Rory Hodd (moss); Susannah

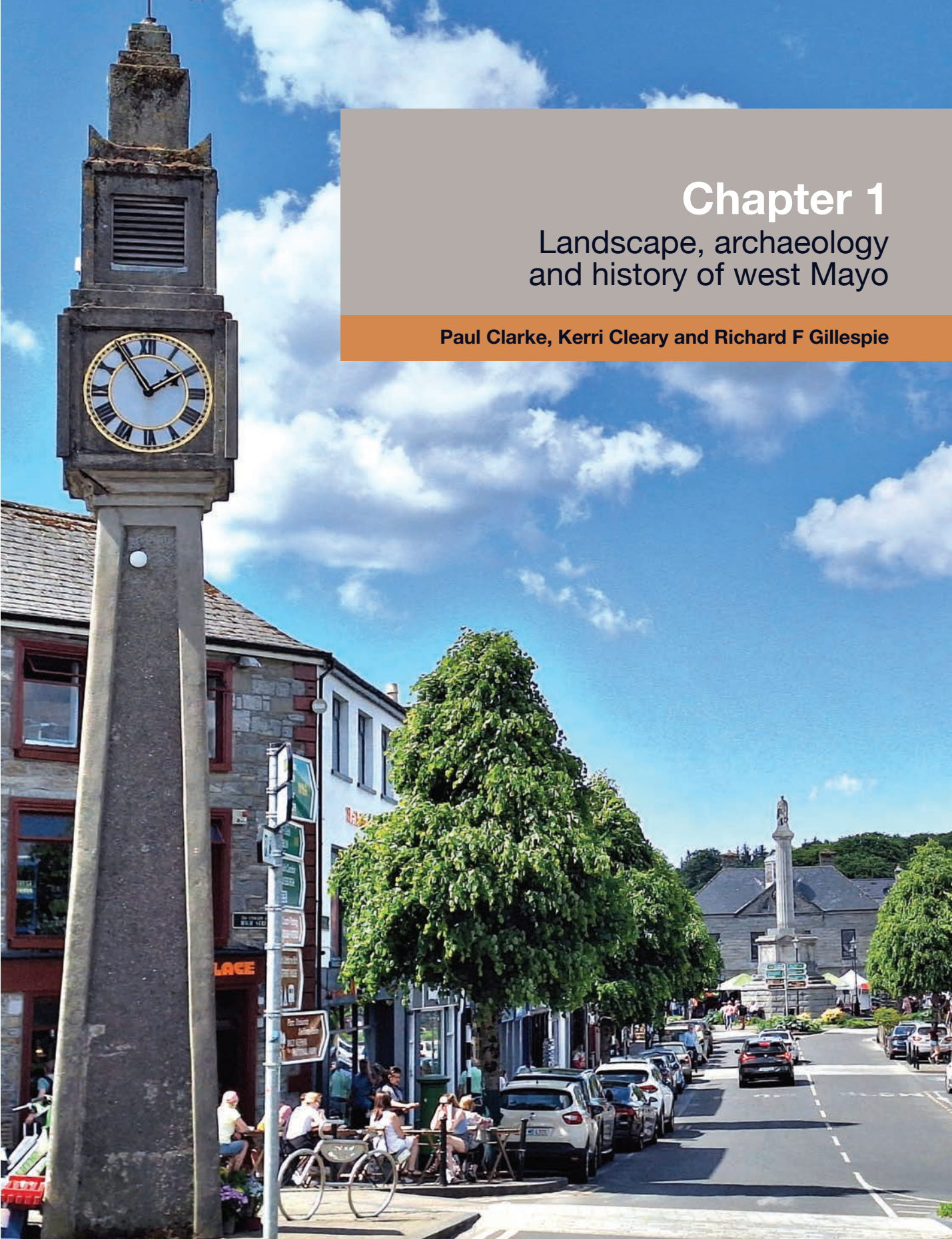
Kelly (artefacts conservation); Dr Linda G Lynch (cremated human bone); Dr Stephen Mandal (lithology); Sara Nylund (artefact illustrations and artist's reconstructions); Oisín O'Brien (artefact illustration); Dr Ellen OCarroll (wood and charcoal); Ian Riddler (bone beads); Dr Ben Spillane (Bayesian statistical modelling); Dr David Stone (plant remains); Angela Wallace (metallurgical waste); and Ken Williams (Reflectance Transformation Imaging). Radiocarbon dates were obtained from Adam Mickiewicz University, Poznań, Poland, and from Beta Analytic Inc., Florida, USA. Dr Ellen OCarroll was overall palaeoenvironmental specialist for the project. Arlene Coogan organised the processing and analysis of artefacts as Post-Excavation Officer at ACSU Ltd.

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Co. Mayo, including unpublished reports and scientific dating. Deirdre Cunningham, Heritage Officer at Mayo County Council, and Jane O'Shaughnessy, National Monuments Service, provided advice and support at various stages of the project. James O Connor, Mayo County Library, provided references advice and support.

The maps, plans and other line drawings in the book are by Martin Halpin and Chiara Mazzanti (ACSU Ltd). Artefacts were photographed by Ian Russell. Rob Goodbody drew our attention to the hitherto unpublished Willam Larkin (1808) map of the *First Division of the Mail Coach Road from Ballinasloe to Westport*, and James Harte of the National Library of Ireland provided a digital copy of the map. Assistance in sourcing other illustrations and permissions for their use were provided, variously, by Dr Rose M Cleary and Sue Zajac (Illus. 1.17); Clare McNamara and Sharon Weadick of the National Museum of Ireland (Illus. 1.19, 2.32 and 2.33); Sally Donovan of Amgueddfa Cymru (National Museums of Wales) (Illus. 2.35); Ken Williams (Illus. 3.9); Conor McDermott (Illus. 4.3); and Dr Paul Rondelez, Mark Dillon, Robert Seiler and Charles Torres (Illus. 4.6 and Illus. 4.7).

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Chapter 1

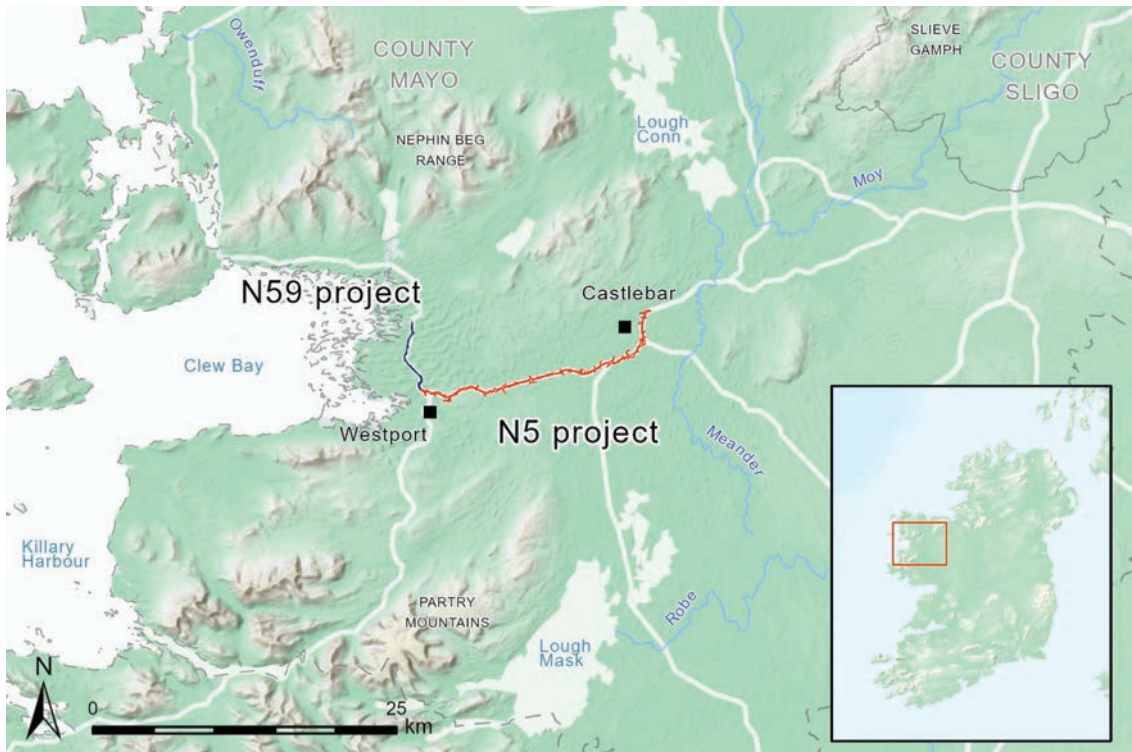
Landscape, archaeology
and history of west Mayo

Paul Clarke, Kerri Cleary and Richard F Gillespie

Landscape, archaeology and history of west Mayo

The start of any new development can be a step into the unknown, especially when it traverses a rural landscape. The N5 Westport to Turlough road project extends over 25.5 km in a varied landscape of hills and hollows, rivers and bogs, scrubland and open fields, largely unaffected by modern development. On such large road projects, the archaeologist's role begins with the

earliest design phases and can last beyond construction. This publication describes the investigation of 58 archaeological sites on the route of the N5 between Westport and Turlough in Co. Mayo and also, for completeness, another three archaeological sites on the adjoining Barleyhill to Kilmeena section of the N59 Westport to Mulranny road (Illus. 1.1).



Illus. 1.1 Location map of the N5 Westport to Turlough and Barleyhill to Kilmeena section of the N59 Westport to Mulranny road projects (ACSU Ltd based on Tailte Éireann map).

Archaeological investigations

Archaeological surveys and test-excavations on the N5 Westport to Turlough project were carried out in accordance with Ministerial Directions (No. A0069) issued to Mayo County Council following approval of the project by An Bord Pleanála in July 2014. Surveys and excavations on the N59 Westport to Mulranny project were subject to licences issued to the individual excavation directors by the National Monuments Service, on behalf of the Minister. All of the work was funded by Transport Infrastructure Ireland (formerly the National Roads Authority).

N5 Westport to Turlough

The N5 route was chosen to avoid or at

least minimise impacts on archaeological, architectural or cultural heritage. The background research to achieve this began in 2009. Assessment reports on archaeology, architectural heritage and cultural heritage were prepared by Valerie J Keeley Ltd, as part of the Environmental Impact Statement (EIS) for the project (Roughan & O'Donovan-Faber Maunsell Alliance 2013). The archaeological assessment report identified areas of archaeological potential based on field inspection, aerial photographs and early map evidence. Preliminary test-excavations using mechanical excavators were carried out in these areas by archaeologists from Mayo County Council in 2009–11 (Gillespie 2009a–b; 2011a–f). The test-excavations found that all the potential archaeological features in these areas—with the exception of a mill site at Liscromwell—were natural topographical



Illus. 1.2 Geophysical survey work on the undulating landscape of the N5 road project (Earthsound Archaeological Geophysics).



Illus. 1.3 Test-excavations in Drumneen with trenching in peaty topsoil in progress in the foreground and completed, backfilled trenches on the hillslope in the background (ACSU Ltd).

features or modern features of non-archaeological origin. Test-excavations also established that any archaeological remains associated with two previously recorded monuments—ringforts in Liscromwell and Aghadrinagh—were outside the lands required for the road project and would not be affected by it.

This work was followed in 2015 by surveys by Earthsound Archaeological Geophysics (Illus. 1.2) using the magnetic gradiometry and electrical resistance methods (Bonsall & Gimson 2015). The survey was not confined to the areas of archaeological potential identified in the EIS but covered all land that was available and deemed suitable for geophysical survey. The surveys recorded numerous anomalies of potential interest, including possible ring-ditches, burnt

mounds, other areas of burning, and relict ditches related to roads or field boundaries known from historic mapping. Subsequent test-excavations (below) would discover that most of these anomalies did not correspond with significant archaeological features and were instead geological or modern in date. One geophysical anomaly was found to coincide with a prehistoric burnt mound (*fulacht fiadh*), afterwards excavated as Cloondeash 3. A circular anomaly at Lisnageeha 1 (also known as Milebush) was interpreted as a possible ditch or round-house. This was found by test-excavations to coincide with a concentration of charcoal and a sample from this (hazel) was dated to 2559–2292 BC (Poz-80371). Upon further investigation, however, the geophysical anomalies at this site were found to have

natural, geological origins. In fact, the underlying boulder clay of the N5 landscape was not conducive to the detection of many sorts of archaeological features and, ultimately, most of the excavated sites on the project were discovered by machine testing (Illus. 1.3) rather than geophysical survey.

Following the geophysical survey, a programme of further archaeological surveys and test-excavations was rolled out on the N5 route in 2015 and 2018 by Archaeological Consultancy Services Unit Ltd (ACSU) and Archaeological Dive Company Ltd (ADCO). As described above, test-excavations by machine examined sites of geophysical anomalies, but also investigated all other accessible areas along the project route, with the aim of assessing any sub-surface archaeological remains that might be discovered by this method (Russell et al. 2015; Murphy 2018). In tandem with this work there were surveys of upstanding built heritage remains and townland boundaries by ACSU Ltd (Stirland 2015; Russell et al. 2015) and underwater surveys at river crossings by ADCO Ltd (Brady & Bangerter 2015).

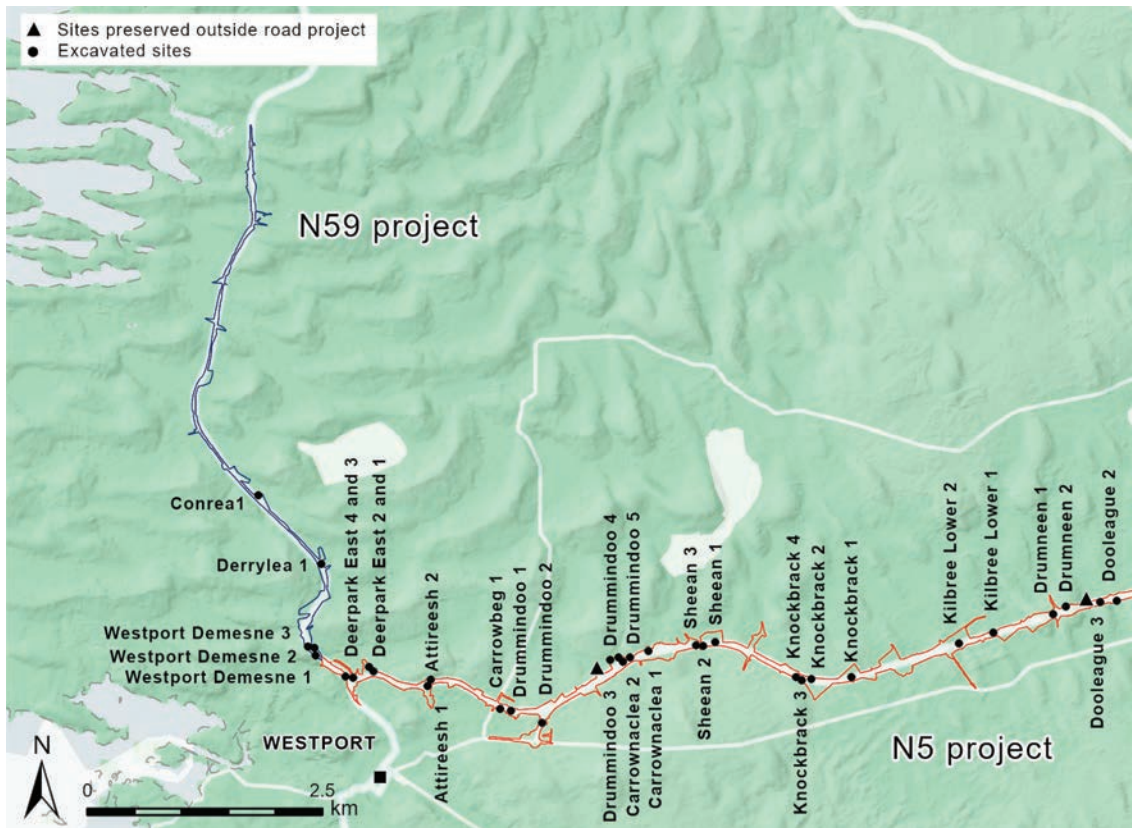
Overall, test-excavations identified features of potential archaeological interest at 66 locations on the N5 route. At one of these sites (Carrowbeg 1) there was only a single feature that was fully recorded during testing. The remaining sites were excavated by ACSU Ltd in June to December 2016 and October to December 2018. This revealed that eight sites (Aghalusky 2, Deerpark East 2, Derrinlevaun 1, Dooleague 1 and 2, Lisnageeha 1, Pheasanthill 1 and Sheean 2) were geological or not archaeological in nature, leaving 58 confirmed archaeological sites (Illus. 1.4).

Subsequently, when the N5 road was being constructed, additional archaeological

test-excavations were undertaken by Moore Environmental and Archaeological Services Ltd between May 2020 and June 2021 (Moore 2020a–b; Quinn & Moore 2021a–d). This identified a further eight archaeological sites, all of which were avoided and preserved outside the road project. These comprise burnt mounds or burnt stone spreads, three in the townland of Aghadrinagh, one in Claggarnagh East and two each in the townlands of Drumneen and Drummindoo (Table 1.2). A possible wedge tomb was also identified at one of the Drumneen burnt mound sites (Chapter 3). All sites were reported to the Archaeological Survey of Ireland.

N59 Barleyhill to Kilmeena

An assessment report on archaeology, architecture and cultural heritage was compiled for the N59 Westport to Mulranny road project—including the section between Barleyhill and Kilmeena that is described in this book—by archaeologists from Mayo County Council (Gillespie & Sexton 2010). This was followed by test-excavations by machine in 2011, 2012 and 2015, as different areas of the route became available for investigation (Gillespie 2015). This work identified several new archaeological sites. Six of them were in the Rossow Bends section, in Drumard and Keeloges, and were investigated in 2014 by Rubicon Heritage Services Ltd. The six sites were prehistoric burnt spreads or mounds, at Keeloges 1–2 and Drumard 1–4 (Gilligan & Hession 2014a–c; Hourihan & Hession 2014a–c). South of this, three other archaeological sites were discovered and investigated in the Barleyhill to Kilmeena section in 2016 by ACSU Ltd (Murphy 2017). These were prehistoric burnt mounds at Conrea 1 and



Illus. 1.4 Location map of archaeological sites recorded on the N5/N59 project (ACSU Ltd based on Tailte Éireann map).

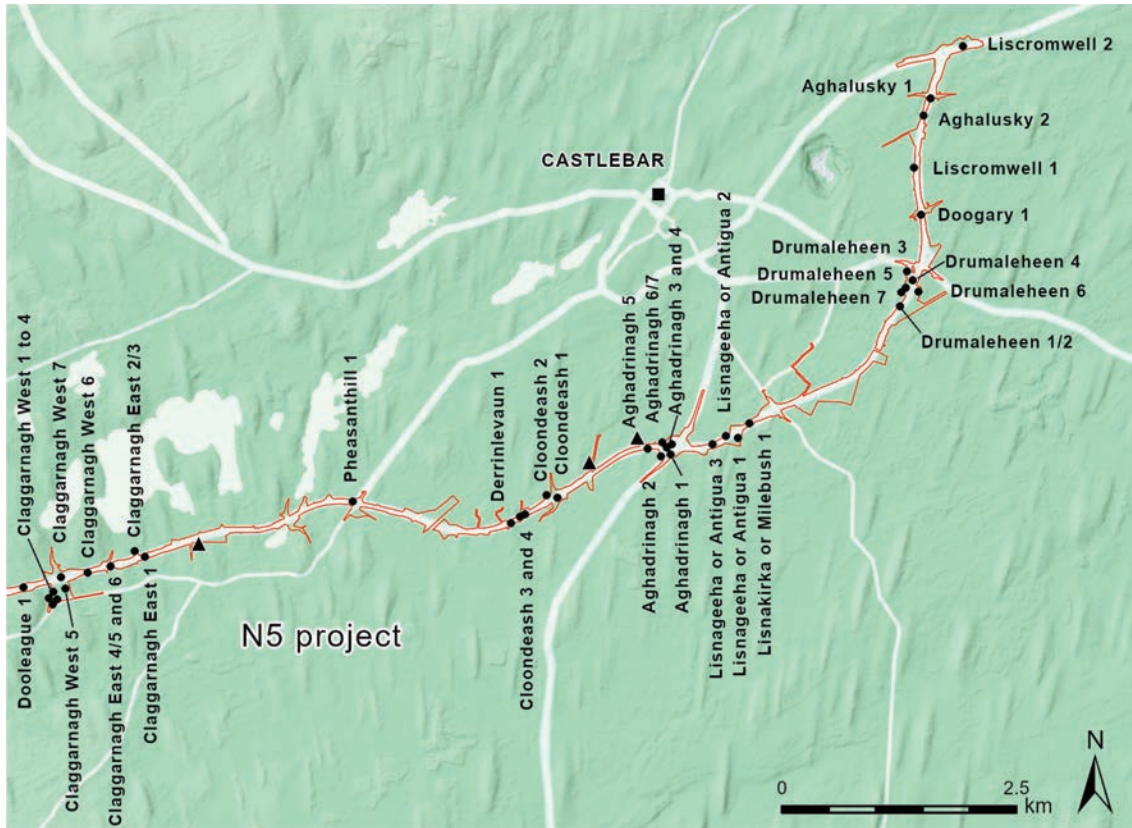
Derrylea 1 and medieval charcoal kilns at Westport Demesne 1–3 (Illus. 1.4).

The archaeological sites on the N5 Westport to Turlough road project and the three sites on the Barleyhill to Kilmeena section of the N59 Westport to Mulranny road project were all excavated by ACSU Ltd and combine to form the subject of this book. For brevity and simplicity, throughout the book, we shall refer to the combined area of these investigations as the N5/N59 project.

New discoveries

The archaeological sites described in the book range across 5,000 years, from the Neolithic period to the 19th century. In describing

the sites, we use conventional chronological periods throughout the book (Table 1.1) and these largely align with the ‘Archaeological periods for the island of Ireland’ proposed by Carlin et al. (2022) in the international PeriodO gazetteer of archaeological, historical and art-historical periods. Prehistoric sites dominate the record (Table 1.2), with 48 burnt mounds and burnt stone spreads, ranging in date from the Late Neolithic period to the Late Bronze Age (Illus. 1.5) (Chapter 2). These are notable for the preservation and variety of their wood-lined troughs. Artefacts were rare at these sites, so three bone beads from Deerpark East 4 and part of a carved wooden vessel from Knockbrack 4 are of particular interest.



Illus. 1.4 Location map (continued)

Table 1.1—Chronological periods in this book

Period	Date	Period	Date
Earlier Mesolithic	8000–6700 BC	Late Bronze Age	1100–800 BC
Later Mesolithic	6700–4000 BC	Early Iron Age	800–400 BC
Early Neolithic	4000–3600 BC	Middle Iron Age	400 BC–AD 1
Middle Neolithic	3600–2900 BC	Late Iron Age	AD 1–400
Late Neolithic	2900–2500 BC	Early medieval	AD 400–1100
Chalcolithic	2500–2200 BC	Late medieval	AD 1100–1540
Early Bronze Age	2200–1600 BC	Post-medieval	AD 1540–1700
Middle Bronze Age	1600–1100 BC	Early modern	AD 1700–1900



Illus. 1.5 Drummindoo 4. Burnt mound sites typically occur at the margins of low-lying, wetland areas with high water tables (ACSU Ltd).

Table 1.2—Chronology of the archaeological sites discovered on the N5/N59 project (* an asterisk denotes locations with one or more burnt mound sites preserved *in situ*, outside the road project)

Site	Undated	Mesolithic 8000–4000 BC	Neolithic 4000–2500 BC	Chalcolithic 2500–2200 BC	Bronze Age 2200–800 BC	Iron Age 800 BC–AD 400	Early medieval AD 400–1100	Late medieval AD 1100–1540	Post-medieval AD 1540–1700	Early Modern AD 1700–1900
N5 Westport to Turlough										
Aghadrinagh 1										
Aghadrinagh 2										
Aghadrinagh 3										
Aghadrinagh 4										
Aghadrinagh 5										
Aghadrinagh 6/7										
Aghadrinagh*										

Table 1.2—Chronology of the archaeological sites (continued)

Site	Undated	Mesolithic 8000–4000 BC	Neolithic 4000–2500 BC	Chalcolithic 2500–2200 BC	Bronze Age 2200–800 BC	Iron Age 800 BC–AD 400	Early medieval AD 400–1100	Late medieval AD 1100–1540	Post-medieval AD 1540–1700	Early Modern AD 1700–1900
N5 Westport to Turlough										
Aghadrinagh*										
Aghadrinagh*										
Aghalusky 1										
Attireesh 1										
Attireesh 2										
Carrowbeg 1										
Carrownaclea 1										
Carrownaclea 2										
Claggarnagh East 1										
Claggarnagh East 2/3										
Claggarnagh East 4/5										
Claggarnagh East 6										
Claggarnagh East*										
Claggarnagh West 1										
Claggarnagh West 2										
Claggarnagh West 3										
Claggarnagh West 4										
Claggarnagh West 5										
Claggarnagh West 6										
Claggarnagh West 7										
Cloondeash 1										
Cloondeash 2										
Cloondeash 3										

Table 1.2—Chronology of the archaeological sites (continued)

Site	Undated	Mesolithic 8000–4000 BC	Neolithic 4000–2500 BC	Chalcolithic 2500–2200 BC	Bronze Age 2200–800 BC	Iron Age 800 BC–AD 400	Early medieval AD 400–1100	Late medieval AD 1100–1540	Post-medieval AD 1540–1700	Early Modern AD 1700–1900
N5 Westport to Turlough										
Cloondeash 4										
Deerpark East 1										
Deerpark East 3										
Deerpark East 4										
Doogary 1										
Dooleague 3										
Drumaleheen 1/2										
Drumaleheen 3										
Drumaleheen 4										
Drumaleheen 5										
Drumaleheen 6										
Drumaleheen 7										
Drummindoo 1										
Drummindoo 2										
Drummindoo 3										
Drummindoo 4										
Drummindoo 5										
Drummindoo*										
Drummindoo*										
Drumneen 1										
Drumneen 2										
Drumneen*										
Drumneen*										

Table 1.2—Chronology of the archaeological sites (continued)

Site	Undated	Mesolithic 8000–4000 BC	Neolithic 4000–2500 BC	Chalcolithic 2500–2200 BC	Bronze Age 2200–800 BC	Iron Age 800 BC–AD 400	Early medieval AD 400–1100	Late medieval AD 1100–1540	Post-medieval AD 1540–1700	Early Modern AD 1700–1900
N5 Westport to Turlough										
Kilbree Lower 1										
Kilbree Lower 2										
Knockbrack 1										
Knockbrack 2										
Knockbrack 3										
Knockbrack 4										
Liscromwell 1										
Liscromwell 2										
Lisnageeha (or Antigua) 2										
Lisnageeha (or Antigua) 3										
Lisnakirka (or Milebush) 1										
Sheean 1										
Sheean 3										
N59 Barleyhill to Kilmeena										
Conrea 1										
Derrylea 1										
Westport Demesne 1										
Westport Demesne 2										
Westport Demesne 3										
TOTALS	12	0	2	4	37	3	8	6	0	3

Among other prehistoric sites (Chapter 3), a hill in Drumneen was intermittently visited and reused over a long period. The evidence included a row of post-holes that may represent a palisade enclosure on the hilltop in the Middle Neolithic period, an Early Bronze Age cremation burial, and four substantial post-holes dated to the Late Bronze Age that could have supported a raised structure such as a grain silo. A Bronze Age barrow and an Iron Age ring-ditch in Drumaleheen may have been ceremonial or funerary monuments, although human remains were not found in either monument.

Medieval features (Chapter 4) included a drying kiln in Lisnageeha and several small-scale industrial sites in Aghadrinagh, Claggarnagh East, Dooleague, Drummindoo and Westport Demesne, where charcoal kilns and metal-working evidence were found. A more complex metal-working site in Kilbree Lower, dated to the 13th or 14th century, produced large slag cakes of a size and weight unique in the Irish archaeological record.

Among the early modern features examined (Chapter 5), a lime kiln and the remains of a water-powered mill were recorded in Liscromwell and the levelled remnants of a farmhouse were excavated in Claggarnagh East, where an interesting assemblage of early modern glass and pottery was also recovered.

Taken all together, while the record is wide-ranging it is also uneven and does not account for all periods of human prehistory and early history. There are numerous features of Bronze Age date, especially the water-heating sites known as burnt mounds or *fulachtaí fia*, but the project produced no evidence that relates to the Mesolithic period and no new features of post-medieval or early modern date, other than building remains on sites that were identified from map evidence

or known locally.

Archaeological sites and monuments, including building remains, suffer from a variety of vicissitudes over time. Some of the excavated sites were affected by later attempts at drainage and land reclamation. For instance, a hollowed-out tree trunk used as a trough on a prehistoric burnt mound site at Knockbrack 4 was truncated by a large drain that formed part of an early modern townland boundary. The drainage work was so ineffective, however, that the wooden trough survived in a waterlogged condition. Tillage took a heavier toll on the excavated sites. The internal mound of a prehistoric barrow at Drumaleheen 1/2 was almost entirely ploughed down, with only a very thin deposit remaining. Two of the most recent features recorded—the early modern watermill at Liscromwell and the farmhouse at Claggarnagh East—were also levelled. There were sub-surface rubble spreads on these sites but most of the stone had been removed and, presumably, recycled in buildings and field walls elsewhere in the environs.

A landscape of hills and hollows

This new road cuts through an undulating landscape of mountains, low hills and hollows, shaped by the last great glacial period to affect Ireland, c. 80,000–13,000 years ago. Low-lying areas were covered by glacial deposits of sand and gravel and later by peat and soils. The N5/N59 project corridor lies within this rolling landscape where landforms such as eskers and drumlins (Illus. 1.6) were fashioned as the ice began to retreat. The end of this period of drumlin formation, c. 17,000 years ago, can be dated from ancient mollusc shells (*Macoma calcarean*) found at Belderg, on the north



Illus. 1.6 A drowned landscape of glacial drumlins forms a spectacular seascape of small islands in Clew Bay, on the Atlantic coast of Co. Mayo (by Geyo John (2009) CC BY-SA 3.0).

coast of Co. Mayo, and which occur today in arctic waters (McCabe et al. 1986).

Drumlins are typically about 100–300 m in length, up to 15 m in height and about 30–105 m in width (Hennessy et al. 2019, 33). They commonly occur in fields, belts or clusters and their long axes run in the same direction as that of the retreating glaciers. They are formed from the deposition or erosion of material that is then worked by a glacier. Consequently, they can be composed of a variety of materials, often mixed, including glacial till or boulder clay (crushed sediments of glacial origin), sand, gravel, or

even bedrock, depending on the geological substrata. Soils on drumlins are often poorly drained, depending on the composition of the parent material (Gardiner & Radford 1980, 32).

As the climate gradually warmed and the glaciers receded, sea levels rose, flooding low-lying areas. This extended into the Mayo drumlin belt, forming Clew Bay, where numerous drowned drumlins now form small islands in a spectacular seascape overlooked by Croagh Patrick to the south and the Nephin Beg range to the north.

Further inland, the low-lying areas

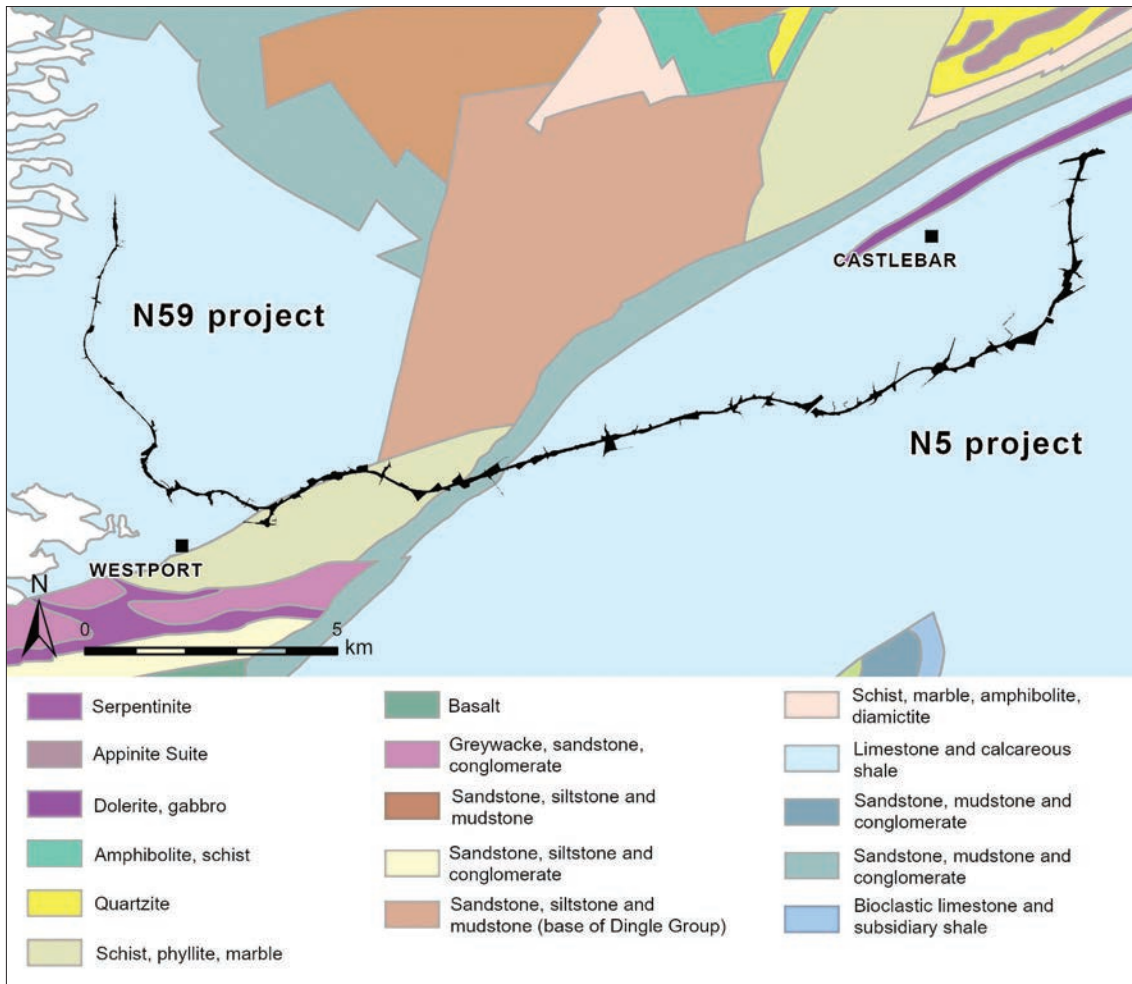


Illus. 1.7 Excavating Claggarnagh East 4/5 (foreground) and 6 between two drumlins, looking north to Islandeady Lough, Co. Mayo (Firefly Photography for Mayo County Council).

between the drumlins offer poor drainage and, coupled with high levels of rainfall and the natural run-off from their steep sides, provide a suitable environment for the development of bogs, rivers and lakes. A series of lakes, including Islandeady Lough and Lough Lannagh (also known as Castlebar Lough), occupies the inter-drumlin areas on the northern side of the N5, between Westport and Castlebar (Illus. 1.7).

Underlying this rolling landscape in the Clew Bay area, the bedrock geology of the road corridor is Lower Carboniferous limestone (c. 360–300 million years old) overlying Devonian sandstones (c. 420–360 million years old) (Illus. 1.8). In the region directly west of Westport, however, throughout Drummindoo, Sheean, Knockbrack and Drumneen, there are

even older, Dalradian metamorphic rocks (over 500 million years old), overlain by Devonian sandstones and conglomerates. Overlying the bedrock, the quaternary sediments are mostly glacial tills derived from Carboniferous limestones and Devonian sandstones, while the associated soils vary from coarse loam over calcareous gravel to fine loam with siliceous stones corresponding, respectively, with the Baggotstown and Crosstown soil series (Illus. 1.9). As described above, these soils are interspersed with peat deposits and lakes, and traversed by numerous rivers and streams. Large areas of the flatter peatland, in west Mayo, have been reclaimed for grassland or ploughed and drained for commercial forestry (Hammond 1981, 31).



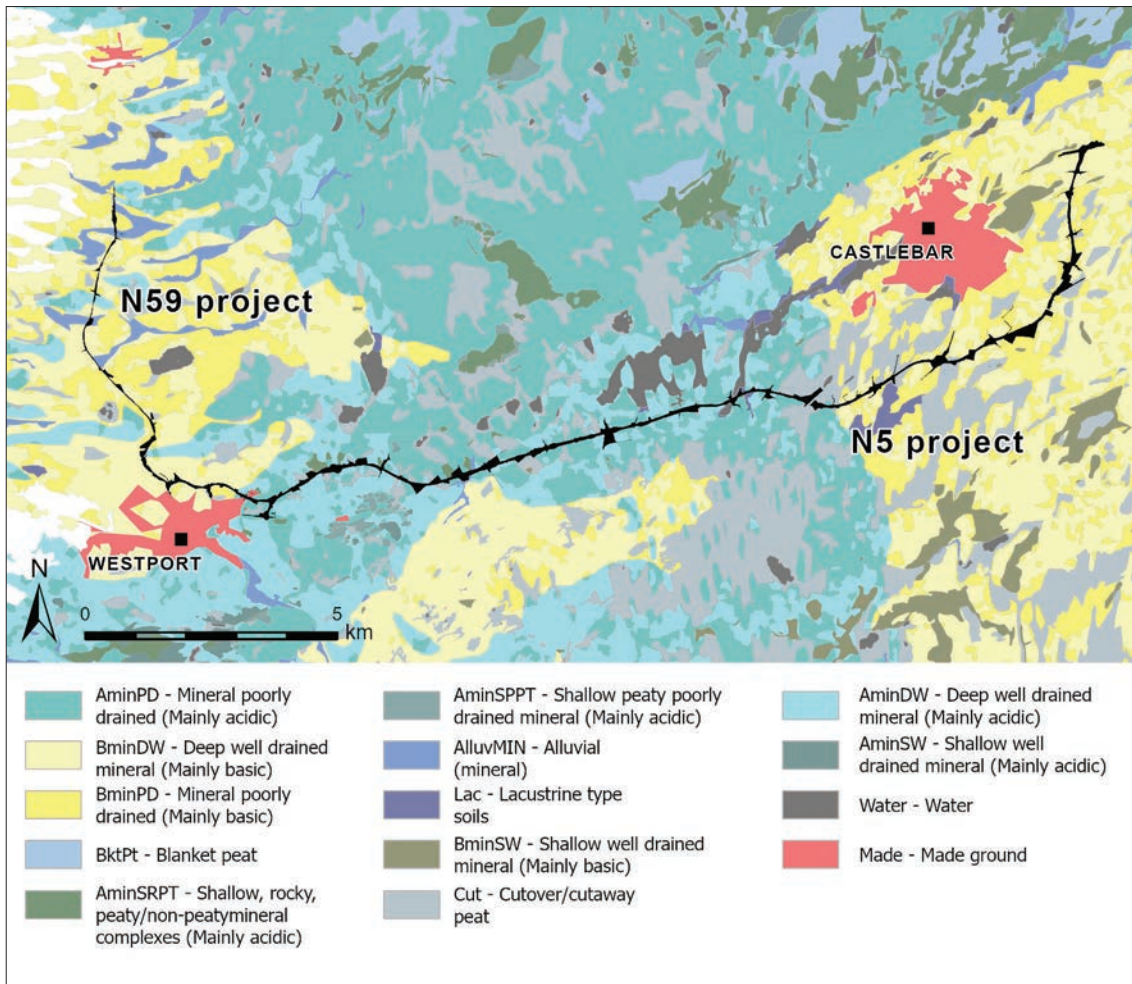
Illus. 1.8 Solid geology of the landscape of the N5/N59 project (ACSU Ltd based on Irish Public Sector Data Geological Survey Ireland, Creative Commons BY 4.0).

Placenames, folklore and fieldwork

Placenames

Irish placenames most often reflect physical characteristics in the landscape. The word *drumlin*, for example, is from the Irish word *droimnín* (little ridge). The drumlin landscape form is reflected in many townland names in the region through the use of *drom* (ridge) and *cloon* (dry place), including Drumneen, Drummindoo and Cloondeash.

Placenames can also reflect the cultural landscape and sometimes even hint at forgotten histories. Lisnageeha is a good example of this. Lisnageeha or ‘fort of the wind’, probably refers to one of the two ringforts in elevated positions within the townland. But Lisnageeha was also known as Antigua. The placename ‘Lissnageyha’ dates to at least 1617 (Calendar of Patent Rolls), while the placename Antigua is first recorded in 1783 (Registry of Deeds). Why does one of the two names associated with the townland



Illus. 1.9 Soil map of the landscape of the N5/N59 project (ACSU Ltd based on the Teagasc 1:250,000 soils map).

refer also to a Caribbean island? The answer may lie in a house depicted on the first edition Ordnance Survey six-inch map of 1839 (surveyed 1837) but absent from later maps. The house name is given as 'Antigua'. The Brownes of Westport House came to Mayo in the 16th century and prospered, ultimately receiving the titles Earl of Altamont and Marquess of Sligo. Among the surviving documentary sources relating to their estate of Westport is a deed that records the inclusion of land in Lisnageeha (Westport Estate Papers NLI MS 40,888/8(5)). Peter

Browne, 2nd Earl of Altamont, married Elizabeth Kelly in 1752. Elizabeth was the only child of Denis Kelly, who was Chief Justice of Jamaica. Through this marriage the Brownes inherited his Jamaican sugar plantations (O'Connor 2021, 68), which seems a likely explanation of the connection between Lisnageeha in Mayo and Antigua in the Caribbean.

Placenames can also be misleading or, specifically, their folkloric interpretation can be misleading. The townland of Liscromwell, for example, has a long-held



Illus. 1.10 Three 19th-century milestones on the approaches to Westport at Creggaunnahorna (left), Drummindoo (middle) and Moyhastin (right) (Richard F Gillespie).

local association with Oliver Cromwell. A folklore record gathered in the 1930s by the Schools' Collection (National Folklore Collection 2024a) explains that 'Lios Cromhail' is a 'big fort and at the time of the big war when Cromhail [Cromwell] was in Ireland he built it and from that fort the village got its name'. However, according to the Placenames Database of Ireland (www.logainm.ie), Liscromwell, or Lios Cromaille, means ringfort/enclosure of Cromall (person's name) and is first recorded in 1574 when it was referred to as 'Lysencromale'. This reference is in a State Paper of the reign of Elizabeth I that details the 'division of Connaught into counties and baronies, with notes of chief countries and special castles'. The reference pre-dates the Cromwellian conquest of Ireland (1649–53) by some 75 years and is supported by other records in the early 1600s, including the Westport Estate Papers (NLI MS 40,884/4(3)) and the Strafford inquisition of County Mayo (O'Sullivan 1958, 180, 185). Despite this, the association of the townland name with Oliver Cromwell persists to the present day in local folklore.

Three milestones

Local knowledge, combined with fieldwork observations, can also be important in exploring the history of a landscape. A milestone on the north side of Westport was brought to the attention of Mayo County Council by a local landowner, who identified it following hedge clearing in Creggaunnahorna. Another milestone on the east side of Westport, in Drummindoo, was recorded and removed for safekeeping during archaeological test-excavations on the N5 road project. These discoveries prompted an examination of the available early maps, which revealed that at least three milestones were once positioned on the approach roads to Westport, at the north, east and south-east. This resulted in the third milestone, south-east of the town, being duly identified on the ground at Moyhastin. The milestones were roughly equidistant from the town centre, which is reflected in their identical inscriptions: 'To Westport 1 Mile' (Illus. 1.10). All three were marked on the latest six-inch Ordnance Survey map (Mayo Sheet 88; revised third edition 1923) but



are absent from earlier maps. Nonetheless, they probably date to the mid or later 19th century as their distance from Westport town centre is an imperial mile (c. 1.6 km) and not an old Irish mile (c. 2 km). The old Irish mile persisted locally in the West of Ireland after the Acts of Union 1800, but was finally extinguished by the Weights and Measures Act 1824. A 19th-century date for the milestones would correspond with the style of the inscription as its tall, slender letter-forms are certainly not modern. The milestones are most likely to have been erected by the county Grand Jury—the local administrative body that was the precursor to the County Council.

Early maps

The changing Irish landscape has been mapped and remapped by generations of cartographers. The Down Survey of Ireland (1656–58) (Illus. 1.11) was the world's first detailed land survey on a national scale, recording baronies, parishes and townlands at a scale of 40 perches (one old Irish mile) to one inch (roughly 1:10,000). The survey was directed by Sir William Petty, an English polymath who served as Physician General to Cromwell's army in Ireland. The surveyors were mostly former soldiers, working with basic survey instruments designed by Petty, and measuring chains. The maps showed principal buildings (castles, churches) and roughly represented mountains, routeways and rivers, but were mostly focused on quantifying the lands in each townland. The aim was to record lands to be forfeited by the Catholic Irish for redistribution to Protestant English soldiers and merchant adventurers. The survey recorded over 1,000 parish maps, which were the basis for barony maps bound as *Hibernia Regnum*. The parish maps were

destroyed in fires in Dublin in 1711 and 1922. No parish maps for Mayo are known to survive. The Tyrawley barony map and a general map of Mayo were included in the *Hibernia Regnum* volume of barony maps. This was en route from Dublin to London in 1707 when it was captured at sea by a French privateer. The maps were retained in France and are now curated by the Bibliothèque Nationale de France, which also curates the atlas of county maps known as *Hibernia Delineatio* (1660–75). The image reproduced here (Illus. 1.11) is part of this set. A collection of surviving Down Survey maps, or manuscript copies of originals held by the Bibliothèque Nationale de France, is now published in digital form by Trinity College Dublin (Down Survey of Ireland 1656–58 <https://downsurvey.tchpc.tcd.ie>).

Two Scotsmen, George Taylor and Andrew Skinner, surveyed the *Maps of the Roads of Ireland* in 1777 (first published 1778; revised 1783) (Illus. 1.12). This was commissioned by an Act of the Irish Parliament but was largely funded by subscriptions from major landowners. Some topographical features (hills, rivers, lakes) are roughly represented but are incidental to the main interest, which is the principal roads, the towns they connect, 'milepoints' shown at intervals of old Irish miles (1.27 imperial miles) along the roads, and gentlemen's houses in the countryside.

The Irish cartographer William Larkin produced maps for the Bog Commissioners, the Post Office, private estate owners and at least a dozen county Grand Juries. His *First Division of the Mail Coach Road from Ballinasloe to Westport* (1808) set out the most favourable line for a new post road between Ballinasloe and Westport. It was drafted on 15 sheets of varying dimensions, at a scale of 320 perches to one inch. These

were endorsed by Alexander Taylor, Director of the Post Road Surveys and, incidentally, brother of George Taylor, whom he had previously assisted with the *Maps of the Roads of Ireland* (Taylor & Skinner 1778). Larkin's map accurately depicted all the towns and villages along the way, including Castlebar and Westport (Illus. 1.13 and Illus. 1.14). It also included topographical features such as hills and rivers where they might influence the line of the road and names of the affected landowners. In Castlebar, Larkin proposed to route the road through the town, diagonally across the green and along Spencer Street, which would be unthinkable today in the context of modern traffic volumes and the importance of the green in the social and cultural life of the town. North of Castlebar, sections of the proposed road were eventually built along the route of the current N84; but the section linking Castlebar to Westport was never built. In a sense, the new N5 road project (2019–22) completes this section of a road originally planned by Larkin over 200 years ago. The section of the N5 at Ballymacraha and Annagh, crossing the western end of Lough Lannagh, most closely coincides with Larkin's planned route.

William Bald was another accomplished Scottish cartographer who worked in Ireland. His *Map of the Maritime County of Mayo* (1830; surveyed 1809–17) was made for the county Grand Jury. It was recorded at a scale of four inches to an imperial mile and drawn at three inches to a mile. Due to a dispute over print costs, it was not published until 1830, when it was eventually produced in Paris, on 25 sheets. It shows topographical features (uplands, rivers, lakes and routeways) accurately and records towns, villages and rural settlements to the level of individual buildings. It is a rare example of large-scale professional cartography in



Illus. 1.12 Extract from Taylor & Skinner's (1778) *Maps of the Roads of Ireland* showing the road from Westport to Castlebar. Note the milepoints at intervals of one old Irish mile (1.27 imperial miles) (www.askaboutireland.ie).

Landowners and tenants on historic maps

William Larkin's *First Division of the Mail Coach Road from Ballinasloe to Westport* (1808) records names of the landowners on the route of a proposed new post road (Illus. 1.13 and Illus. 1.14). Much of the land required for the road, between Castlebar and Westport, was owned by aristocrats, in particular the Marquis of Sligo and the Earl of Lucan (commonly known as Lord Lucan), whose seats were in Westport and Castlebar, respectively. Other gentlemen landowners included The Ormsby Esq., Owen O Melia Esq., Daniel Sheridan Esq. and Sir John Knox. Some lands were owned by partnerships, such as 'Sir Roger Palmer, Richard & Edward Gerraghty & Partners'. In the immediate environs of Castlebar, much of the land was in the possession of local business people: Tim Lamb, William Stricket, John Gibbons, John Dudgeon, John Smith and John Carr Esq. The clergy and professions are represented by Reverend Ormand Ash and Doctor Hamilton, who held land to the north of Castlebar.

The tenant farmers who worked this land, but could not aspire to owning it, are not named on Larkin's map but are represented instead by the farmhouses, cabins and clustered dwellings (*clachans*) recorded along the way. The first edition Ordnance Survey six-inch maps also record these dwellings in meticulous detail. They represent a landscape of populous rural settlements that were largely extinguished by the Great Famine (1845–52) and its aftermath. Aghadrinagh village is a striking example.



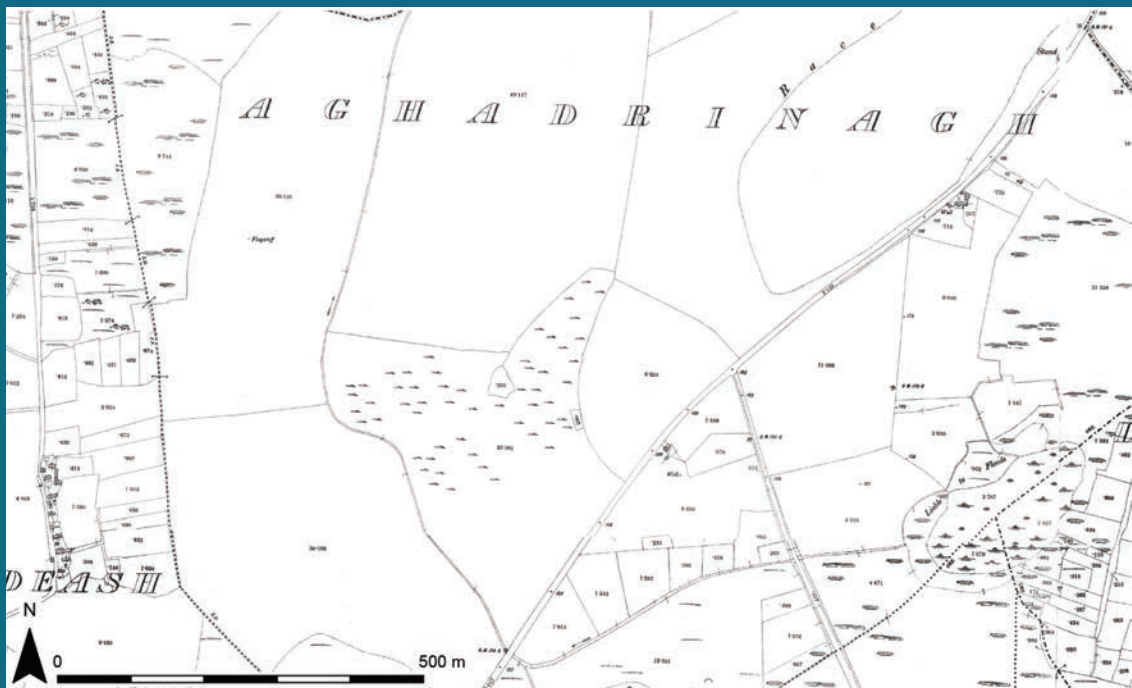
Illus. 1.13 Extract from Larkin's (1808) *First Division of the Mail Coach Road from Ballinasloe to Westport*, showing Castlebar, with the proposed road cutting through the green. Landowners' names are written on the maps in cursive script (National Library of Ireland).

The population of Aghadrinagh is recorded as 314 in the census of 1841 (Hamrock 2004, 147). It is depicted on the first edition Ordnance Survey map of 1839 (surveyed 1837), as a haphazard cluster of over 70 buildings, surrounded by small 'infield' enclosures, with lanes or trackways radiating out to the surrounding lands (Illus. 1.15). The survivors of the Great Famine were evicted by the 3rd Earl of Lucan in May 1848 and, consequently, by the census of 1851 the population had plummeted from 314 to only nine remaining souls in two houses (ibid.). Hon. Frederick Cavendish, speaking in 1850 during election nominations in Castlebar, reported that the cleared lands were used to feed Lord Lucan's cattle (*Freeman's Journal* 27 July 1850, 5). The 4th Earl of Lucan built a racecourse with a rifle range there in the 1880s (shown on the Ordnance Survey 25-inch map surveyed in 1895). These facilities remained in use until the early 20th century, when the Congested Districts Board acquired the land and divided it into economic landholdings for small freeholders who had once been tenants (Landed Estates Database 2024).

Archaeological work on the N5 road project sought to identify remains of these and other early modern rural dwellings, using targeted geophysical surveys and test-excavations in Aghadrinagh, Annagh and Claggarnagh East. The only surviving remains were found in Claggarnagh East (Chapter 5).



Illus. 1.14 Extract from Larkin's (1808) *First Division of the Mail Coach Road from Ballinasloe to Westport*, showing the proposed road extending through lands owned by the Marquis of Sligo and terminating at the entrance to Westport (National Library of Ireland).



Illus. 1.15 Extract from the first edition Ordnance Survey six-inch map of 1839, surveyed 1837 (top), showing the village of Aghadrinagh in pre-Famine years, with over 70 buildings; and an extract from the Ordnance Survey 25-inch map of 1898, surveyed 1895 (bottom), showing no trace of the vanished community (Tailte Éireann).

Ireland prior to the Ordnance Survey and is especially important from a placenames perspective.

The Ordnance Survey of Ireland was established in 1824 to conduct a detailed and accurate survey of the whole island of Ireland, for the purposes of land valuation and taxation in the first instance. Established under the Ministry of Defence, it was staffed primarily by the Royal Engineers and Royal Miners and Sappers. In tandem with their survey work, Irish scholars in the Topographical Department, including George Petrie, John O'Donovan and Eugene O'Curry, made an invaluable record of local archaeology, history, traditions and placenames. The first edition Ordnance Survey maps for Co. Mayo were completed between 1837 and 1839, with the entire country completed by 1846, at a scale of six inches to a mile. A second edition was completed for Mayo between 1893 and 1900 and an incomplete third edition between 1913 and 1917 (revised in 1923–25). Between 1863 and 1924 a survey of Ireland at a scale of 25 inches to a mile was also conducted, allowing for greater detail than the previous six-inch series. The survey for Mayo was largely completed between 1893 and 1898.

Archaeology of a settled landscape

The natural landscape traversed by the route of the N5/N59 project has been subject to human impacts since prehistoric times. Previously identified archaeological sites in the landscape of Mayo, as listed in the statutory Record of Monuments and Places and the Sites and Monuments Record of the Archaeological Survey of Ireland, as well as those sites more recently discovered by pre-development investigations and research

projects, comprise a rich palimpsest of evidence for prehistoric and historic communities, past land-use practices, and social and cultural changes through time.

Mesolithic hunter-gatherers (8000–4000 BC)

On current evidence, the first people are believed to have arrived in Ireland around 8000 BC, in the Mesolithic ('middle stone age') period. This narrative has recently been challenged by Upper Palaeolithic dates (c. 11,000 BC) on a bear bone with butchery marks from a cave in Co. Clare (Dowd & Carden 2016), but there is to date no similar evidence from Co. Mayo. The Mesolithic inhabitants of Mayo were most likely a nomadic people who hunted, fished and gathered wild foodstuffs. While evidence for their campsites and burials is very limited, there are traces in the archaeological record of a Mesolithic population across Ireland, including fires or hearths, pits, cave deposits and scatters of chipped stone tools and waste flakes (Woodman 2015; Warren 2022). A major review of Mesolithic artefacts from the West of Ireland, for example, confirmed flint and slate (or mudstone) flakes and points from several locations in Mayo, including Leedaun, Ballycurrin Demesne, Lough Urlaur, Burrishoole and Mallaranny (Driscoll 2006, 19, 134, 146, 216). In 2003, the excavation of a late medieval burial ground beside the River Moy at Tonybaun, between Ballina and Foxford, also led to the discovery of Early Mesolithic artefacts in the form of a chert microlith, a quartz narrow blade core and a stone axehead, as well as a Late Mesolithic chert blade (Nolan 2006; Joanna Nolan pers. comm.). An excavation at Belderrig, on the north Mayo coast, recorded a Late Mesolithic site represented by a scatter of worked quartz

and other chipped stone material, plant remains including hazelnuts, and insects, mammal and fish bones, all sealed by a layer of peat (Warren 2006, 1–5; 2009). The people at Belderrig were exploiting both terrestrial and marine resources, including cod, ballan wrasse, conger eel and perciformes (perch-like), hazelnuts and wild animals (the animal bone fragments from Belderrig were too small to be identified to species) (Warren 2015; 2022, 75).

Neolithic first farmers and tomb-builders (4000–2500 BC)

In the early fourth millennium BC, a new group of settlers arrived in Ireland bringing changes that included agriculture and animal husbandry, sedentary settlement in large, permanent houses, and pottery making.

These first farmers practised both cremation and inhumation and, by around 3800 BC, were burying at least some of their dead in the stone-built, chambered, funerary monuments known as megalithic tombs. These are the earliest surviving architectural structures in Ireland and, across the island, take a variety of forms. There are over 800 megalithic monuments that can be classified—as portal tombs, court tombs and passage tombs—and over 1,100 others that remain unclassified. Mayo has a particularly rich heritage of megalithic monuments (Illus. 1.16), with over 200 surviving examples, attesting to permanent and widespread occupation in the Neolithic period.

In north-west Ireland, one focal point for Neolithic communities was the area around the Céide Fields (Behy/Glenulra). At over 1,000 hectares in extent, this is one



Illus. 1.16 Court tomb at Keel West on Achill Island (MA042-021001), Co. Mayo, situated in a complex prehistoric landscape that represents evidence in the region for a settled population during the Neolithic and Bronze Age (Richard F Gillespie).

of the largest relict Neolithic and Bronze Age landscapes to survive on Europe's Atlantic coast (Waddell 2000, 36; Caulfield et al. 2011). The area is best known for its extensive field systems but there are also hut sites, enclosures and megalithic monuments, including court and portal tombs. This landscape continues just 12 km to the east, at Rathlackan, where among the field walls there are also hut sites, enclosures, unclassified megalithic tombs and an impressive court tomb dated to the mid-fourth millennium BC (Cooney 2000, 46). Evidently there was a relatively large Neolithic population in north Mayo and many of the dated sites in this landscape are broadly contemporary with domestic buildings and other occupation evidence discovered elsewhere in Mayo in more recent years, particularly in advance of

development. In 2004, excavations along the route of the N5 Charlestown Bypass uncovered sites of Neolithic date in Sonnagh, Lowpark, Ballyglass West and Cashelduff (Gillespie 2010a; 2010b, 157–94; Kerrigan & Gillespie 2010a, 74–6). At Sonnagh II, foundation trenches of at least two and possibly five small, circular structures of likely Early Neolithic date were identified. Early Neolithic pits and a Late Neolithic ceremonial timber circle, associated with Grooved Ware pottery, were recorded at Lowpark, 650 m east of the Sonnagh site. A Middle to Late Neolithic date was returned for a burnt spread from Ballyglass West, 300 m east of Lowpark, and a burnt mound dating to the Late Neolithic period was excavated at Sonnagh III. At Cashelduff, a stone tool assemblage, two arcs of large boulders and a disturbed cairn might have



Illus. 1.17 Broken Neolithic carinated bowl (original rim diameter of 240 mm and height of 220 mm), found in 2002 during excavations in Carrowkeel, west of Crossmolina, Co. Mayo (Tomás Tynner after Cleary 2011, plate 14).

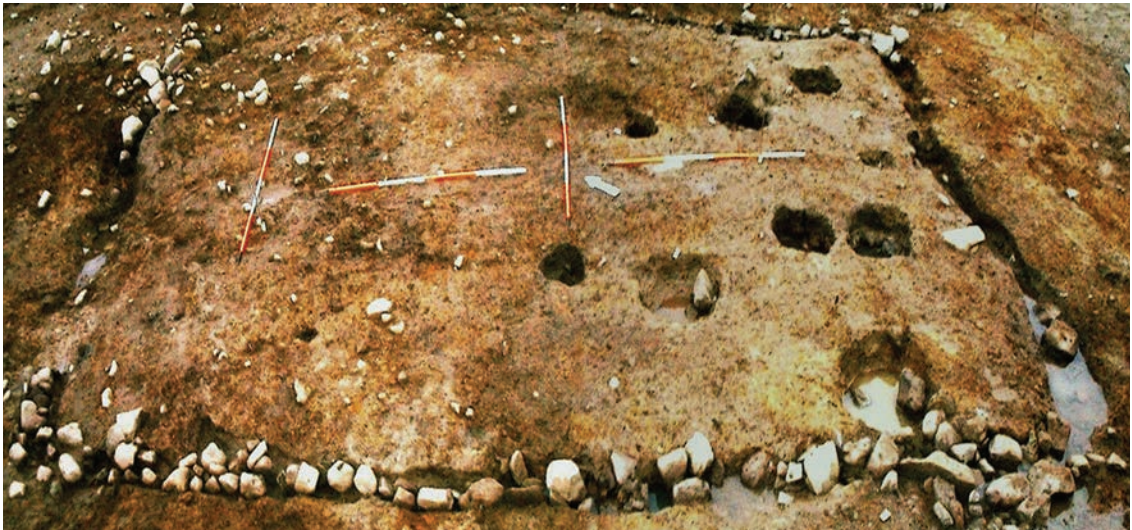
been remains of a megalithic tomb. In 2002, an investigation during the realignment of part of the N59, west of Crossmolina, uncovered a multi-period site that included a pit containing part of a Neolithic carinated bowl (Zajac 2011) dating to the mid-fourth millennium BC (Illus. 1.17).

While the buildings at Sonnagh II were circular in plan, large rectangular houses are a distinctive feature of the Early Neolithic and especially c. 3720–3620 BC (McSparron 2003; 2008; Smyth 2014, 41–50). Two such rectangular houses are known from Co. Mayo, at Ballyglass, near Ballina, and at Gortaroe, near Westport. The Ballyglass house was discovered beneath a court tomb (Ó Nualláin 1972). Associated artefacts included up to 18 broken carinated bowls and a small collection of stone tools, including leaf-shaped arrowheads and a plano-convex knife (Smyth 2020). Located 230 m to the south was a second court tomb where two, possibly three, additional buildings were uncovered adjacent to the tomb, defined by stone-packed foundation trenches and stake-hole clusters that suggest C-shaped huts (Ó

Nualláin 1998; Smyth 2014, 81). Many stone tools were recovered from the site, including concave scrapers, indicating a later fourth millennium BC (Middle Neolithic) date.

The Gortaroe house was excavated during archaeological works on the Westport Main Drainage Scheme (Gillespie 2007, 81–2). The ground plan was indicated by slot-trenches lined with packing stones (Illus. 1.18). Charcoal and nut shells from the foundation trench returned date ranges in the mid-fourth millennium BC (Cleary & Gillespie: text box).

Many of the field walls, habitation sites and tombs of Neolithic communities described above were discovered below blanket peat. This became widespread from the late third millennium BC and covers much of the upland terrain in the West of Ireland. Examples include field systems with stone walls at Behy, Glenulra and Belderrig, west of Ballycastle on the north Mayo coast. At Glenulra, an oval, stone-built settlement enclosure was also found beneath the peat. There were remnants of a stone structure, post-holes and charcoal spreads in the



Illus. 1.18 Gortaroe, Co. Mayo. The foundation trench for the timber walls of a Neolithic house was recorded on the Westport Main Drainage Scheme (Richard F Gillespie).



Illus. 1.19 Neolithic necklace made with discoidal beads carved from steatite (average diameter of 15 mm and thickness of 4 mm). The beads were found deep in a bog near Westport, c. 1900 (National Museum of Ireland).

interior, probably representing more than one phase of occupation, dating to the Early or Middle Neolithic period (Caulfield et al. 2011, 70–73). Elsewhere, a collection of 77 beads representing a necklace was found deep in a bog near Westport c. 1900 (NMI Ref. RIA 1901:70.1–77; Corlett 2001, 9, 17) (Illus. 1.19). These were made from steatite, discoidal in form, and similar to beads recovered from Neolithic contexts elsewhere in Ireland, including a stone bead from the Neolithic house at Gortaroe (Chapter 2).

Chalcolithic and Bronze Age (2500–800 BC)

In the Chalcolithic or Beaker period (2500–2200 BC) the first metal-using peoples are encountered in the archaeological record,

first through the manufacture of copper objects and then the widespread use of bronze (copper mixed with tin), with various types of axeheads, spearheads and swords developed throughout the Bronze Age (2200–800 BC). In the Sites and Monuments Record for Co. Mayo there are 38 of the megalithic monuments known as wedge tombs; 142 standing stones; 28 stone alignments (rows or pairs of boulders or standing stones); 24 stone circles; and over 550 burnt mound sites (*fulachtaí fia*), all dating broadly to this period. Again, the distribution and diversity of these sites and monuments attest to a relatively large population in the region at this time.

Chalcolithic period finds in Mayo include Beaker pottery sherds, representing two vessels from a Neolithic court tomb



Illus. 1.20 Stone row or remains of megalithic monument in Gortnafolla (MA070-187), south of Turlough, Co. Mayo. Erected on a very steep slope in the Neolithic or Chalcolithic period (Richard F Gillespie).

in Ballyglass (the vessels are evidently secondary deposits in an older monument); two gold lunulae from beneath a boulder in Rathroeen, north of Ballina; and a pair of gold discs from Rappacastle (Carlin 2018, 108; Cahill 2005; 2015). Wedge tombs are a later form of megalithic tomb, built and first used in the Chalcolithic period, from 2450 BC to 2050 BC. The nearest recorded example to the N5/N59 project is in Knockshanbally, north-east of Turlough, near Straide village. A stone row is recorded in Gortnafolla (Illus. 1.20), just south of Turlough, but the stones are not clearly aligned in a row and an investigation in 1988 suggested they were more likely to be remains of a megalithic tomb (Walsh 1988, 57–65). There are concentrations of standing stones south-east of Castlebar, in the adjacent townlands of

Cloonconragh East, Lagakilleen, Carrowjames and Curry; and in the landscape around Westport, including Slaugar to the north, Cloonmonad to the west and Killaghoor to the south-east. These monuments may have been aligned on the sun, moon or stars, to mark seasonal events, or, more mundanely, have been routeway and boundary markers. They are difficult to date precisely and were probably erected throughout the Neolithic period and the Bronze Age.

A classic study of Bronze Age burials in the 1980s recorded 28 sites from Co. Mayo (Waddell 1990, 113–22). They include cremated remains placed in stone-lined cists within earth mounds or barrows at Thornhill, west of Westport, and at Cashel, a few kilometres south of the N5 road. There was a barrow cemetery at Carrowjames, 8

km south-east of Castlebar, with at least 10 barrows and two standing stones. Nine of the barrows were excavated in the 1930s. Most had cremation burials, some accompanied by bronze razors and cordoned urns. The cemetery was in use for over 1,500 years, into the Iron Age (Raftery 1939; 1940). Since Waddell's (1990) study, at least another seven possible Bronze Age burial sites for Co. Mayo are known. This includes a cairn-covered cist at Ballykine Upper and single cists at Clooneen and Tawnaghmore, all excavated by the National Museum of Ireland (Cahill & Sikora 2011, vol. 1), another single cist at Dooyork (Corlett 1999), two cremation burial pits at Rockfield (Joanna Nolan pers. comm. in Guinan 2022, 269), one cremation burial pit with a vase food vessel at Lowpark (Gillespie 2010b, 195–205), and a possible cemetery of four ring-ditch funerary monuments at Kilmoremoy near Ballina (Wallace 2007).

Bronze Age settlement evidence has been recorded across Co. Mayo, largely in the form of round-houses and burnt mounds. There was a round-house with a nearby field system beneath the peat at Belderg Beg (Caulfield 1988; Caulfield et al. 2009). Two Middle Bronze Age round-houses and an associated field system were partly excavated on Slievemore on Achill Island (Rathbone 2009; 2011). Another Middle–Late Bronze Age round-house was excavated at Rossbeg, south-west of Westport, where a decorated stone spindle whorl was recovered from an adjacent pit (Gillespie 2007, 5–11). West of Killala, an Early–Middle Bronze Age round-house at Killybrone was associated with a large assemblage of charred cereal grains identified as barley and wheat (Zajac & Walsh 2011). At Leedaun, south of Claremorris, a cluster of stake-holes, a curved slot-trench

and a hearth suggested the remains of another Bronze Age building. A midden layer included pottery sherds representing up to 10 domestic vessels and a nearby burnt mound was dated to the Middle Bronze Age (Walsh 1996; Gillespie 2012). Across Ireland, an increase in visible settlements can be seen from 1700 BC, alongside a dip in tree pollen in palaeoecological records, indicating an opening up of the landscape for agriculture (Plunkett 2009). This, and the subsequent expansion of farming into uplands, suggest an increase in population at this time (Ginn & Plunkett 2020). Palaeoecological evidence from sample sites at Céide, Belderg and Carrownaglogh, all in Co. Mayo, records an expansion of farming onto wetter land also, particularly towards the end of the Bronze Age (Molloy & O'Connell 1995; Plunkett 2009).

Many burnt mounds have been excavated across Co. Mayo and especially on public infrastructure projects including the Westport Main Drainage Scheme, Ballinrobe Sewerage Scheme and N5 Charlestown Bypass. Of 80 Mayo sites catalogued in a recent study (Hawkes 2018), 51 mounds had associated troughs, while many also had pits, hearths, water channels, post-holes, stake-holes, working surfaces and trackways; one had a well. The scientifically dated examples ranged from the Late Neolithic to the Late Bronze Age. The excavation of over 40 previously unknown burnt mounds on the N5/N59 project (Chapter 2 and Appendix 2) has greatly added to this dataset. They have also increased our understanding of prehistoric settlement in an area just north of Westport, where excavated prehistoric sites across four townlands were clustered along a watercourse that was once a wooded valley.

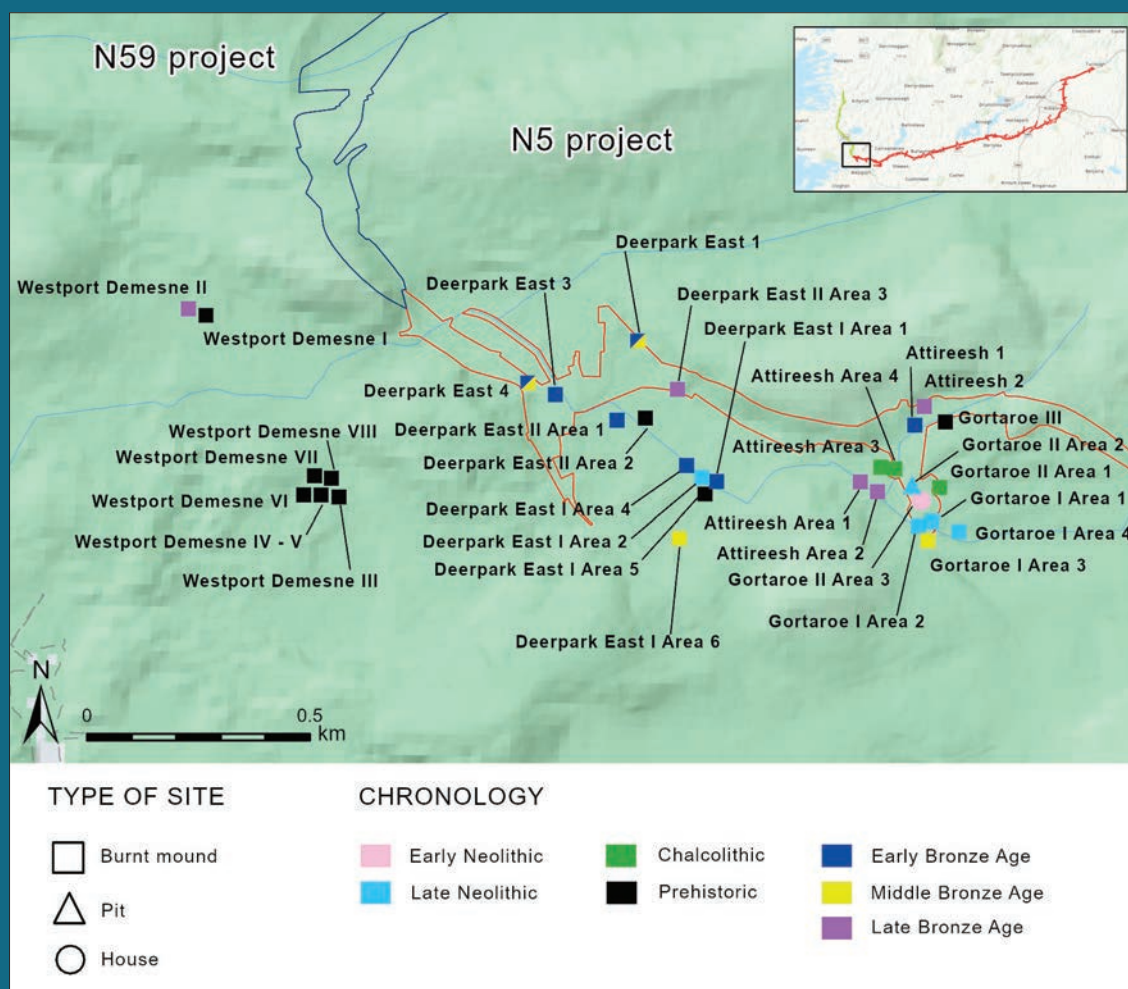
The prehistory of a wooded stream valley

Kerri Cleary and Richard F Gillespie

At the west end of the N5 project route, north of Westport, clusters of prehistoric sites dating from the Early Neolithic period to the Late Bronze Age were found along both banks of a local stream, winding between drumlins in a narrow, once wooded valley (Illus. 1.21).

Five burnt mounds were excavated here on the N5 route (Attireesh 1 and 2, Deerpark East 1, 3 and 4) but if we consider other sites in Attireesh, Deerpark East, Westport Demesne and Gortaroe—discovered by investigations for the Westport Main Drainage Scheme (Gillespie 2007), new industrial parks (Gillespie 2004; Quinn 2004), and a housing development (Taylor & Walsh 2022)—there are 30 excavated burnt mounds and spreads along this valley.

The earliest dated feature in these environs is an Early Neolithic house at Gortaroe II (Illus. 1.18), with associated finds including leaf-shaped arrowheads, hollow scrapers and an unfinished javelin head, also a pottery sherd and a stone bead. Hazel or acorn nut shell and



Illus. 1.21 Location map of a concentration of prehistoric sites discovered along the banks of an unnamed stream between drumlins north of Westport (ACSU Ltd based on Tailte Éireann map).

charcoal from the foundation trench were dated to 3634–3377 BC (Poz-105520: 4740 ± 40 BP) and 3528–3108 BC (GrN-27800: 4620 ± 50 BP) (Gillespie 2007, 81–100). A nearby pit containing a hollow scraper, hazelnut shells and a sherd of prehistoric pottery was dated to 2663–2469 BC (GrN-27798: 4040 ± 30 BP), at the end of the Neolithic period (*ibid.*, 94).

The pit at Gortaroe II was broadly contemporary with four nearby burnt mounds at Gortaroe I and Deepark East I, and possibly also another burnt mound at Attireesh (Gillespie 2007, 13–79). Of the remaining 25 burnt mounds and spreads found in the stream valley (i.e. from all reported development projects), 15 have radiocarbon dates. Analysis of the dates suggests four main pulses of water-boiling activity: in the Late Neolithic to early Chalcolithic period (2630–2450 BC), the Early Bronze Age (2130–1850 BC), Middle Bronze Age (1550–1450 BC) and Late Bronze Age (1250–1000 BC) (Spillane: Appendix 3). The burnt mounds from this valley, similar to examples elsewhere on the N5/N59 project (Chapter 2 and Appendix 2), had a variety of rectangular and round troughs, including well-preserved examples lined with wood and moss, hollowed-out tree trunks and smaller wattle-lined troughs.

In the remote past, the valley would have had fluctuating water levels, and a damp, shady woodland environment, with alder carr woodland giving way over time to oak woods or fen carr, and hazel undergrowth (Illus. 1.22) (Stuijts 2007, 156). Today we would consider this a marginal place, but it was favoured by prehistoric peoples for the ready availability of wood and water. They were adept at exploiting these natural resources, moving around the landscape as sites flooded and dried out again, ready to construct a new trough or reuse an old one. Today, what remains undeveloped of the valley has a peaty floor and must be considered an area of high archaeological potential.



Illus. 1.22 Brackloon, south of Westport, is an ancient woodland where ash grows along the open, well-lit riverbank, giving way to oak with an understory of hazel and holly deeper in the woods (Richard F Gillespie).

From the Bronze Age to the Iron Age (800 BC–AD 400)

The Sites and Monuments Record for Co. Mayo includes a variety of monuments that potentially date from the Late Bronze Age or Iron Age: there are five hillforts or hilltop enclosures, up to 90 promontory forts and over 260 crannogs (lake settlements). Hillforts are not common in Ireland, with just over 100 sites known, and while excavated examples mostly date from the Late Bronze Age to Early Iron Age, some sites may have existed as early as 1400 BC (O'Brien & O'Driscoll 2017, 340). In Co. Mayo, south-west of Shrule, a hillfort at Brodullagh South, overlooking the Black River, is a good example: it has a footprint of c. 2.3 ha within a circular stone bank measuring c.

180 m in diameter (ibid., 452) (Illus. 1.23). Promontory forts have a wider potential date range, extending into the early medieval period. The north-west Mayo coastline has a high concentration of candidate promontory forts, though excavation would be required to validate some of these (Casey 1999). Crannogs also have a wide date range and were built or occupied in the Late Bronze Age, the Early Iron Age, and the early and later medieval periods (Fredengren 2002, 283).

An Iron Age site was recorded at Lislackagh, Co. Mayo, on the Swinford Bypass (Walsh 1992; 1993; 1995a). A ditched enclosure with an internal bank contained foundation trenches of three small round-houses and evidence of iron smelting. Finds included an iron knife, animal bone,



Illus. 1.23 Aerial view of the hillfort at Brodullagh South, Co. Mayo (MA123-041) (Google and Maxar Technologies 2018).

chipped stone tools and blue glass beads. This site would typically be interpreted as an early medieval homestead (or ringfort) but charcoal from the round-houses returned Middle–Late Iron Age radiocarbon dates ranging from 195 BC to AD 225 (Walsh 1993). These scientific dates were initially questioned by Kerr et al. (2010, vol. 2, 500), but subsequently reassessed and endorsed by Becker et al. (2017, 93–6). The reassessment noted that the dated samples, chipped stone tools and blue glass beads (which fit Iron Age typologies) all derived from the house foundation trenches, whereas the medieval artefacts were derived from overlying and disturbed layers and may therefore correspond with a later phase of occupation on the site (*ibid.*).

During test-excavations by ACSU on the N5 project, a translucent glass bead of likely Iron Age date was recovered from the topsoil in Carrowbeg (Illus. 1.24). The colourless glass of this bead is unusual and can be compared with the base glass of later Iron Age beads, which tend to be decorated,

particularly with opaque yellow glass (Cropper 2018).

Early medieval Mayo (AD 400–1100)

A population surge in Ireland in the mid-first millennium AD is still represented in the landscape today by numerous circular enclosures, built with stone or earth, known as cashels and raths (also called ringforts). These enclosures were the homesteads of farmers, the courts of lords, kings and queens and the estates and monasteries of the church—a social hierarchy often reflected in the size and complexity of the encompassing stone and earthworks. In Mayo, there are concentrations of ringforts between Castlebar and Turlough, and near Westport, with some sites also in the vicinity of the lakes (Illus. 1.25). Crannogs are also typical of the period, though less abundant, and, like some larger ringforts and cashels, are more likely to have had elite occupants or housed specialised craft activities. There are crannogs north of Westport and west of

Castlebar, on Ballin Lough, Clogher Lough and Lough Lannagh.

Several early medieval settlement sites have been investigated in Mayo in recent years. Lowpark was a large, complex, multi-period site excavated on the N5 Charlestown Bypass (Gillespie 2010b).

Initially, the site may have been open but was at some point enclosed with large wooden palisades. Iron-working



Illus. 1.24 Iron Age glass bead (E4621:211:26) from Carrowbeg, Co. Mayo (Ian Russell).



Illus. 1.25 Cluster of ringforts south of Castlebar: Cloonagh (MA078-038), Aghadrinagh (MA078-040), Lisnagheha (MA078-041) and Drumneen (MA078-042) (Google and Maxar Technologies, 2018).

was evidently important here, with evidence from AD 560–970, which included semi-underground workshops, pits with anvils/crushing stones, ceramic bellows nozzles (*tuyères*) and 1,360 kg of iron waste or slag. There were also two well-preserved, stone-built souterrains (underground chambers), a substantial stone-lined pit, and evidence of buildings including one possible round-house. A very diverse range of artefacts was recovered. Some items reflect an interest in personal adornment: copper-alloy dress pins and buckles, a bone pin, glass and bone/antler beads, lignite armlet fragments, and a gold filigree panel. Other objects afford glimpses of everyday life: iron knives, nails and hooks, sharpening stones and grinding stones. Another site from the N5 Charlestown Bypass was a ditched enclosure

with a souterrain, at Cloonaghboy (Gillespie 2010c). This levelled site was originally a bivallate ringfort (i.e. with a double bank-and-ditch earthwork). Charcoal samples were dated to between AD 565 and 860. Finds included animal bone, an antler pin, iron knives, and quern stones. Another bank-and-ditch enclosure, at Carrowkeel, was partly excavated on a realignment of the N59, west of Crossmolina. This was a univallate ringfort with evidence of iron-working (Zajac 2011). On the N17 Knock–Claremorris road project, part of another ditched enclosure was investigated at Castlegar, with a souterrain partly visible in the interior—evidently part of a large ringfort (Zajac & Scully 2004). There were bones from cattle, sheep/goat and pigs in the ditch fills, along with part of a blue glass bangle and a millstone from the type of

simple, early mill known as a ‘horizontal mill’ (because the waterwheel was set horizontally on an axle that communicated directly with the mill-house overhead).

Investigations of crannogs are less common but include one striking discovery from the mid-19th century. This was reported in *The Mayo Constitution* (as referenced in *The Nation* 19 June 1852), when two crannogs were exposed by drainage operations at Lough Lannagh. The drainage work exposed: ‘two artificial islands (or once were), composed of piled oak, regularly mortised in the joints, and of amazing strength; about each of them are traces of a fosse or stockade formed by spiked timber in three regular rows.’ The associated finds included up to 20 logboats of various sizes, quantities of animal bone, and ‘curious-shaped bottles or flagons, brass dirks, and specimens of

disconnected quartz, impregnated with rich ores of copper and tin’ (ibid.). On another crannog site, at Lough More, near Bofeenaun, modern excavation discovered a timber palisade consolidating a built-up surface with metal-working evidence. The site was dated to the early medieval period using tree-rings (dendrochronology) (Keane 1995).

Early church sites like Fahburren, Knappaghmanagh, Aghagower, Ballynew and Turlough would have been important focal points around which communities developed. Physical traces of the earliest church sites include large enclosures or *termans*, and stone objects such as cross-inscribed slabs and bullaun stones (boulders with hollows believed to have been holy water fonts)—elements that can be found at Knappaghmanagh and Fahburren (Corlett 2001, 42). The monastic house established



Illus. 1.26 Turlough church and round tower, Co. Mayo (MA070-144001–2) (Richard F Gillespie).

at Aghagower was strategically positioned on the Tóchar Phádraig, the pilgrim route to Croagh Patrick. By the 12th century a round tower had been constructed both here and at Turlough (Illus. 1.26). Holy wells are also found near many early church sites, including Aghagower, Turlough, Ballynew and Mayo Abbey—though their antiquity cannot easily be confirmed in all cases.

Throughout Ireland, the uniform character and distribution of the settlement types in this early medieval period suggests a homogenous and settled society, but this masks boundaries between tribal territories and conflicts between neighbouring tribes. One of the main rivalries in Connacht was between the Uí Fiachrach and the Uí Briúin Aí (later known as the Ua Conchobair). The Uí Briúin Aí, from their heartlands in latter-day Roscommon, dominated Connacht from the late seventh century and were the provincial kings until the arrival of the Normans, though the Uí Fiachrach Aidne (south Galway) and the Uí Fiachrach Muáide (Sligo and north Mayo) would also hold the kingship for short intervals in the seventh and eighth centuries (Stout 2017, 77, 115). Within these larger territories there were also smaller subdivisions of land, occupied by subordinate tribes. The region of southern Mayo associated with the Uí Fiachrach can be mainly linked to the Fir Chera, although the Clann Cúain controlled the area of Carra north of the Castlebar River (Tighe 2021, 194). After the Ua Conchobair consolidated power in the ninth and 10th centuries little is known of the local kingdoms, although it is suggested that they were reflected in the reformed diocesan boundaries of the 12th century (ibid., 216). They included Umhall (or Owel) around Clew Bay, a former O'Malley territory largely equating to the modern

baronies of Murrisk and Burrishoole (Knox 1908a, 300, 303; Corlett 2001, 36); while around Castlebar, the modern barony of Carra largely corresponds with the territory of the Clann Cúain (Knox 1908a, 286).

Norman colonists and medieval towns

After the invasion of AD 1169, the Normans moved quickly to build castles and to establish towns and villages in their conquered lands in the south and east of Ireland. But life in Connacht did not change radically in the first decades after the invasion. This was partly because of the remoteness of the west but also, perhaps, as a consequence of the Treaty of Windsor (AD 1175), whereby King Henry II of England recognised Ruaidrí Ua Conchobair (O'Connor) as High King of Ireland in unconquered areas, including most of Connacht (Jordan 1994, 19). By AD 1227, however, in a period when the kingship was disputed by rival O'Connor claimants, they were forced to forfeit their claim to rule the whole province and much of their land was confirmed to Richard de Burgo. (The original grant had been to his father, William de Burgo, in AD 1195, but was not executed by him.) A full-scale Norman military campaign ensued in AD 1235. This firmly established de Burgo as Lord of Connacht. His home estates were in the Norman heartlands of east Galway, where he founded a new walled town and built a castle at Loughrea. He granted lands to other Norman barons in the province including Maurice FitzGerald, Lord of Offaly and Chief Justiciar in Ireland (i.e. the king's lieutenant), who founded settlements, among other places, at Loughmask and Ballinrobe in south Mayo (Peros 1997).

Medieval origins of Castlebar

There is abundant evidence in the hinterland of Castlebar for early medieval settlement including ringforts and early church sites, such as the old church of Aglish Coyne, which gives its name to the parish of Aglish. ‘Clancowane and Fertyr’ (probably corresponding with Aglish parish) was granted to a de Barry, whose name survives in Castlebarry (Knox 1908a, 288). The territory of the Conmaicne Ceara, afterwards the barony of Carra containing Castlebar, fell to the Normans in AD 1237 and Orpen (1920, 216) believed that the first castle here may well have been built by a de Barry. Despite this, the first documented name associated with the town is a de Cogan, who held it in AD 1333 (at the outbreak of a fierce civil war among rival descendants of Richard

de Burgo) (Bradley & Dunne 1989, 31).

By the 16th century the castle at Castlebar was in the possession of descendants of Richard de Burgo, now styled Burke or Bourke. Though they fought for their lands against the encroachment of later, ‘New English’ settlers, by 1586 the castle had been granted to Sir John Bingham. This grant to John Bingham was a reward for fighting alongside his brother Sir Richard Bingham, who was the Crown’s appointed Governor of Connacht, during the latter’s raids in the province. Following further disputes and intrigue, on 26 March 1613, King James I granted John Bingham a charter of incorporation for Castlebar. This provided that the town would be governed by a portreeve (mayor) and a 15-member corporation (or council). The corporation



Illus. 1.27 Westport House. This neoclassical mansion was built by John Browne, 1st Earl of Altamont, on the site of the later medieval O’Malley castle of Cathair na Mart (Richard F Gillespie).

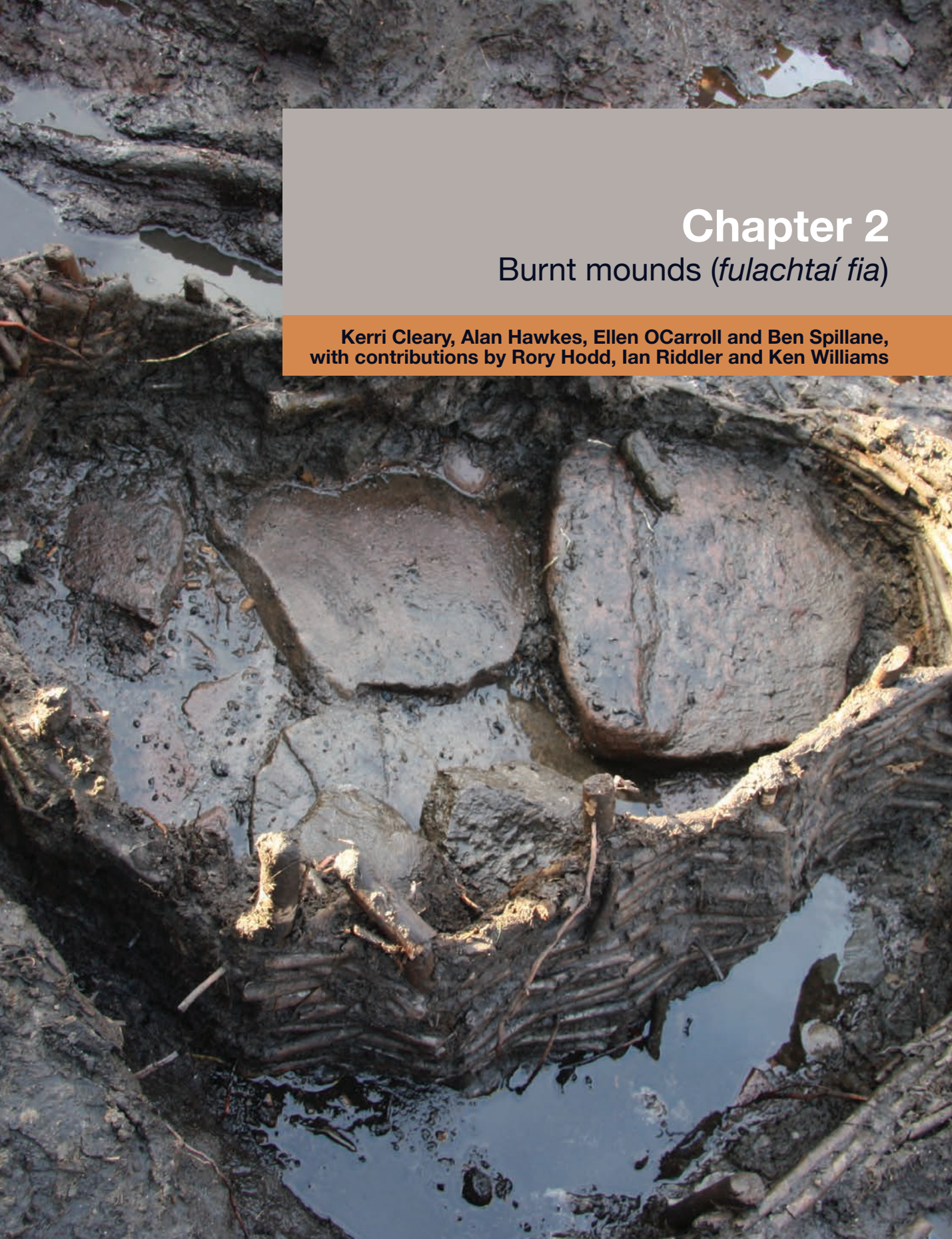
could make byelaws for the town, manage markets and professions, and appoint constables. The mayor was also the judge of the borough court (Campbell 2017). Until 1800, the corporation of Castlebar was entitled to send two members to the Irish Parliament.

Later medieval origins of Westport

The O'Malley clan emerged from the tumultuous rebellions and feuds of the later medieval period in the West of Ireland as a powerful sea-faring family, based principally in the barony of Murrisk, south of Clew Bay. They held several of the tall, slender castles known as tower houses in coastal or maritime settings, including Clare Island. Some of these castles had small villages nearby, and associated mills (Corlett 2001, 58–65). The origins of Westport can be traced to one of them, an O'Malley castle overlooking Clew Bay at Cathair na Mart.

By the mid-17th century, Cathair na Mart formed part of the estates of Theobald Bourke, a grandson of the famous 'pirate

queen' Grace O'Malley, and now 3rd Viscount Mayo. In the aftermath of the Cromwellian campaigns that ravaged Ireland in 1649–52, Theobald Bourke was executed and his estates were confiscated (Corlett 2001, 80–2). Some years later, in the reign of King Charles II, the former Bourke estate was granted to John Browne, a successful lawyer who had obtained extensive estates in Mayo and Galway, and who was married to Theobald Bourke's daughter Maude. In the Williamite versus Jacobite war in Ireland (1689–91), John Browne, now Colonel Browne, was a prominent and active supporter of James II. Consequently, as history repeated itself, most of his estates were confiscated, leaving him with only the O'Malley castle at Cathair na Mart, its tenants and a few hundred acres of land. His grandson John, 1st Earl of Altamont, would eventually restore the family fortunes. He built a neoclassical mansion (Illus. 1.27) on the site of the castle and developed a planned town of Westport in place of the old village (Kennedy 2009, 15–16).



Chapter 2

Burnt mounds (*fulachtaí fia*)

Kerri Cleary, Alan Hawkes, Ellen OCarroll and Ben Spillane,
with contributions by Rory Hodd, Ian Riddler and Ken Williams

Burnt mounds (*fulachtaí fia*)

The drumlin landscape of west Mayo is interwoven with rivers, streams and lakes. This is a perfect landscape for a proliferation of burnt mounds in prehistory and also provides the peaty conditions in which they remain preserved to the present day. Burnt mounds, commonly known as *fulachtaí fia*, are found across Ireland, with over 8,000 examples recorded by the Archaeological Survey of Ireland (2025) and the Historic Environment Division in Northern Ireland (2025). They typically occur on the margins

of wetlands, in places with high natural groundwater levels, along watercourses or peatland edges (Illus. 2.1). Many of them are upstanding features, preserved as mounds of heat-shattered stone in a charcoal-rich soil. A great many others, with no above-ground expression, have been levelled over the subsequent centuries but can be identified by archaeological investigations, particularly in advance of public infrastructure developments. A study of the data from these many recent excavations, by Alan Hawkes



Illus. 2.1 Cloondeash 3 and 4. Aerial view of burnt mounds adjacent to a former stream during excavation (ACSU Ltd).

(2018), argued that, as gathering places for cooking, feasting and bathing, burnt mound sites had a special importance in the social life of prehistoric communities.

Prior to the archaeological work on the N5 and N59 road projects, 553 burnt mound sites were recorded in Co. Mayo by the Archaeological Survey of Ireland. In reality, the number of sites is likely to be much higher, as a relatively small proportion of the county has been fully surveyed and many areas have expanses of blanket bog, which, no doubt, cover many more burnt mounds, obscuring them from view (Kerrigan & Gillespie 2010a, 46; Kerrigan et al. 2010, 7). With the discovery of 54 new sites, archaeological work associated with the N5 and N59 road projects has increased the known total of burnt mound sites in the county to 607. Of these, 40 previously unknown sites were excavated within the footprint of our N5/N59 project (i.e. N5 Westport to Turlough and the Barleyhill to Kilmeena section of the N59) and a further eight were newly identified, and avoided, preserved outside the road project (Illus. 2.2). Three of these preserved sites are in the townland of Aghadrinagh, one in Claggarnagh East, and two each in the townlands of Drumneen and Drummindoo. The remaining new sites, two in Keeloges and four in Drumard, were excavated by Rubicon Heritage Services Ltd on the Rossow Bends section of the N59 and are not included here (Gilligan & Hession 2014a–c; Hourihan & Hession 2014a–c).

Cooking, feasting, bathing

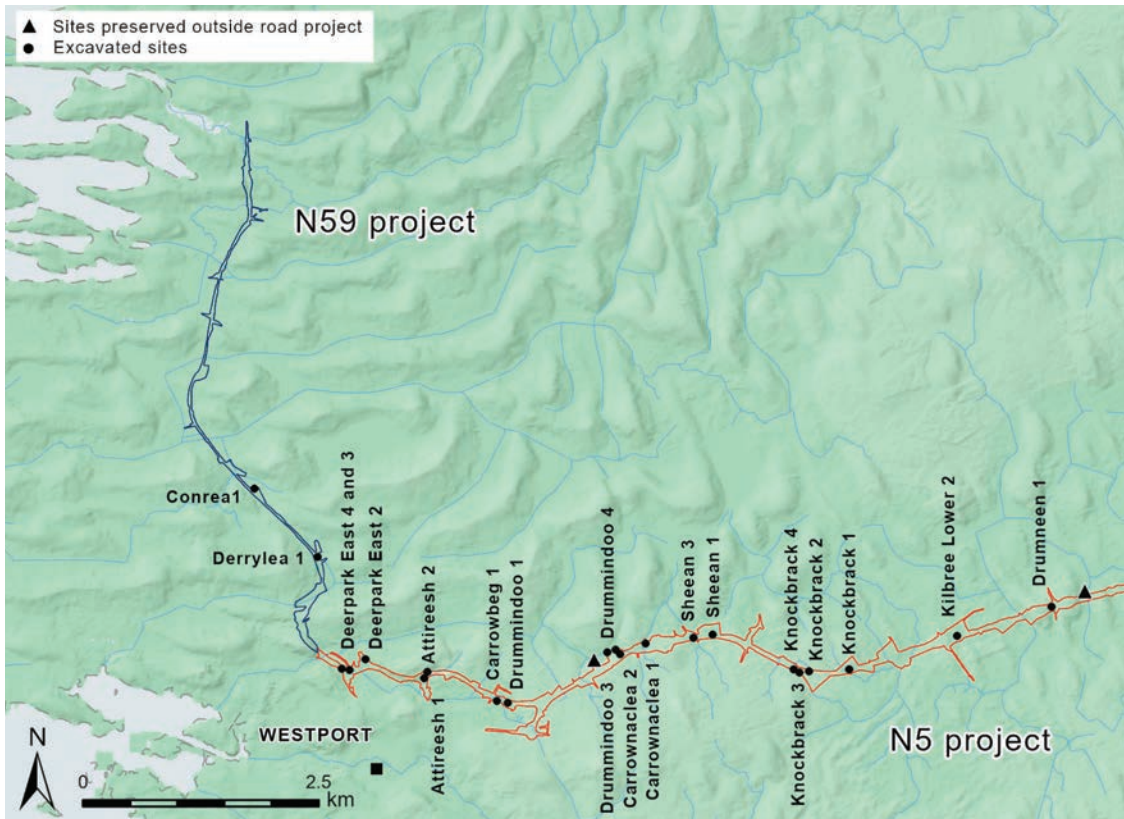
Burnt mound sites are relatively common in the Irish landscape. They contribute to our understanding of prehistoric communities because they represent aspects of life

centred around cooking, eating and bathing. Heating stones on an open fire to store and transfer heat ('pyrolithic technology' in the archaeological literature) is a simple concept but its execution required a lot of effort. No doubt the effort was worthwhile as it solved problems that we take for granted in today's world of electric kettles, gas-fired ovens and indoor heating systems.

The stones were gathered locally and heated on an open hearth or fire. Once heated, the stones were transferred to water-filled pits or troughs to heat or boil water. At some sites there is evidence that hot stones were also placed in dry pits, which could have been used for roasting and baking. The large quantities of heat-shattered stone and charcoal typically found at a burnt mound site represent the waste material generated by this process, which was often dumped around the trough to form a horseshoe-shaped mound.

Troughs full of hot stones, enclosed by a tent or hut, were sometimes used as steam baths or saunas, often with an external plunge pool. Other uses for burnt mounds that have been suggested, but that are difficult to prove, include harvesting animal fat and bone grease (i.e. secondary products of cooking meat), brewing beer, retting flax, tanning leather or dyeing cloth (Monk 2007; Quinn & Moore 2007; 2009; Reilly & Brown 2012).

Professor Michael J O'Kelly, of University College Cork, was a pioneer of experimental archaeology in Ireland. He published a seminal paper (O'Kelly 1954) on 'Excavations and experiments in ancient Irish cooking places' that created a lasting popular image of a burnt mound site: a wood- or stone-lined rectangular trough, a fire or hearth, and a horseshoe-shaped mound of burnt stone. This image remains valid for the classic

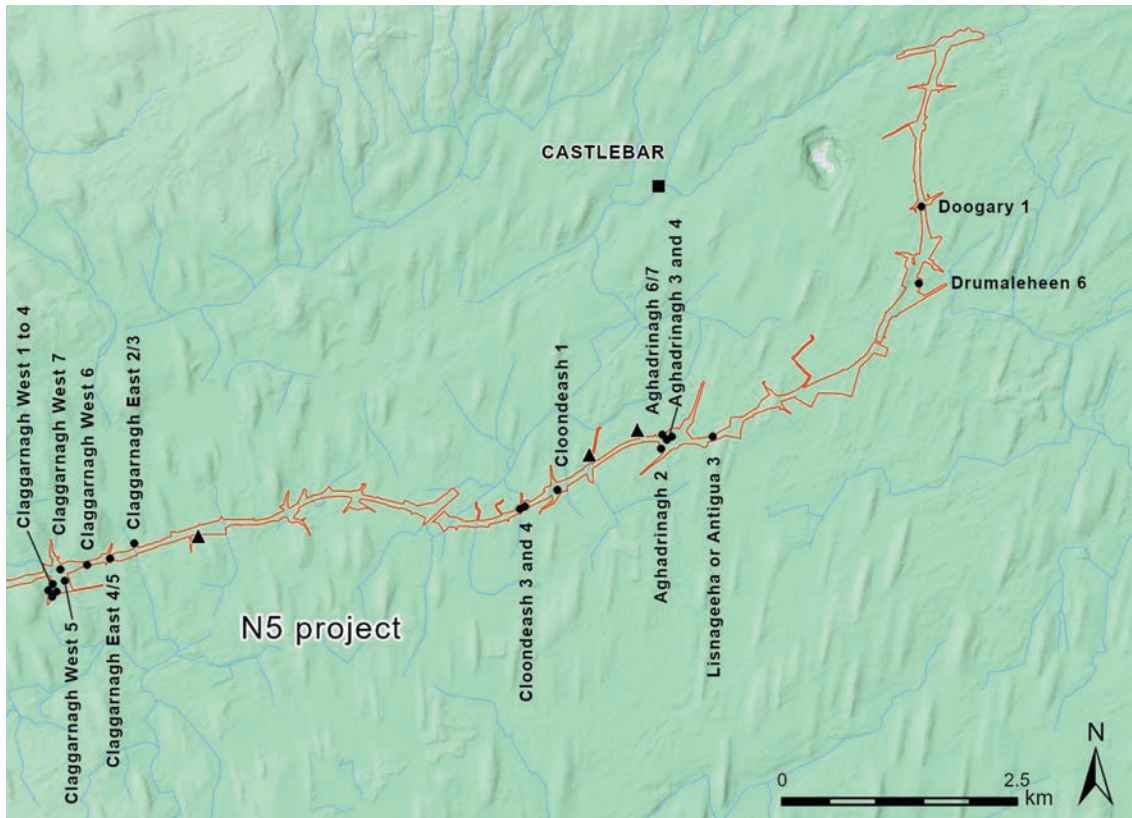


Illus. 2.2 Excavated burnt mounds on the N5/N59 project (ACSU Ltd based on Taillte Éireann mapping).

elements of a burnt mound, but the potential complexity and variability of the site type is now far better understood. This is a result of over 2,000 excavations that have taken place since then, especially in recent decades on large-scale public development projects. These excavations have demonstrated the diverse morphologies of troughs; the prevalence of associated features such as water channels and drains, wells and cisterns, footpaths, working surfaces and huts; the connection between burnt mounds and nearby settlements; the range of potential uses of heated stones; and intriguing patterns of use, abandonment and reuse of burnt mound sites over time (Hawkes, below).

Dating burnt mounds

Excavations of burnt mounds have demonstrated that these outwardly simple sites can have very variable individual histories. Some were active for short periods, while others had prolonged, but probably intermittent use, as well as episodes of reuse after long intervals of abandonment. These variations are often represented in the excavation record by well-defined layers in the mounds, inter-cutting troughs and relined (i.e. reused) troughs, but are sometimes indicated only by scientific dates from charcoal, wood or other organic sample material. Choosing the best dating samples can be tricky, however. Burnt mounds are susceptible to disturbance

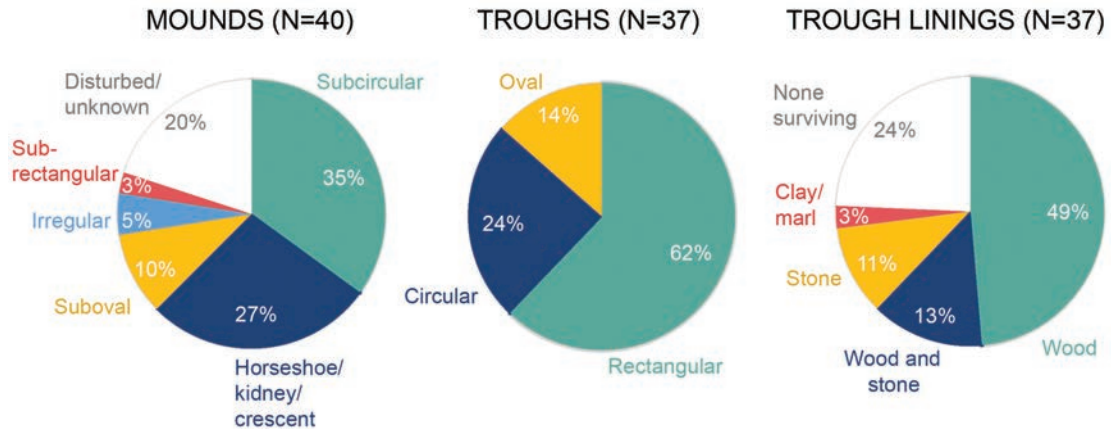


Illus. 2.2 Excavated burnt mounds on the N5/N59 (continued).

or outright levelling by tillage or land improvements, as well as inundation by water and peat, which all affect the integrity of the stratigraphic record to varying degrees. Furthermore, in archaeological practice to date, it is very seldom that more than one or two radiocarbon dates are obtained for individual excavated burnt mounds. Taking these factors all together, the construction of refined chronologies for burnt mound sites can be challenging (Hawkes 2018, 117–9; Spillane: below and Appendix 3). Nonetheless, general patterns can be observed, with most burnt mounds dating to the Bronze Age, particularly between 1800 BC and 800 BC, although examples are also known from the Neolithic period, mainly between 3000 BC and 2500 BC, the

Chalcolithic period (2500–2200 BC) and the Iron Age, largely between 800 BC and 400 BC (Hawkes 2018, 121, 125, 131).

A similar chronological pattern emerges from the many burnt mounds excavated to date across Co. Mayo. Along with those discovered on the N5/N59 project, they include examples from other road projects around Charlestown, Moylaw near Crossmolina, Rossow north of Westport and Cloongullaun Bridge near Swinford (Kerrigan & Gillespie 2010a; Zajac 2008; 2012a–b; Gilligan & Hession 2014b; Hourihan & Hession 2014a; Sutton 2022; 2024; Sutton et al. 2025), and also from gas pipeline and water drainage projects (Murphy et al. 2008; Gillespie 2007; Guinan 2015). Assessment of the scientific dates from these and other



Illus. 2.3 Shape and form of excavated mounds and troughs on N5/N59 project (ACSU Ltd).

projects indicates that the first burnt mounds in Co. Mayo appeared in the Late Neolithic period (c. 2700–2500 BC) and the last ones in the Early Iron Age (c. 750–500 BC). To take this a step further, we can use Bayesian statistical modelling to more rigorously interrogate both the dating and stratigraphic records from burnt mounds (Spillane: below and Appendix 3). If used on individual sites with multiple radiocarbon dates, this technique can help to detect distinct phases of use, abandonment and reuse. Applying the technique to multiple sites, as we have done for the present N5/N59 project, allows us to see fluctuations in burnt mound activity across a landscape over time. This in turn allows us to ask how a local community used such wetland places—which we might see as marginal and removed from everyday life—and how this was bound into the way people navigated things such as climate, food and social interactions.

Burnt mounds of the N5/N59 project

Burnt mounds were by far the most numerous site type discovered on the N5/

N59 project: 38 sites were excavated on the N5 Westport to Turlough road project and two on the adjoining N59 between Barleyhill and Kilmeena. The excavation results from all 40 sites are summarised in Appendix 2 and all associated radiocarbon dates are given in Appendix 1. As a large and diverse sample of the site type, the following discussion draws on details from the excavation record of these 40 sites, to extrapolate general information about their construction, dating and use.

Mounds

The characteristic debris that accumulated on burnt mound sites generally consists of fire-cracked stone mixed with charcoal-enriched sediment from the fires that were used to heat the stone. This debris often developed as a crescentic, kidney- or horseshoe-shaped mound around a trough. The size of the mound depended on the number of episodes of stone-heating that took place, but also the type of stone that was used, with diverse lithologies (e.g. sandstone, limestone, granite) fracturing in different ways during heating/quenching cycles (Buckley 1990; Hawkes 2018, 56).



Illus. 2.4 Claggarnagh East 2/3. Burnt mound under excavation with part of the site continuing to the north, beyond the lands acquired for the road project (ACSU Ltd).

Across Ireland, a high percentage of excavated burnt mounds tend to be irregular in shape because, typically, they are levelled or disturbed sites that are discovered in pre-development investigations, whereas well-preserved standing mounds are often avoided in the planning phase of developments and, therefore, are not excavated. Of the 40 sites excavated on the N5/N59 project, 11 were the characteristic horseshoe/kidney/crescent shape, 14 were subcircular, four were suboval, two were irregular and one was subrectangular (Illus. 2.3). The remaining eight were either too heavily disturbed to be interpreted or not fully excavated as they extended outside the lands required for the road project (Illus. 2.4).

The largest excavated mound on the N5/N59 project was identified at Cloondeash 4.

It was 44 m long by 14 m wide and up to 0.60 m thick (Illus. 2.1). It had been extensively disturbed, however, by a canalised stream to the west, drainage works to the east and north, and a stone and earth field boundary through the middle, all of which dispersed the mound across a larger area than it originally covered. On the other end of the spectrum, one of the smallest mounds was a subcircular deposit at Carrowbeg 1, measuring 1.40 m long by 1.30 wide and up to 0.42 m thick. This was preserved in a slight hollow and may have been dispersed through ploughing from a nearby burnt mound. In terms of surviving height or thickness, the mounds on the N5/N59 project were 0.38 m thick on average, ranging from a maximum of 0.95 m for a kidney-shaped mound at Deerpark East 4 to a minimum of 0.05 m

for the remains of a heavily truncated and dispersed mound at Claggarnagh West 7.

Stone selection

Sedimentary rock types were favoured at burnt mound sites, dominated by sandstone followed by limestone and a combination of both, with sandstone perhaps preferred for its thermal quality (Hawkes 2018, 60). Even where the underlying bedrock is limestone, sandstone seems to have been collected in preference, as was suggested previously for burnt mounds at Cahiracon, Co. Clare; Polldrian, Co. Mayo; and Ballyadam and Carrigtowhill, Co. Cork (Grogan et al. 2007, 98; Murphy et al. 2008, 13; Cleary & Hawkes 2013, 23, 25; 2014, 111–2). Based on a perceived lack of burnt mounds in limestone areas, O’Kelly (1954, 144–5) suggested in the 1950s that sandstone was the more suitable stone type because roasted limestone (calcium carbonate) converts to calcium hydroxide when immersed in water, which is unsuitable for cooking food. Since then, however, burnt mounds have been discovered across predominantly limestone landscapes, such as Limerick, Clare and Galway. O’Kelly’s proposal was also challenged by Grogan et al. (2007, 98), who proposed that the quantities of calcium hydroxide produced in a burnt mound trough would not have been harmful, especially when cooking meat



Illus. 2.5 Knockbrack 4. Unburnt sandstone cobbles and smaller stones filling a trough (ACSU Ltd).

wrapped in straw. This remains to be tested, however, as experimental burnt mounds have predominantly used sandstone to effectively cook wrapped meat (O’Kelly 1954; Lawless 1990; Hawkes & O’Driscoll 2012), although in one case, limestone mixed with sandstone was used successfully to cook meat (venison, lamb and mutton) wrapped in straw (Allen 1994). Indeed, across the Irish midlands, where limestone forms a major component of burnt mound sites, higher quantities of animal bone are found (Hawkes 2018, 157). Doubtless, this is because limestone geology is more conducive to bone preservation and not because limestone was preferred for cooking meat, but it does challenge the traditional view that limestone and cooking

are mutually exclusive.

The heat-shattered stone on the N5/N59 sites was predominantly sandstone (Illus. 2.5), although a layer of shattered limestone was found in the mound at Cloondeash 4 and some quartz was present in mounds at Knockbrack 4, Drummindoo 4 and Derrylea 1. The geology of the area to the south and south-west of Castlebar and north of Westport is dominated by Lower Carboniferous limestone, interspersed with Lower Carboniferous sandstones and Devonian sandstones and conglomerates, while quartz is also available locally in the glacial till and sandstone bedrock (Chapter 1; Long et al. 2005). Clearly, the dominance of sandstone in the excavated burnt mound sites on the N5/N59 project represents deliberate selection of a preferred stone type. The layer of heat-shattered limestone at Cloondeash 4, which separated two layers of heat-shattered sandstone, is interesting in this context, with these layers perhaps reflecting different episodes of use, possibly by people without a pronounced preference for sandstone or who sometimes favoured limestone.

Troughs

Twenty-six (65%) of the burnt mounds on the N5/N59 project had associated troughs, suitable for holding water, with seven sites having more than one trough, resulting in 37 troughs in total. Of these, 23 were rectangular in form, nine were circular and five were subcircular or oval (Illus. 2.3). This corresponds well with those analysed from across Ireland by Hawkes (2018, 67), who found that almost half (48%) were rectangular, followed by oval (24%) and circular forms (20%), with the remainder either irregular (3%) or square (1%), or not

fully defined during excavation (4%).

Hawkes (2018, 68) observed that troughs vary widely in size and capacity, that shape may have had little bearing on function, and that many troughs were altered through extensive use or later disturbance. Also, some ‘unlined’ troughs may originally have contained a lining that, having rotted or been removed, results in a false impression of the original shape and capacity of the trough. Accordingly, although calculating the capacity of a trough can be useful, it only reflects what survives in the archaeological record. Also, even for fully intact troughs, their total capacity is not identical to the amount of water they held when in use because, in practice, immersing heated stones in the troughs would have displaced an equivalent volume of water. As such, caution is needed when extrapolating and interpreting the dimensions of troughs and their volumes. On the N5/N59 project, comparing troughs as found, we can say at least that the estimated capacity of rectangular troughs was greater than the capacity of circular and oval troughs (Table 2.1).

Table 2.1 — Average measurements of burnt mound troughs on the N5/N59 project

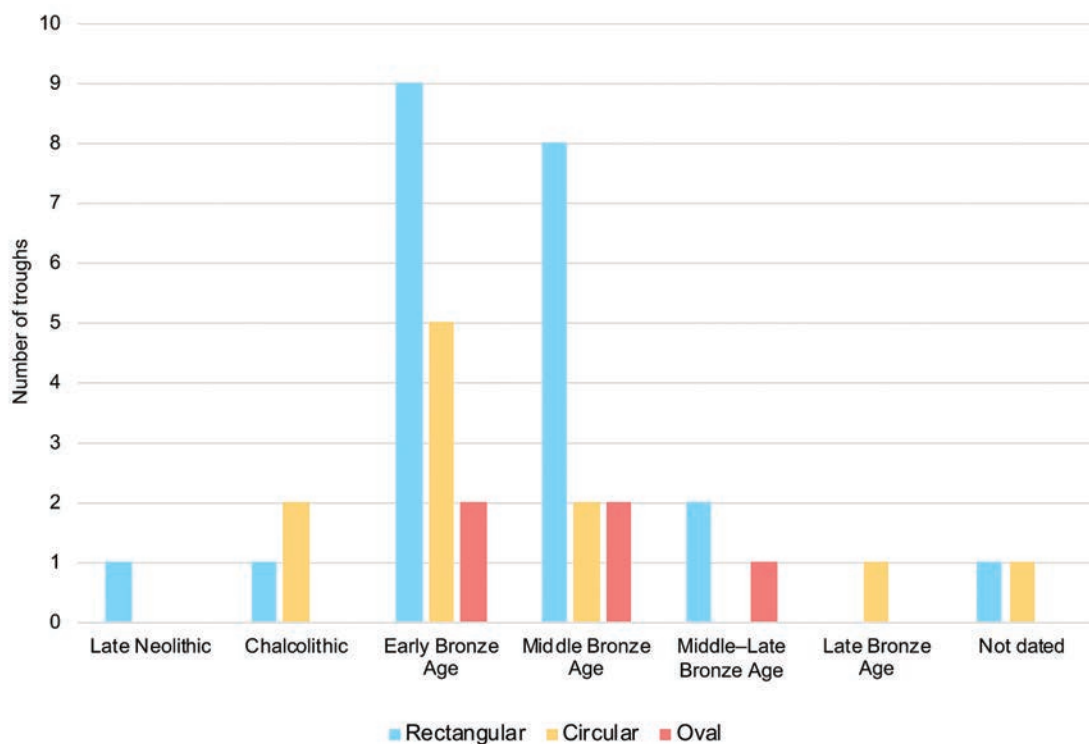
	Rectangular	Circular	Oval
Length	2.03 m	1.69 m	1.52 m
Width	1.23 m	1.47 m	0.99 m
Depth	0.35 m	0.27 m	0.20 m
Capacity	0.97 m ³	0.74 m ³	0.37 m ³

Past attempts to develop a typochronology of troughs suggested that circular examples were early and rectangular ones later in the sequence (Ó Néill 2009a). Although true for some sites, an increasing number of excavated examples now suggests

there are too many variations to support that proposal (Hawkes 2015; 2018). The trough forms uncovered on the N5/N59 project reflect this, with rectangular troughs constructed over a long time span, from the later Neolithic period to the later Bronze Age (Illus. 2.6). More recently, it has been proposed that the trough lining can be a stronger indicator of chronology. According to this proposal, wattle-lined troughs are more likely to date to the Chalcolithic/Early Bronze Age, stone-lined and hollowed tree-trunk forms were more common during the Middle to Late Bronze Age, and plank linings were prevalent throughout the Bronze Age, with the earliest examples found in the Late Neolithic period (Cleary & Hawkes 2013, 27–8; Hawkes 2014a; 2018, 80). Some of the N5/N59 troughs do correspond with this

broad typo-chronology, such as a wattle-lined example at Deerpark East 1 dated to the Early Bronze Age and a hollowed tree-trunk trough at Knockbrack 4 dated to the Middle Bronze Age; but many others are more difficult to categorise as they had only partly surviving linings or used mixed materials, including roundwood timbers ('Trough linings', below).

Of the 14 sites on the N5/N59 project that did not have a trough (as found), four were not fully excavated as they lay partly outside the lands required for the road project, while the others displayed considerable disturbance from drainage works and cultivation furrows. At Doogary 1, the burnt mound comprised intermittent patches of sediment up to 0.08 m thick, suggesting a heavily disturbed mound that



Illus. 2.6 Chronological distribution by form of 37 burnt mound troughs on the N5/N59 project (ACSU Ltd).

was levelled and redeposited by agricultural work such as ploughing. In contrast, Aghadrinagh 4 comprised a large subcircular mound up to 0.44 m thick, which was partly truncated by some cultivation furrows, but with no trough or other features beneath the mound. It was, however, close to three other burnt mounds (Aghadrinagh 2, 3 and 6/7), each of which had a trough (Illus. 2.7). It may, therefore, have simply been formed by mound material redeposited from these sites, particularly from Aghadrinagh 3, which lay directly to the east.

Trough linings

Of the 37 troughs excavated on the N5/N59 project, 28 had evidence for some form of lining (Illus. 2.8). Based on the surviving

remains, at least 18 were originally lined with wood, four with stone, one possibly with clay or marl, and the remaining five with a combination of wood and stone (Illus. 2.3). Wood lining can take several forms including wattlework, planks, roundwood/brushwood, hollowed tree trunks and even reused dugout canoes. While some linings were intended to make troughs watertight, others allowed springwater or groundwater to seep into the trough. Direct dating of the wood-lined troughs indicates that the earliest surviving examples were built during the Chalcolithic period and continued to be constructed into the Late Bronze Age, albeit with most dating to the Early and Middle Bronze Age, between 1900 and 1400 BC (Spillane: below and Appendix 3).



Illus. 2.7 Aerial view of multiple burnt mounds on the N5/N59 project, in Aghadrinagh townland, looking south (ACSU Ltd).



Illus. 2.8 Examples of trough forms from burnt mound sites on the N5/N59 project. Chalcolithic: Claggarnagh West 1 (top left) and Knockbrack 1 (top right). Early Bronze Age: Drummindoo 4 (middle left), Deerpark East 1 (middle right) and Deerpark East 4 (bottom left). Middle Bronze Age: Deerpark East 1 (bottom right) (ACSU Ltd).

Combined wood and stone lining

The five troughs with a combination lining of wood and stone varied in form (Illus. 2.9) but all dated to the earlier part of the Bronze Age, in the years 2000–1400 BC. At Attireesh 1, a rectangular trough had a stone-lined base, long sides lined with roundwoods, and short sides supported by upright stones. Similarly, at Claggarnagh West 2 and Knockbrack 2, the short sides of rectangular troughs were at least partly stone lined. Claggarnagh West 2 also had roundwoods in the base and some stakes lining the long sides, indicating there may originally have been wattles. In contrast, the long sides of the Knockbrack 2 trough were formed by split planks and the base was partly lined by flat stones. Stone-lined bases also featured in oval and circular troughs at Deerpark East 1 and Claggarnagh West 4. Wattles defining the trough sides was preserved at Deerpark East 1 (the lower or earlier of two troughs at the site). Stakes ringing the Claggarnagh West 4 trough indicate that a wattle lining was originally present there too. This form of trough construction, where materials are mixed, is relatively rare in the archaeological record but, where it does occur, the use of stone is usually confined to the shorter ends or the base (Hawkes 2018, 79–80). The addition of at least five further sites in this category of trough linings is therefore important.

Similar combinations of wood and stone have been recorded in trough linings at other burnt mound sites across Co. Mayo, suggesting it was a regional practice. Troughs with wattle-lined sides and stone-lined bases occurred at Deerpark East II, Attireesh and Gortaroe I, all on the Westport Main Drainage Scheme; and a rectangular, wood-lined trough at Gortaroe I was lined on one short side by a large upright stone (Gillespie 2007, 26, 60–2, 68, 75). Across

the county boundary in Roscommon, a wood-lined trough at Currinah IV, on the N5 Charlestown Bypass, was similarly lined on one short side by a large upright stone; while a trough at Currinah I had upright stones on the short sides, and a stone-lined base, but also stake-holes in the corners, suggesting the sides may originally have been lined with wood (Kerrigan & Gillespie 2010a, 126–9, 133–6).

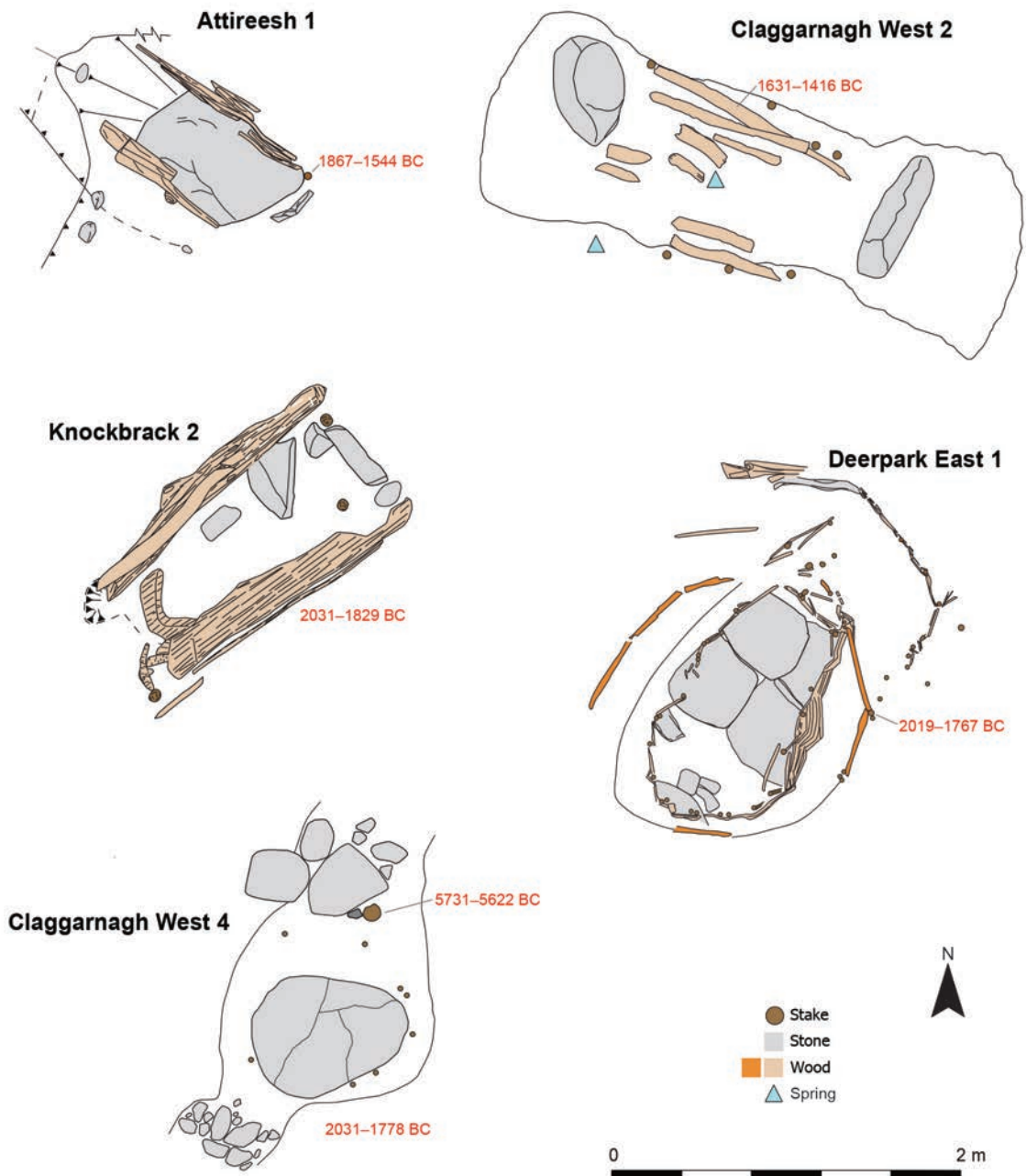
Stone lining

In addition to the five troughs mentioned above, at least a further four on the N5/N59 project had a stone element but without any surviving wooden lining or any stake/post-holes to indicate that wood was originally present. At Aghadrinagh 2, all that remained was a single, large upright stone in one of the short sides of a rectangular trough. Stone lining was present around the sides of circular troughs at Sheean 3 and Lisnageeha 3. A trough at Claggarnagh West 1 had a partly lined base of horizontal flagstones. Sandstone and limestone were used in these troughs and both were used together in the trough at Sheean 3.

Wood lining

Remains of a wooden lining were preserved or partly preserved in 23 of the troughs on the N5/N59 project, including the five examples described above that also had a stone element. Analysis of the preserved wood identified a variety of species, reflecting what was available in the immediate environs, but also knowledge of the suitability of different tree types (O'Carroll, below).

Split planks were used in the bases of rectangular troughs at Claggarnagh East 4/5 (including a relining), Claggarnagh West 5 (Illus. 2.10), Sheean 3 and possibly also



Illus. 2.9 Five Bronze Age troughs from the N5/N59 project lined with a combination of wood and stone (ACSU Ltd).



Illus. 2.10 Claggarnagh West 5. Plank-lined base of a trough (ACSU Ltd).

Attireesh 1 and Drummindoo 4. The wood in the last two was poorly preserved, however, and may equally represent split roundwoods. Planks lined the long sides of the rectangular trough at Knockbrack 2 (Illus. 2.11) and were placed upright at the short ends of the hollowed tree trunk forming the trough at Knockbrack 4 (Illus. 2.12). A split plank and roundwoods lined the base and sides of a rectangular trough at Deerpark East 1 (the upper or later of two troughs at the site). Roundwoods, many of them split, lined the bases of troughs at Attireesh 1, Claggarnagh West 2, Deerpark East 4, Claggarnagh West 3, Knockbrack 1 and possibly also one of the circular troughs at Sheean 3, as well as the long sides of troughs at Attireesh 1 and Deerpark East 4.

Stakes found in some troughs may have been used to hold in place base or side

linings. They occurred in troughs at Attireesh 1, Claggarnagh East 4/5 (Illus. 2.13), Claggarnagh West 2, 4 and 5, Deerpark East 1, Drummindoo 3 and 4, Knockbrack 1, 2 and 4 and Sheean 3. Alternatively, the stakes may be remnants of wattlework, such as those found in the circular troughs at Drummindoo 3, Claggarnagh West 4 and Sheean 3.

Alder was the preferred wood for many of the planks and roundwoods. Ash was used for the roundwood lining in the base of a trough at Claggarnagh West 3 and the sides of a trough at Attireesh 1. Hazel most frequently was used for stakes and wattlework due to its flexibility, but small amounts of alder, ash, birch, holly and oak were also used (e.g. in the wattlework of the oval trough at Deerpark East 1). The hollowed, split tree-trunk trough at Knockbrack 4 was oak, with additional, upright pieces of oak at the short ends, and



alder positioned along the upper edge resembling an out-turned lip (Illus. 2.12).

Moss lining

Moss is commonly found packed beneath the base and behind the side timbers of wood-lined troughs, where it acted as a filter for groundwater (Hawkes 2018, 73). Eleven of the 28 lined troughs on the N5/N59 project had evidence for moss packing, all of which dated from the Early to Middle Bronze Age.

At Claggarnagh West 2 and 5, moss was found beneath the wood-lined bases of three troughs (Illus. 2.14). It was packed around the

Illus. 2.11 Knockbrack 2. Plank-lined sides of a trough (ACSU Ltd).

Illus. 2.12 Knockbrack 4. Hollowed-out tree-trunk trough, with upright planks at the short ends and pieces of alder forming a lip along one side (ACSU Ltd).





Illus. 2.13 Claggarnagh East 4/5. Stake-holes in the corners of a second phase of trough lining (ACSU Ltd).

wood-lined base of the rectangular trough at Deerpark East 1 and below the hollowed tree-trunk trough at Knockbrack 4. A small amount of moss survived on the base of the circular trough at Drummindoo 4. There was a moss lining behind the wood-lined sides of a second trough at Drummindoo 4 and in a trough at Knockbrack 2. Moss was recorded above the partly stone-lined base of a trough at Attireesh 1, where it had probably been displaced from the wood-lined sides. Moss was also packed between the stones that lined the base of the trough at Claggarnagh West 4 and was entwined in the wattle walls of the oval trough at Deerpark East 1.

Moss packing was also found between the wood-lined sides of troughs and outer wattlework panels at three of these sites: Drummindoo 4, Knockbrack 4 and Deerpark

East 1. The outer wattled panels were used to both contain the moss and stabilise the pits dug to contain the troughs on boggy sites susceptible to ground collapse. The oval trough at Deerpark East 1 provides a particularly good example of this use of wattlework and moss filtering (Illus. 2.15). A large quantity of moss was packed between the inner wattled lining of the trough and an outer wattled wall, filling an area 0.10–0.20 m wide and up to 0.30 m deep. This would have captured organic detritus in the groundwater, arising from peaty conditions at the site (Illus. 2.16). This form of trough, with double wattle walls, is rare in the archaeological record, but in a similar example discovered elsewhere in Mayo, at Began near Claremorris, an oval trough had 34 stakes positioned around the



Illus. 2.14 Claggarnagh West 2. Moss layer underneath wood-lined base of a trough, visible after some of the roundwoods were removed (ACSU Ltd).

circumference, either individually or in pairs (Guinan 2015, 11–28). The stakes around the eastern end were arranged in a double ring, which may originally have contained a moss filter similar to that at Deerpark East 1.

The moss layer from a trough at Claggarnagh West 2 was analysed for species composition. Several varieties of moss were present, from at least three different habitats in the local area (Hodd: text box). To date, analysis of moss linings has only been completed for a small number of burnt mounds, in counties Mayo, Roscommon and Donegal: Attireesh (Area 1) (van Reenen 2007); Sonnagh I, IV, V and IX and Fauleens I and II (Hall & Kenward 2010), and Pollsharvoe 1 (Sutton 2022; Sutton et al. 2025), all in Mayo; Currinah IV (Gillespie & Kerrigan 2010a, 134) and Kilbegly (Overland & O’Connell 2010), in Roscommon; and Errorooey More (Lyons 2017), in Donegal.

In the Mayo examples, the most frequent species was *Thuidium tamariscinum*, which is a common moss occurring in woodlands.

Clay lining

Most of the troughs discovered on the N5/N59 project would have filled naturally with groundwater or with water directed towards them by earth-cut channels. A rectangular trough at Aghadrinagh 2 was different. There was no inlet channel and the base and sides were lined with clay, which helped both to retain water and prevent the walls from collapsing. As groundwater would not have penetrated the clay lining, the trough must have been filled manually. There was a large stone in one of the short sides of this trough, possibly a remnant of a mixed stone-and-clay lining. This site was also one of the few with evidence for trough-side furniture (below).



Illus. 2.15 Deerpark East 1. Artist's impression of a wattle-lined trough with moss lining to filter groundwater (Sara Nylund).



Illus. 2.16 Deerpark East 1. Comparing moss-filtered (right) and unfiltered (left) water samples from the wattle-lined trough (ACSU Ltd).

Moss lining in a trough at Claggarnagh West 2

Rory Hodd

Two rectangular troughs at Claggarnagh West 2 were built in the Middle Bronze Age. Moss shoots from a layer beneath the wood-lined base of one trough were examined under a binocular microscope. Leaves were also detached for examination in more detail, at high power magnification, with particular attention paid to leaf shape and form, cell size and shape, and other features, such as toothiness of the leaf margin. Due to the age and often degraded state of the mosses, it was necessary to narrow the identification to a group of species, with the species identification then refined and confirmed using detailed descriptions, drawings and photographs (Smith 2004; Lüth 2019). Four samples of this moss layer were examined and eight species were identified (Table 2.2).

Table 2.2—Claggarnagh West 2. Moss species in samples from a trough

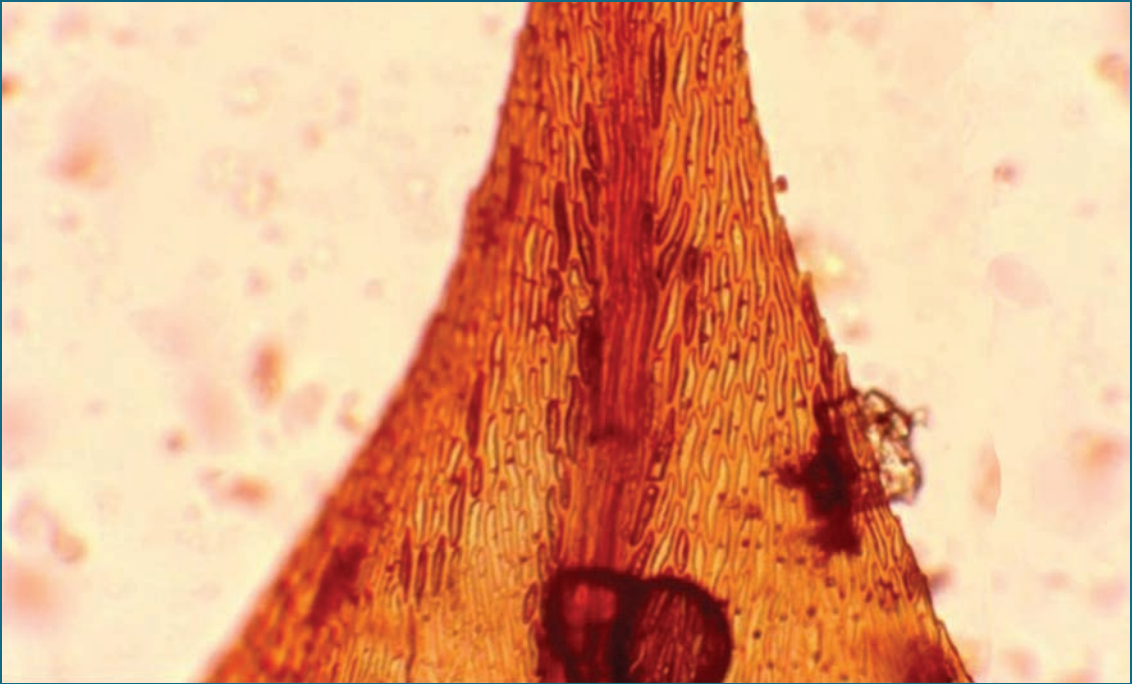
Species	Sample Number			
	1	2	3	4
<i>Loeskeobryum brevirostre</i>	✓	✓	✓	✓
<i>Thuidium tamariscinum</i>	✓	✓	✓	✓
<i>Rhytidiadelphus loreus</i>	—	✓	✓	✓
<i>Sphagnum</i> cf. <i>palustre</i>	✓	—	—	✓
cf. <i>Brachythecium rutabulum</i>	✓	—	—	—
<i>Climacium dendroides</i>	✓	—	—	—
cf. <i>Hygroamblystegium</i> sp.	✓	—	—	—
<i>Thamnobryum alopecurum</i>	—	✓	—	—

The moss species identified from Claggarnagh West 2 are likely to have been collected locally and are still found in the area today (Blockeel et al. 2014). The only possible exception is the *Hygroamblystegium* species (Illus. 2.17), but this could not be identified with confidence. It is unlikely that all of the species would have been growing together and they may have been collected from three different habitats. *Loeskeobryum brevirostre* and *Rhytidiadelphus loreus* would probably have been found on rocks in woodland. *Climacium dendroides* and *Thamnobryum alopecurum*, as well as the possible *Hygroamblystegium* species, may have come from the rocky edge of a neutral to mildly base-rich lake. (This is likely to have been Islandeady Lough,

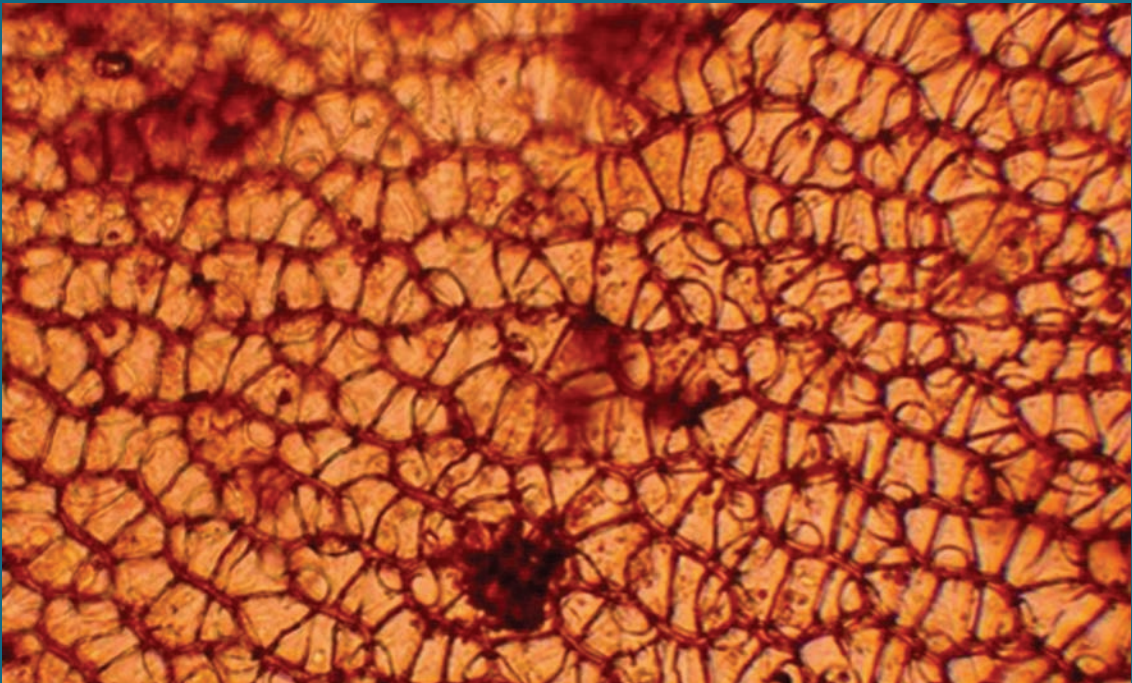
which is within a few hundred metres of the site.) *Thuidium tamariscinum* and *Brachythecium rutabulum* grow in both habitats. Finally, *Sphagnum palustre* (Illus. 2.18) would not have grown directly in association with any of the other species found, and probably came from an area of wet woodland, possibly close to the lake shore. Though the species identified grow in different habitats it is possible that the habitats themselves were in close proximity to each other, depending on variations in topography and wetness locally.

It is not possible to deduce the time of year when the mosses were collected. This is because they grow all year round, and also because no sporophytes, which are most commonly produced in winter, were found. Conversely, no conclusions can be drawn from the lack of sporophytes as the species present do not produce them frequently. Sporophytes are also delicate and less likely than leafy parts of the plant to be preserved.

Most of the species were probably not selected for any specific properties, but rather for their large size, mat-forming growth habit and abundance, making them easy and quick to collect in large quantities. It is possible, however, that *Sphagnum palustre* was specifically sought for its high efficiency at purifying water and filtering out pollutants, as *Sphagnum* species have long been used, worldwide, and for a variety of such purposes (Glime 2017).



Illus. 2.17 Claggarnagh West 2. Moss lining in a trough. Part of leaf of cf. *Hygroamblystegium* species, showing a thick, prominent nerve (Rory Hodd).



Illus. 2.18 Claggarnagh West 2. Moss lining in a trough. Leaf cells of *Sphagnum* cf. *palustre* (Rory Hodd).

Water management

Siting burnt mounds on wetland margins meant that controlling the flow of water and dealing with waterlogged conditions were ongoing issues. Linear gullies, interpreted as overflow channels, allowed excess water to be directed away from a trough and working area, while inlet channels could be used to regulate the supply of water (Hawkes 2018, 82–3). Inlet channels are often found in association with natural water sources such as springs and wells, or with earth-cut cisterns where water was stored before being directed to a trough. On the N5/N59 project, five burnt mounds had water channels (Illus. 2.19). There were wells at two other sites, in the form of large pits dug to access natural springs.

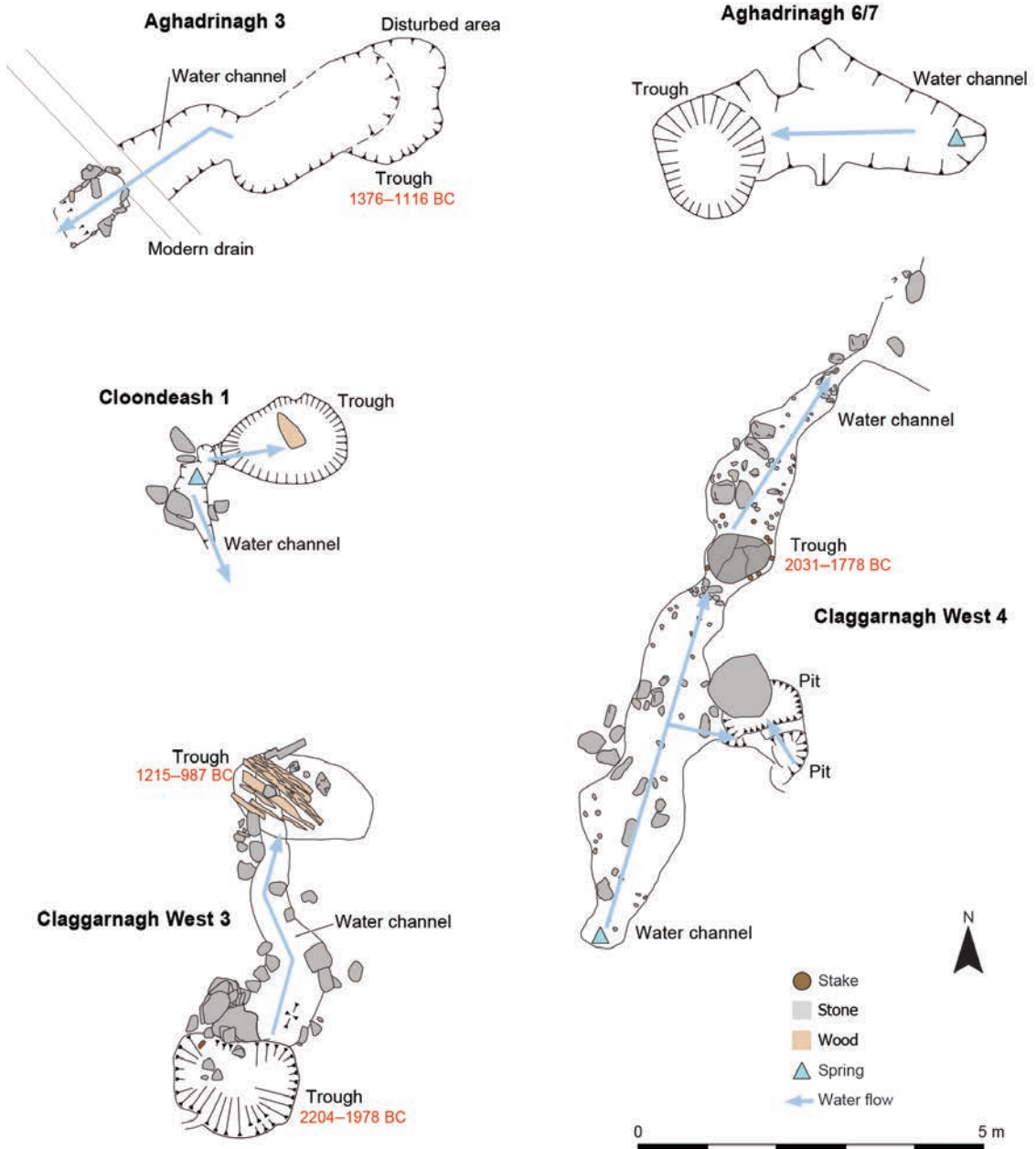
Sluice-like features have been recorded at some burnt mound sites. These would have controlled the flow of water but could also have been adapted to filter out any heat-shattered stone and fire debris from water being delivered to the troughs (Cleary & Hawkes 2014, 109; Hawkes 2018, 83). The evidence for sluices takes the form of stake- and post-hole arrangements that, presumably, held some form of movable barrier, and possibly straw or wattle filter-screens.

At Aghadrinagh 3, a linear gully at one end of the trough was probably an overflow channel, allowing excess water to be diverted away from the trough and towards wetter ground to the west, downslope from the site. Conversely, a gully at Aghadrinagh 6/7, east of the trough, appears to have supplied water to it, probably from a nearby spring, upslope from the site. An unusual concentration of unburnt stones where this water channel joined the trough may have been the remains of a dam. Similarly, at Cloondeash 1, a short

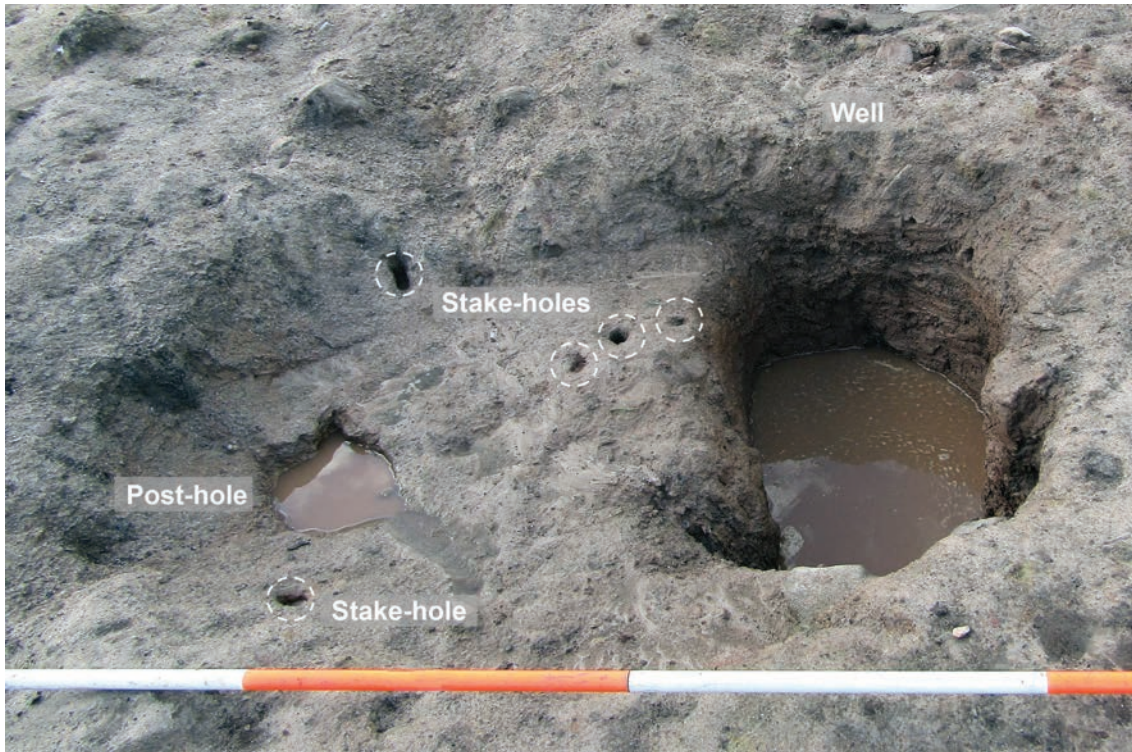
gully brought fresh water into the trough from a natural spring located on higher ground to the west. A second gully allowed excess water to drain away downslope to the south, ensuring that the flow of water could be controlled and the site would not flood.

At Claggarnagh West 3, a shallow gully extended between two troughs, allowing water to flow downslope from one to the other. If both troughs were in use together, this would have functioned both as an overflow channel from the upper trough and an inlet channel supplying the lower trough. It is more likely, however, that the upper trough was a cistern, or an older trough reused as a cistern, when the lower trough was made.

A complex water-management system was also employed at Claggarnagh West 4, where the trough was set within a broad, shallow gully that traversed the site. From the south side the gully allowed water to flow towards the trough from a spring, upslope from the site; and on the north side, the gully discharged excess water away from the trough towards boggy ground, downslope from the site. Excess water from the spring could also be diverted into two large pits at one side of the gully, interpreted as cisterns. There were two close-set rows of sandstone slabs across the width of the gully where it joined the south side of the trough. The stones probably housed some form of wooden feature acting as a sluice gate. A similar feature may have existed on the north side, where there were two large slabs of sandstone and limestone in the west side of the gully, where it discharged the overflow from the trough. Adjacent to the stones there were the remains of a wooden post (ash), 0.10 m in diameter. However, this returned an anomalous Late Mesolithic date of 5731–5622 BC (Poz-97440), so its association with



Illus. 2.19 Water-management features at five burnt mounds on the N5/N59 project (ACSU Ltd).



Illus. 2.20 Claggarnagh East 4/5. A pit with a post-hole and several stake-holes on one side is interpreted as a well with remains of a wooden platform (ACSU Ltd).

the burnt mound is tenuous, unless it was preserved old wood put to new use.

There was a well at Claggarnagh West 2, in the form of a shallow, partly stone-lined pit with a natural spring in its base. This adjoined the southern one of two troughs on this site. After this trough was no longer used, a second pit was dug through its wood-lined base, to access the groundwater or clay marl below (Illus. 2.44).

At Claggarnagh East 4/5, a pit 3 m north of the trough (Illus. 2.20) naturally filled with water, forming a well. On the west side this was 1 m deep, to access the water table, whereas the east side was shallower and contained a post-hole and five stake-holes, probably remnants of a wooden platform or some form of mechanism for raising water from the well.

Fires

Fire was crucial for heating stones but surviving fire settings are seldom found on excavated burnt mound sites. Fires set on the topsoil surface, without a hearth pit, leave little or no trace in the archaeological record. Also, at burnt mound sites, fires may have been placed on bases of stone or clay, or raised areas of burnt mound material, or at the edge of troughs, with the ash and charcoal that remained after the fire had extinguished simply incorporated into the mound (Hawkes 2018, 64, 107).

Possible fires were found at five of the burnt mound sites on the N5/N59 project. At Attireesh 1, a charcoal-rich deposit, 0.70 m wide and 0.05 m thick, was found on the north-east side of one of the troughs.

Charcoal samples from the remains of the fire were identified as hazel with a small amount of holly. At Deerpark East 4, a similar ashy charcoal deposit, 0.60 m wide and 0.15 m thick, was found on higher ground, directly north-west of a trough. It was located within a compacted, stony surface that also contained a post-hole and three stake-holes. A fire at Derrylea 1 was represented by a concentration of ash and charcoal, 0.65 m wide and 0.08 m thick. It was mainly confined to a shallow depression over 2 m north of a trough. The charcoal included oak with lesser amounts of hazel, holly and alder. Just south-east of the rectangular trough at Deerpark East 1 there was a concentration of small, angular stones and an adjacent deposit of ash, 0.40 m wide and 0.02 m thick. At Claggarnagh East 4/5, a large depression at the north-west end of a trough contained a charcoal-rich deposit measuring 0.70 m by 0.30 m and 0.03 m thick. It may have been the remains of a fire setting or simply material dumped from a nearby fire. The charcoal included alder and ash, with a smaller amount of oak. There was no evidence of oxidisation (fire-reddened soil) on the ground at any of these sites, but this is not unusual for burnt mounds or indeed on house floors at contemporary settlement sites (Doody 2000, 145; Ginn 2016, 101–2). Experiments show that fires will not cause the underlying soil to redden where there is surface

organic matter and a relatively high soil moisture content (Canti & Linford 2000).

The fires at Attireesh 1, Deerpark East 1 and Derrylea 1 were positioned at the long sides of the rectangular troughs, albeit some distance from the trough at the latter site. At the other two sites, Deerpark East 4 and Claggarnagh East 4/5, the fires were at the short ends of the troughs, which is more in line with national trends (Hawkes 2018, 64). Fires at the short ends of troughs were often in slightly elevated positions, which allowed the heated stones to be simply rolled into the trough (Illus. 2.15; Cleary & OCarroll: text box).

Pits

At Claggarnagh East 4/5, a circular pit, with the remains of a stone lining around the upper edge and a heat-affected base, was interpreted as a primitive oven or roasting pit (Illus. 2.21). This was located in the



Illus. 2.21 Claggarnagh East 4/5. Possible oven or roasting pit (ACSU Ltd).

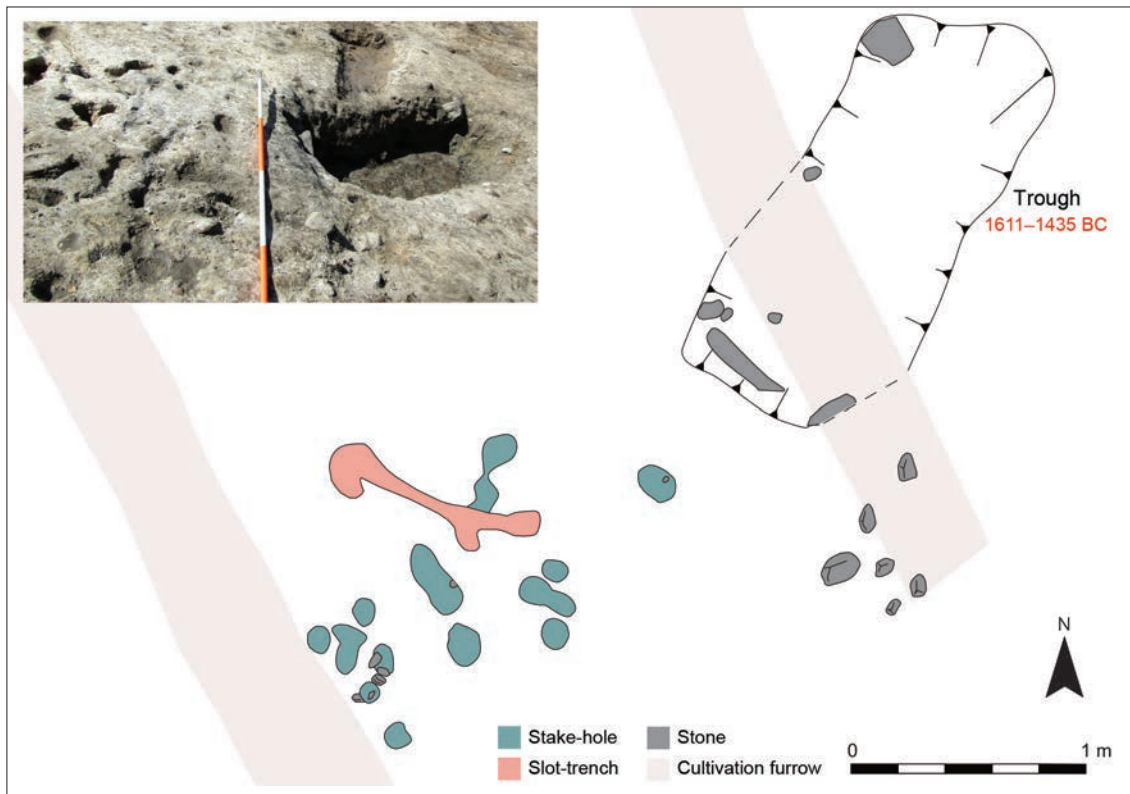
higher, drier area of a site that sloped down to the west, towards a former watercourse, with a trough 11 m south-west of the pit.

Other than troughs, cisterns and a roasting pit, a miscellany of other pits was recorded on the burnt mound sites excavated on the N5/N59 project. These varied considerably in size and shape and probably had as many different uses (Hawkes 2018, 85–9). Some possibilities include steaming food, waste disposal, and tree-throw holes. At least a few were quarry pits (below). One novel suggestion is that some pits on burnt mound sites were dug as trial holes to check the water-table levels (Ó Drisceóil 1987, 51), with the successful trial pits being expanded to become troughs.

Wooden structures

Slot-trenches and post/stake-holes on burnt mound sites have variously been interpreted as the remains of huts or light, tented structures; as superstructures associated with troughs; or as fence-lines, revetments, windbreaks, drying-racks and tripod frames (O’Kelly 1954; Cleary 2015, 81–2, 89–93; Hawkes 2018, 98–108).

At Aghadrinagh 2, a short slot-trench and up to 18 stakes-holes were concentrated within 1 m of the short end of a rectangular trough (Illus. 2.22). Many of the stake-holes abutted one another, perhaps indicating replacements or different episodes of use. They suggest a rack or some similar trough-side fixture, replaced or rearranged over time.



Illus. 2.22 Aghadrinagh 2. A slot-trench and clustered stake-holes near one end of the trough were interpreted as a rack or some similar fixture (ACSU Ltd).



Illus. 2.23 Claggarnagh East 4/5. Tripod-like arrangement of stake-holes at the short end of a trough (ACSU Ltd).

At Claggarnagh East 4/5, three stake-holes formed a roughly triangular arrangement at one end of a rectangular trough, possibly representing a tripod, rack or windbreak (Illus. 2.23). Similar examples have been found with hearths, both on burnt mound sites and on Bronze Age house sites, where they can be more confidently attributed to cooking (Hawkes 2018, 108); but some other examples have been interpreted as tripods to suspend animal carcasses for butchery and to separate fat, meat, offal and blood for processing in the troughs (Delaney & Tierney 2011a, 43). No animal bones were found at Claggarnagh East 4/5, but this is not unusual for burnt mounds

and it has long been suggested that any meat bones left around a site might have been scavenged by dogs and other animals (O’Kelly 1954).

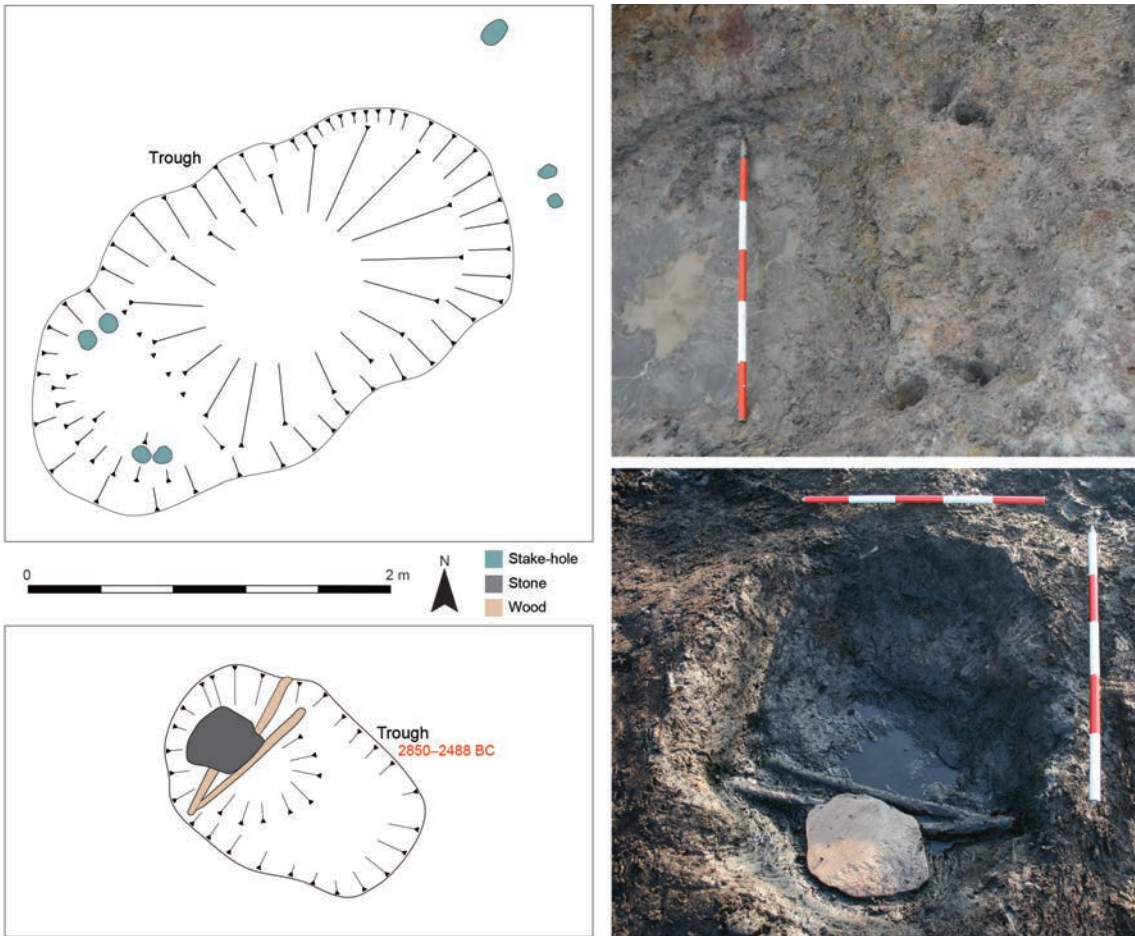
At Deerpark East 4, three stake-holes and a post-hole defined a roughly rectangular area, to one side of a trough, that measured 1.64 m by 1.43 m. The stake-holes and post-hole were partly within a metallised surface (below) and may have supported a raised platform or rack, or potentially a temporary shelter. At Attireesh 1, a line of three post/stake-holes, 1 m long and adjacent to a trough, suggests a screen or rack. Similarly, at Derrylea 1, there were three stake-holes parallel to the short end of a trough.

At Deerpark East 1 there were preserved remains of a curved wattle screen, 1.5 m long, and concentric with the wattle-lined oval trough (Illus. 2.15). A sample of the wattled wood was identified as birch. The structure may have

been erected to retain upcast burnt mound debris from slipping back into the trough, or it may simply have been a windbreak. Similar structures have been observed at other burnt mounds and Hawkes (2018, 107–8) observed that many were positioned near the troughs at the shorter ends, perhaps to screen fires. There was no evidence for a fire, however, in this position at Deerpark East 1.

Trough steps/ledges

The short, south-west end of a rectangular trough at Derrylea 1 was stepped by a narrow ledge, with four stake-holes on the ledge set in opposing pairs (Illus. 2.24). This



Illus. 2.24 Derrylea 1 (top) and Knockbrack 3 (bottom). Troughs with stepped short ends (ACSU Ltd).

step-like feature could have provided access to the trough, or a place for a person to sit and bathe their feet or wash clothes, with the stake-holes forming a frame, a small compartment or a shelf. Another step-like feature was recorded at Knockbrack 3, where a large horizontal flagstone was positioned in the short, north-west end of a rectangular trough, and secured in position by three pieces of alder roundwood (Illus. 2.24). (This reduced the length of the trough to approximately 1 m.) Again, this may have been a step, a shelf or a seat.

Step-like features have been found

elsewhere in Ireland on burnt mound sites. At Sonnagh III, Co. Mayo, a large alder plank, in the side of a circular trough, was held in place at either end by a hazel rod (Kerrigan & Gillespie 2010a, 75–6). Charcoal from the trough was dated to 2870–2498 BC (GrN-30754), in the Late Neolithic period, which is similar to the dates of 2850–2488 BC (Beta-518396) and 2837–2472 BC (Beta-518395) from Knockbrack 3, on the N5/N59 project. At Moanmore 1, Co. Carlow, there was an access point or step in the east end of an oval trough, with a post/stake-hole positioned at either side (Jennings & Coughlan 2012,

6–8). This trough also had post/stake-holes cut into the base in each corner, indicating that it was probably originally wood lined. Charcoal from the trough was dated to 1217–932 BC (UBA-14122) in the Late Bronze Age. Another, smaller trough at Moanmore had an extension on one corner that resembled a step into the trough (*ibid.*, 5). At Pollsharvoe 1, Co. Mayo, a stone-lined ledge on the short side of a rectangular wood-lined trough was interpreted as a hearth setting (Sutton 2022; 2024; Sutton et al. 2025). The setting contained fire debris and the stones showed signs of exposure to heat. Hazel wood from the trough lining was dated to 1207–1013 BC (SUERC-95393) in the Late Bronze Age. Rectangular troughs with a step or ledge on one of the short ends were also recorded at Corrin 4, Co. Cork, and Mullenmadoge I, Co. Mayo (O’Connell 2013a; Kerrigan & Gillespie 2010a, 55).

Working surfaces

The movement of people around an already wet site would have made for increasingly muddy ground conditions. Wooden planks, stone slabs and waste material (i.e. heat-shattered stone) were commonly deployed on burnt mound sites to consolidate conditions underfoot. Metalling also occurs and Hawkes (2018, 97) identified 34 sites where small, unburnt stones were compressed into the natural subsoil, forming working surfaces close to troughs and wells.

At Deerpark East 4, small, subangular stones and larger horizontal flagstones were laid down to create a firm, dry, working surface on peaty, wet soils. At Derrylea 1, there were two flagstones over 1 m away from the trough, possibly forming stepping stones. At Sheean 3, there was a spread of unburnt stones between two troughs (*Illus.*

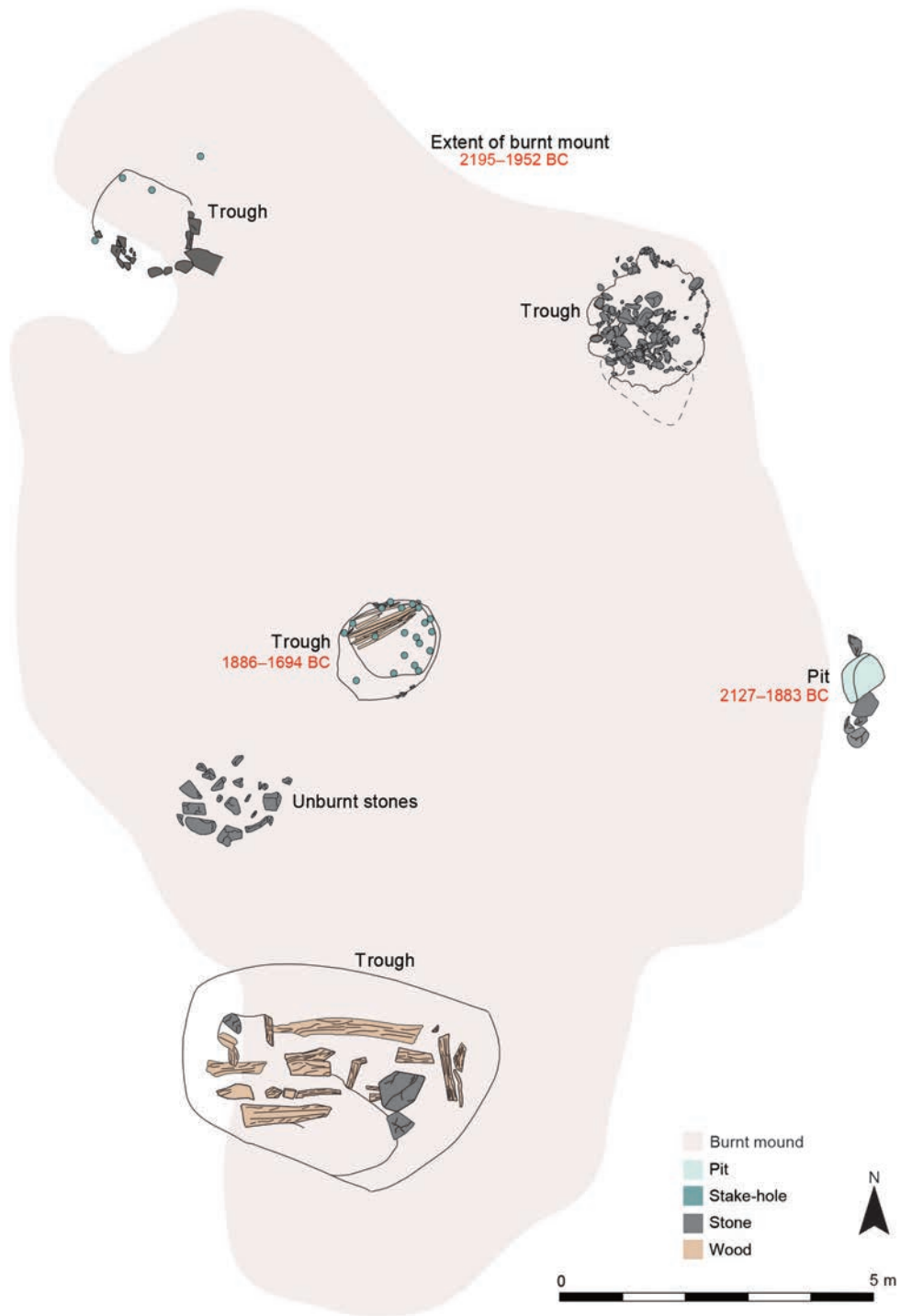
2.25). The stones included shale, sandstone and a single piece of quartz, and were spread over an area c. 2 m in diameter. This might have been the remains of a stockpile of stones gathered for heating, rather than a deliberately made surface, but in either case, the stones would have provided a hard-surfaced area by the troughs.

Stone and wood stockpiles

Stones used for boiling or roasting were sourced locally and stored on burnt mound sites adjacent to the water troughs and roasting pits. Large pits identified at Macetown, Co. Westmeath, Carricknaveagh, Co. Down, and Scrahane, Co. Waterford, were interpreted as quarry pits for extracting stone (Hawkes 2018, 90). Stockpiles of stone were identified at Castleinch, Co. Kilkenny, and Brackbaun, Co. Limerick (*ibid.*, 63). The stones at Castleinch were already partly burnt. The stones at Brackbaun were stored in a pit.

At Claggarnagh West 2, two quarry pits measuring (max.) 2.3 m wide by 0.6 m deep and 3.2 m wide by 0.6 m deep, contained large quantities of sandstone. The larger pit had a water spring in the base and could have supplied water for the troughs, after the stone was quarried. A pit at Claggarnagh West 6, measuring (max.) 1.7 m wide by 0.5 m deep, contained sandstone and limestone, and may have been initially quarried and then used to stockpile stone for heating. At Attireesh 1, a deposit of sandstone measuring 1.15 m wide by 0.33 m thick, placed directly on the peaty soil adjacent to one of the troughs, may also have been a stockpile.

Fuelwood would also have been stockpiled, no doubt, if it could be kept dry. Interpreting remnants of preserved wood is



Illus. 2.25 Sheean 3. A spread of unburnt stones between two of the four troughs beneath the mound was possibly the remains of a stone stockpile but would also have provided a dry, firm surface (ACSU Ltd).

difficult. Some pieces may represent unburnt fuelwood but others may be displaced, scattered remains of trough linings, wood-working debris from trough construction, or even wood litter deposited to create dry, stable work surfaces.

There were two concentrations of wood beneath the burnt mound at Deerpark East 1, adjacent to the two troughs. Some of the wood was identifiable as unworked alder root, which may simply have been residual from trees growing on the site before it was used for burnt mound activities. Alder was one of the main wood species used to build the troughs at Deerpark East 1, so existing alder trees may have been felled here. Deposits of wood at Deerpark East 4 were found near the burnt mound in peat that developed in an infilled palaeochannel, possibly part of a former pool or small lake within this drowned drumlin landscape. Alder, oak, birch, willow and yew were present. There was evidently oak/yew woodland in the area, while alder, willow and birch grew along the wetland margins. Some of this wood may have been felled for fuel.

Artefacts

It is rare to recover artefacts from prehistoric burnt mounds and difficult to link them directly with whatever activities occurred at these sites. The most common objects discovered are worked or chipped stone tools and pottery fragments (Ó Néill 2009a; Hawkes 2018, 116), but a carved wooden fragment and three bone beads also featured in the finds assemblage from the N5/N59 project.

A total of 26 flaked and retouched stone tools (21 chert, three flint, two quartz) was recovered from six burnt mounds on the N5/N59 project. Twenty-one of them were found

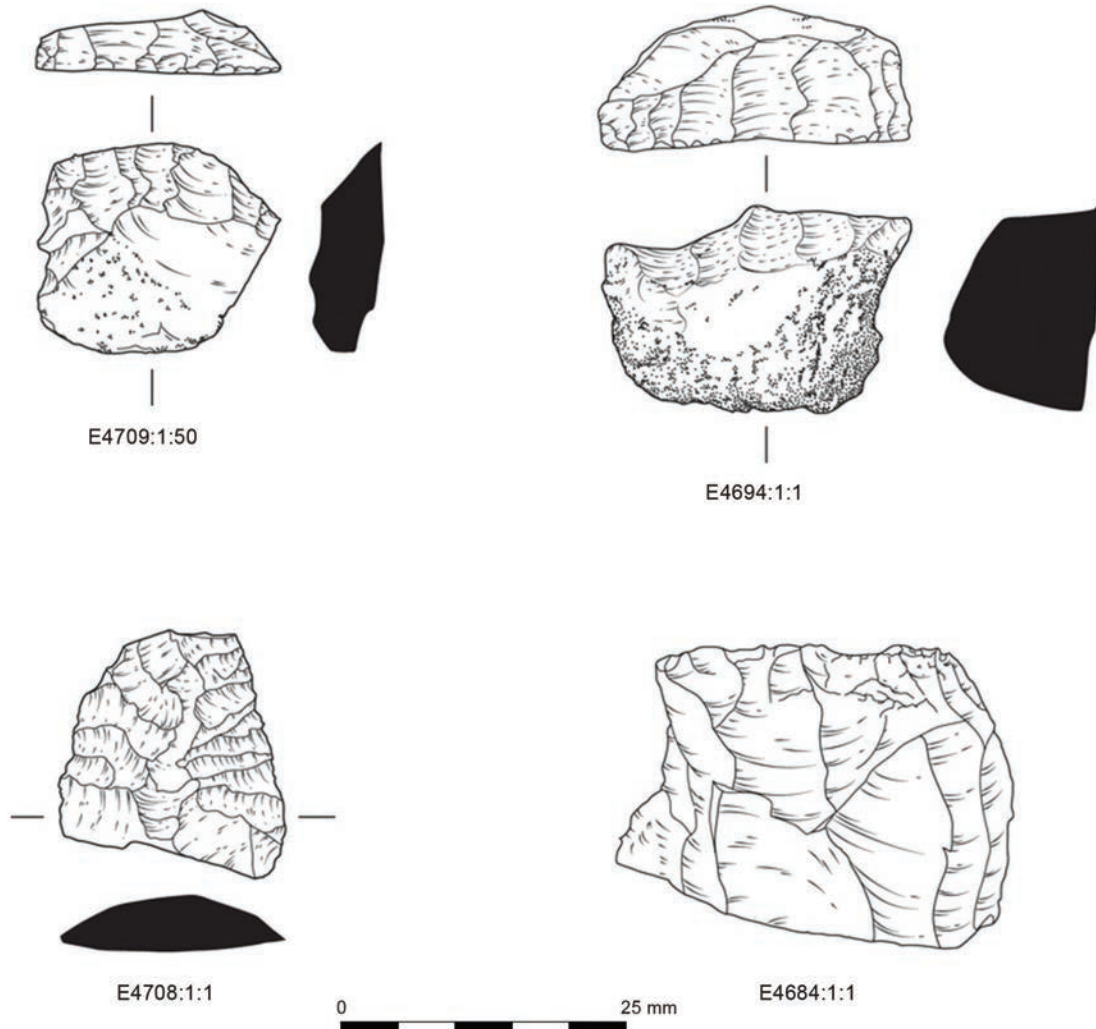
in the topsoil and of these 17 were chert, two flint and two quartz. They included a convex end scraper from Deerpark East 4, a scraper from Claggarnagh East 4/5, and an arrowhead fragment from Deerpark East 3 (Illus. 2.26). The remaining topsoil finds were mostly small to medium-sized flakes. At Deerpark East 4, a chert bipolar flake was found in peat underlying the burnt mound. Only two stone tools were recovered from the burnt mounds themselves, at Aghadrinagh 6/7 and, again, at Deerpark East 4. These were a flint bipolar core (Illus. 2.26) and a chert bipolar flake with edge retouch. The remaining two objects were chert platform flakes from the upper fill of a well at Claggarnagh East 4/5.

The techniques used to work or 'knap' these artefacts are largely undiagnostic so they cannot be dated to any particular period in later prehistory (Driscoll 2020); but the tools found in the burnt mounds and the well are most likely to have been associated with these features and therefore of the same date.

The arrowhead no doubt was a hunting weapon. Scrapers, flakes and blades in later prehistory had many possible uses, but on burnt mound sites they were probably for butchering animals and processing meat, though some could also have been used to work wood and other organic materials. Simple edge-retouched pieces or 'knife' forms recovered from burnt mounds at Sonnagh V and Fauleens on the N5 Charlestown Bypass similarly suggested cutting and food processing (Kerrigan & Gillespie 2010a, 147).

Animal bone

Animal bones have been found on just over 20% of burnt mound sites excavated in Ireland (Hawkes 2018, 156), on a variety of



Illus. 2.26 Stone tools from burnt mounds. Deerpark East 4 chert convex end scraper (top left), Claggarnagh East 4/5 chert scraper (top right), Deerpark East 3 chert arrowhead (bottom left) and Aghadrinagh 6/7 flint bipolar core (bottom right) (Sara Nylund).

soil types (i.e. of varying acidity/alkalinity), though the bones have not always been scientifically dated and are often badly preserved (degraded, fragmented and/or burnt). On the N5/N59 project, small quantities of bone were recovered from four sites. At Aghadrinagh 3 and Claggarnagh West 5 there were only small amounts of burnt bone (0.22 g and 0.67 g), unidentifiable

to species (Coogan 2017), found in the mounds. At Claggarnagh West 2 there was a single sheep/goat metacarpal (foot bone), recovered from a pit cut into a wood-lined trough. At Deerpark East 4, three cattle bone fragments and two teeth were found in the same layer, pre-dating the burnt mound, as two of the bone beads mentioned above (Riddler: text box).

Some other burnt mounds excavated across Co. Mayo have yielded animal bone from similar contexts. At Ballinrobe Demesne (Site 2), for example, over 200 animal bone fragments were recovered from a thin layer of peat directly below a burnt mound. The peat was radiocarbon dated to 2590–2205 BC (lab. code not provided; Walsh 1995b, 12). Only a small number of the bone fragments could be identified to species. They were mostly cattle and principally derived from the meat-rich, upper limb bones of two carcasses, probably butchered off site and brought to the burnt mound as prepared joints (McCarthy 1995). There was also a single horse tooth, a pig phalanx (foot bone), and a red deer humerus (leg bone) that had been broken by a sharp blow across the shaft, probably to expose the marrow (*ibid.*). The horse tooth is notable as, currently, the earliest scientifically dated domesticated horse remains in Ireland suggest they were not introduced until the Middle Bronze Age (Cleary 2016, 144–5).

At Coolroe, Co. Mayo, three burnt mounds yielded animal bones from both beneath and within the mounds, including cattle, pig, sheep, horse and red deer (McCarthy 2021). The red deer remains from one mound consisted mostly of antler fragments, from at least two adult males, though some of the bones had butchery evidence in the form of chop marks (*ibid.*). Hazel charcoal from the base of this mound returned a Chalcolithic date of 2572–2302 BC (GrN-27642) (Gillespie 2021).

Three Bronze Age burnt mounds excavated on the N5 Charlestown Bypass had animal bone (Kerrigan & Gillespie 2010a; Beglane 2010). There were fragments of a pig mandible (lower jaw) in the trough at Sonnagh IX, a charred rib fragment of a small

mammal (unidentified) from a moss layer in the trough at Sonnagh IV, and a cattle maxilla (upper jaw) and rib fragments in a deposit of wood near the trough at Cloonaghboy IV. Six burnt mounds excavated on the Westport Main Drainage Scheme, across the townlands of Attireesh, Gortaroe and Deerpark East, also produced small quantities of animal bone, primarily from the burnt mounds, and these were identified as cattle, pig, sheep and red deer (McCarthy 2007).

Plant remains

The quantity of plant remains from the excavated burnt mounds on the N5/N59 project was very low, consisting only of hazel nuts and shell fragments from four sites (Stone 2018a; OCarroll 2019; 2020). There were only 1–3 shell fragments in troughs at Claggarnagh West 5 and Knockbrack 2, and in the moss lining at Knockbrack 4, but the moss lining of the trough at Deerpark East 1 contained 24 whole nuts and 10 shell fragments. A low level of archaeobotanical remains is not unusual for burnt mounds (Hawkes 2018, 159). While hazel nuts are known to have been important to human diet in all periods in prehistory, the low quantities recovered from burnt mound sites in Ireland suggest they were simply collected along with fuelwood and moss and were not stockpiled or consumed in large quantities at these sites. Plant remains from the burnt mounds excavated at Cloonmeen West and Sonnagh, on the N5 Charlestown Bypass project, were similarly dominated by hazel nuts and shell fragments (Giorgi 2010). At Sonnagh IX, some of the nuts were infested by insects and may have been considered inedible and discarded (*ibid.*, 10).

Bone beads from Deerpark East 4

Ian Riddler

Three bone beads were found at Deerpark East 4 in sediments that pre-dated the burnt mound. They are discoidal beads of Neolithic type (Illus. 2.27) and were probably lost on the shore of a former pool or lake, long before any burnt mound activity on the site.

Discoidal beads (or ‘disc beads’) have flat, broad surfaces. The beads from Deerpark East 4 are all of a similar shape and size, roughly 12 mm in diameter and 2.5–4.5 mm thick. The edges are carinated and they have splayed axial perforations cut from one side with a blade.

These beads resemble some of the smaller stone beads from a pit at Carrickmines Great, Co. Dublin, where charred wheat was dated to 3649–3527 BC (Poz-11604; Ó Drisceoil 2006, figs 6 [no.1] and 7). There is a broadly contemporary set of disc beads, of similar dimensions and made of serpentine, from a Neolithic house at Corbally, Co. Kildare (Purcell 2002, fig. 10). Also, a single stone disc bead was recovered from a Neolithic house at Gortaroe II, just 1 km south-east of Deerpark East 4 (Gillespie 2007, 88; Illus. 2.27). This skilfully made bead is 11 mm in diameter with a splayed perforation, cut by a blade from one side of the object (Riddler 2018).

Stone disc beads are relatively common in the Neolithic period in Ireland but bone beads are much less common, and most prehistoric bone beads from Ireland are not discoidal in form. For example, bone beads from the Middle Neolithic passage tomb at the Mound of the Hostages, on the Hill of Tara, Co. Meath, are in the form of tubes or spacers (O’Sullivan 2005, 139–47). Late Neolithic bone beads from Knockadoon, Lough Gur, Co. Limerick, are mostly barrel-shaped or segmented. There they occurred in small numbers, both in burials and settlements, and were generally found in association with stone beads; several necklaces combining the two materials could be identified (Grogan et al. 1987).

Not all discoidal bone beads are Neolithic. A single discoidal bone bead from Circle K at Lough Gur had a diameter of almost 40 mm, which is significantly larger than any of the beads described here. Circle K was a Neolithic settlement site but also included a Bronze Age enclosure and early medieval finds (Grogan et al. 1987, 358–9); it is likely that the bead is early medieval in date. Similarly, a discoidal antler bead from a Neolithic passage tomb at Ballycarty, Co. Kerry, was recovered from the topsoil over the cairn, alongside other items of early medieval date (Connolly 1999, 30). It had a diameter of 16 mm. A single bone disc bead from Kilgreany Cave, Co. Waterford, with a diameter of 17 mm, also appears to be of medieval type (Movius 1935, 272–3).

Overall, we may say that small discoidal beads, with carinated edges and a splayed perforation cut entirely from one side, are a feature of Neolithic contexts in Ireland. Similarities of shape, size and manufacture suggest that the bone beads from Deerpark East 4 are also of Neolithic date.



Illus. 2.27 Deerpark East 4 and Gortaroe II. Bone disc beads E4709:28:1, E4709:35:1 and E4709:35:2 (Ian Russell). Stone disc bead 01E1042:35:58 (Richard F Gillespie).

Carved wooden fragment from Knockbrack 4

Kerri Cleary and Ellen OCarroll

A piece of carved alder wood was recovered from a Middle Bronze Age burnt mound at Knockbrack 4. It measures 190 mm long, 100 mm wide and 30 mm thick. A curved longitudinal profile suggests it was part of a carved vessel or a scoop-like implement (Illus. 2.28). It is a rare discovery, with only a few comparable objects found at burnt mounds.

Wooden vessels were widely used in prehistory and were often carefully made and finely polished (Earwood 1992, 27). Alder was commonly chosen as it is easy to carve, holds liquids well and does not impart any flavour to foodstuffs (Taylor 1981, 45). The curvature and thickness of the fragment from Knockbrack 4 suggest it might have been part of a large, wide bowl. Several examples of this type have been recovered from bogs and wetland sites. Two examples from Edercloon bog, Co. Longford, were carved from alder. They formed part of a collection of bowls, dishes, tubs and troughs (Moore 2021, 114–20). One of the Edercloon bowls, oblong with a flat base and gradually sloping sides, came from a wooden *togher* (trackway) dated to the Iron Age but with likely Late Bronze Age origins (ibid., 115). A comparable example from Timoney bog, near Roscrea in Co. Tipperary, is believed to be very early, possibly Neolithic (Earwood 1993, 289). At a wetland site in Ballynaclogh, Co. Galway, part of a large, decorated bowl, carved from hazel, was dated to the Iron Age (Moore 2013, 121–3).

Part of a low, wide alder vessel, very similar to that from Knockbrack 4, was also recovered from a Bronze Age enclosure at Rathmullan, Co. Meath, from a segment of the ditch dated to the Middle Bronze Age (Piera et al. 2022, 13). Another shallow, oval, alder bowl or platter was recovered from a burnt mound at Drumacreeve, Co. Monaghan. It was found in a pit beside a wood-lined trough and was dated to the Late Bronze Age (Moore 2024). These shallow bowls may have been used for presenting and sharing food, reflecting the role of burnt mounds as places to gather and feast.

Other wooden artefacts recovered from burnt mounds may resemble parts of bowls, but some are interpreted as fragments of scoop-like implements, like a shovel or ladle, perhaps used to move stones to and from the trough. At Ballybar Lower, Co. Carlow, two pieces of carved alder with charred upper surfaces, from the trough of a Middle-Late Bronze Age burnt mound, were interpreted as remains of shovel heads (Gannon 2009; Moloney 2015a, 118). At Cauran Moore, Co. Galway, a piece of carved oak from the trough of a Middle Bronze Age burnt mound may also have been a shovel or scoop (Bermingham & Péterváry 2014, 98–100). A similar object was recovered from a pit at a burnt mound site at Ballyvolane, Co. Limerick (Coyne 2002).

Comparatively, the carved alder fragment from Knockbrack 4 is probably part of a shallow wooden bowl rather than a scoop or shovel. It is an important addition to the small catalogue of wooden artefacts from burnt mound sites in Ireland.



Illus. 2.28 Knockbrack 4. Carved alder fragment E5018:16:1 (photo: Ian Russell; drawing: Oisín O'Brien).

Lipid analysis

A sample of the heat-shattered sandstone from the base of a trough (made with a hollowed-out tree trunk) at Knockbrack 4 was tested for absorption of the fatty organic residues known as lipids (Dunne et al. 2020). This technique is most often used to identify substances stored or processed in ancient pottery vessels, but heat-cracked stone also has the potential to retain residues from cooking, such as animal fats (Sutton et al. 2023). The stone sample from Knockbrack 4

did not yield a clear lipid profile, but this does not mean that cooking or processing animal products was not done here. In a study of over 70 stone samples from burnt mounds across Ireland only two yielded significant lipid profiles, which were both indicative of degraded animal fat. This result can be interpreted at face value to mean animals were not cooked at burnt mound sites, but may also mean that conditions at burnt mounds are simply not generally favourable for the preservation of lipids in burnt stone (ibid.).

Table 2.3—Summary of wood and charcoal assemblages from 31 burnt mounds on the N5/N59 project

KEY: LNeo = Late Neolithic (2900–2500 BC); Chalc = Chalcolithic (2500–2200 BC); EBA = Early Bronze Age (2200–1600 BC); MBA = Middle Bronze Age (1600–1100 BC); LBA = Late Bronze Age (1100–800 BC)							
Burnt Mound	Wood	Charcoal	LNeo	Chalc	EBA	MBA	LBA
Aghadrinagh 2	—	✓					
Aghadrinagh 3	—	✓					
Aghadrinagh 4	—	✓					
Aghadrinagh 6/7	—	✓					
Attireesh 1	✓	✓					
Attireesh 2	—	✓					
Carrownaclea 1	—	✓					
Carrownaclea 2	—	✓					
Claggarnagh East 2/3	—	✓					
Claggarnagh East 4/5	✓	✓					
Claggarnagh West 2	✓	✓					
Claggarnagh West 3	✓	✓					
Claggarnagh West 4	✓	✓					
Claggarnagh West 5	✓	✓					
Cloondeash 1	—	✓					
Cloondeash 3	—	✓					

Table 2.3—Summary of wood and charcoal assemblages (continued)

KEY: LNeo = Late Neolithic (2900–2500 BC); Chalc = Chalcolithic (2500–2200 BC); EBA = Early Bronze Age (2200–1600 BC); MBA = Middle Bronze Age (1600–1100 BC); LBA = Late Bronze Age (1100–800 BC)							
Burnt Mound	Wood	Charcoal	LNeo	Chalc	EBA	MBA	LBA
Cloondeash 4	—	✓					
Conrea 1	—	✓					
Deerpark East 1	✓	✓					
Deerpark East 3	—	✓					
Deerpark East 4	✓	✓					
Derrylea 1	—	✓					
Doogary 1	—	✓					
Drummindoo 3	—	✓					
Drummindoo 4	✓	✓					
Knockbrack 1	✓	✓					
Knockbrack 2	✓	✓					
Knockbrack 3	✓	✓					
Knockbrack 4	✓	✓					
Sheean 1	—	✓					
Sheean 3	✓	✓					

Woodland resources

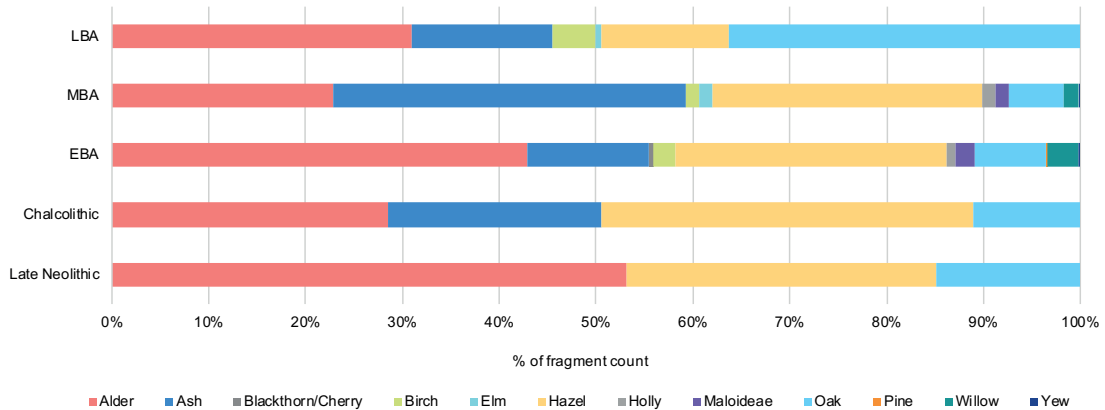
Ellen OCarroll

Charcoal and wood samples were recovered and analysed from 31 of the 40 excavated burnt mound sites on the N5/N59 project (Table 2.3). This assemblage comprised 2,770 charcoal fragments and 454 wood samples. These remains offer insights into the environment of each site and the surrounding landscape, as well as wood selection and use, and woodland management. When combined with

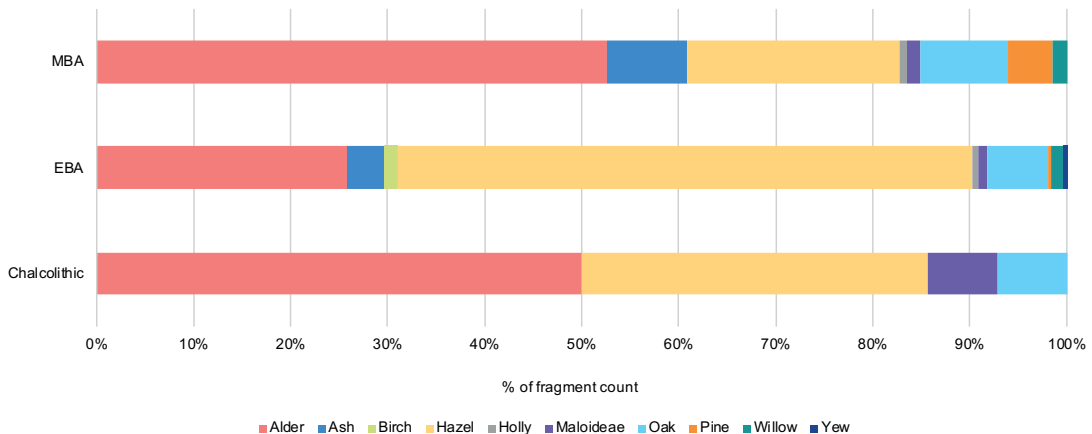
complementary studies or proxies, such as pollen and non-wood plant macro-remains, the charcoal and wood information is greatly enhanced, allowing inferences about the changing nature of the environment in the region over time. Accordingly, previously published pollen studies elsewhere in Mayo were used for comparative purposes (Coxon & Browne 1991; Verrill & Tipping 2010; Hawthorne & Davis 2013).

Due to multiple burning episodes at burnt mounds, they are an excellent source of long-term charcoal deposition and, by inference,

Ancient Places



Illus. 2.29 Charcoal from prehistoric burnt mounds on the N5/N59 project (based on fragment counts $n = 2,770$) (Ellen OCarroll).



Illus. 2.30 Wood from prehistoric burnt mounds on the N5/N59 project (based on samples $n = 454$) (Ellen OCarroll).

local landscape dynamics. Alder (*Alnus* spp.), hazel (*Corylus avellana*), ash (*Fraxinus excelsior*) and oak (*Quercus* spp.) are the most common species identified in the N5/N59 charcoal assemblage, with alder, hazel and oak most common among the preserved wood samples (Illus. 2.29 and Illus. 2.30). Smaller amounts of pomaceous fruitwood (Maloideae), blackthorn/cherry (*Prunus* spp.), holly (*Ilex aquifolium*), yew (*Taxus baccata*),

elm (*Ulmus* spp.), willow (*Salix* spp.), birch (*Betula* spp.) and pine (*Pinus sylvestris*) were also identified. The pomaceous fruitwoods are a sub-family of the Rosaceae family of trees and include crab apple, wild pear, rowan/whitebeam and hawthorn. The levels of all of the tree species represented in the assemblage varied as the local landscape changed over time and this is most notable in relation to ash, oak and hazel.

Late Neolithic period (2900–2500 BC)

Knowledge of Neolithic farming practices, which reached Ireland about 3900 BC, began a process of landscape transformation with a far greater effect on the local environment than the preceding Mesolithic period. Large monuments such as megalithic tombs were constructed, sedentary farm settlements were established, and the evidence of pollen records shows that woodlands were cleared for pasture and tillage (Pilcher & Hall 2001; Verrill & Tipping 2010). This landnam or woodland clearance phase, which occurred in the Early Neolithic, lasted for approximately 300–500 years but did not occur simultaneously across all of Ireland (Hall 2011, 75). From pollen records, the later Neolithic is seen to be a period when farming activity was less intensive and woodland regenerated, and this national trend is reflected also in pollen cores analysed from the north Mayo region (O’Connell & Molloy 2001).

Forty-seven charcoal fragments and three unworked wood fragments were identified from the Late Neolithic site at Knockbrack 3. Alder, hazel and oak¹ were identified, including the three unworked alder roundwood pieces found in the base of the trough. From these remains we can infer that the local environment included a variety of habitats, with the alder probably sourced locally while the hazel and oak could have originated from larger woodlands and scrubland areas.

Chalcolithic period (2500–2200 BC)

Charcoal and wood species were analysed from two burnt mounds, at Doogary 1 and

Knockbrack 1, dated to the Chalcolithic period. In contrast to the Late Neolithic site at Knockbrack 3, ash wood was present at these Chalcolithic sites and was evidently being used as kindling. Charcoal from the two sites also included hazel, alder and oak, which compares well to the Neolithic site. Structural wood identified from the trough at Knockbrack 1 included a lower layer of one split alder plank and seven roundwoods, including two hazel, one oak and one pomaceous fruitwood, an upper layer of six alder roundwoods, and three hazel stakes in the base.

Early Bronze Age (2200–1600 BC)

Bronze Age sites, of various kinds (e.g. settlements, burials, burnt mounds) are the most numerous archaeological discoveries made in advance of large-scale infrastructure developments across Ireland, such as new national roads and gas pipelines (Grogan et al. 2007; Cleary 2015; Johnston & Kiely 2019; Walsh 2021a). The large number of Bronze Age sites identified on these projects indicates a well populated landscape, particularly during the Middle Bronze Age (Spillane, below). Temperatures appear to have fluctuated at this time, being approximately 2–3° C lower than today (Hall 2011, 65). This would have affected farming practices and everyday life. Changes in climate and population pressure may have resulted in building new routeways (toghers or wooden trackways) into marginal areas such as bogs and more intensive habitation in drier, lowland areas. Woodland clearances that began in the Neolithic accelerated during the Bronze Age and were extensive across much of Ireland. Where woodlands

¹ Tree species are listed throughout in order of their relative abundance by fragment count in the samples that were analysed.

regenerated, the species and age range of the trees was altered, forever changing the composition of native woodlands (ibid., 90). This is apparent in the burnt mound data from the N5/N59 project, where ash wood became increasingly abundant as the Bronze Age progressed.

Charcoal and wood species were recorded from 14 sites with Early Bronze Age activity, although the samples analysed from Claggarnagh West 3 fell within the Middle Bronze Age phase of activity at that site (Table 2.3). In the charcoal samples from the remaining 13 sites we see a greater range of species used as fuelwood. This may reflect the greater number of burnt mounds in this period, as well as an opening up of the woodlands through population pressure and a demand for more woodland resources. The mix of species identified includes alder, hazel, ash, oak, willow, birch, pomaceous fruitwood, holly, blackthorn/cherry, pine and yew. Similarly, the wood used in trough construction at this time is more varied, although alder and hazel are still dominant (Illus. 2.30). These results are in keeping with charcoal analyses from other burnt mounds across Ireland, where a range of different wood species is identified depending on what was locally available (O'Carroll 2010a). The wood and charcoal identifications from burnt mounds excavated on the N5 Charlestown Bypass, for example, suggest a similar landscape and woodland use in the Early Bronze Age as seen in the evidence from the N5/N59 project. Alder, oak, hazel and ash dominated the charcoal assemblage, while hazel, alder, oak, ash and holly were more common among the preserved wood samples (O'Carroll 2010b).

Middle Bronze Age (1600–1100 BC)

Eleven wood species were identified from 13 sites with activity dated to the Middle Bronze Age (Deerpark East 1 had a Middle Bronze Age phase also but was already included above under the Early Bronze Age). The dominant trees were ash, hazel and alder (Table 2.3). These main woodland species are similar to those from the Chalcolithic and Early Bronze Age sites, while ash was absent from the Neolithic assemblage. The other trees identified from the Middle Bronze Age sites were oak, willow, elm, holly, pomaceous fruitwood, birch, pine and yew. The frequency of hazel and alder compares well with other large Middle Bronze Age datasets (e.g. O'Donnell 2007; Geber et al. 2009). Ash does appear to be more dominant in this part of Mayo, however, when compared to other regions of Ireland. Hazel was more common at burnt mounds in the midlands (Offaly and Westmeath on the N6 Kilbeggan–Athlone road project), for example, and across Co. Meath (on the M3 Navan to Kells and N52 Kells Bypass road projects) (O'Carroll 2010a; O'Donnell et al. 2021), while in the east and south of Ireland (Kilkenny on the N52 Waterford Bypass road project; Tipperary and Cork on the N8 Cashel to Mitchelstown road project) oak was dominant (Austin 2007; O'Donnell 2011).

Throughout the Bronze Age, alder, hazel and ash remain the most important wood species used in burnt mounds on the N5/N59 project, with a significant increase in ash as the Bronze Age progressed. As mentioned, this probably reflects human population increase and the growth of secondary woodland in clear-felled areas. Ash trees flourish in natural light and will not grow in closed canopy woodlands. This indicates that much of the woodland in this area of

Mayo was relatively open from the Early Bronze Age onwards. During the Early and Middle Bronze Age, the level of pomaceous fruitwood also increases. Like ash, this group of trees prefers open clearings where light is plentiful. The levels for oak decrease only slightly at this time and this too indicates an opening up of the forest canopy. Evidence from excavations on the N5 Charlestown Bypass also suggested that the percentage of ash used as kindling and in the construction of troughs increased in the Middle Bronze Age (O'Carroll 2010b). Overall, it seems that land throughout Mayo was being clear-felled for an ever-expanding population during the Bronze Age.

Late Bronze Age (1100–800 BC)

Two burnt mound sites on the N5/N59 project, at Aghadrinagh 4 and Carrownaclea 1, were dated to the Late Bronze Age (Claggarnagh East 4/5 was counted above under Middle Bronze Age although some Late Bronze Age activity was also recorded). By this time, the occurrence of oak increases to represent nearly 40% of the overall charcoal fragment counts. In contrast, the values for hazel and ash are reduced.

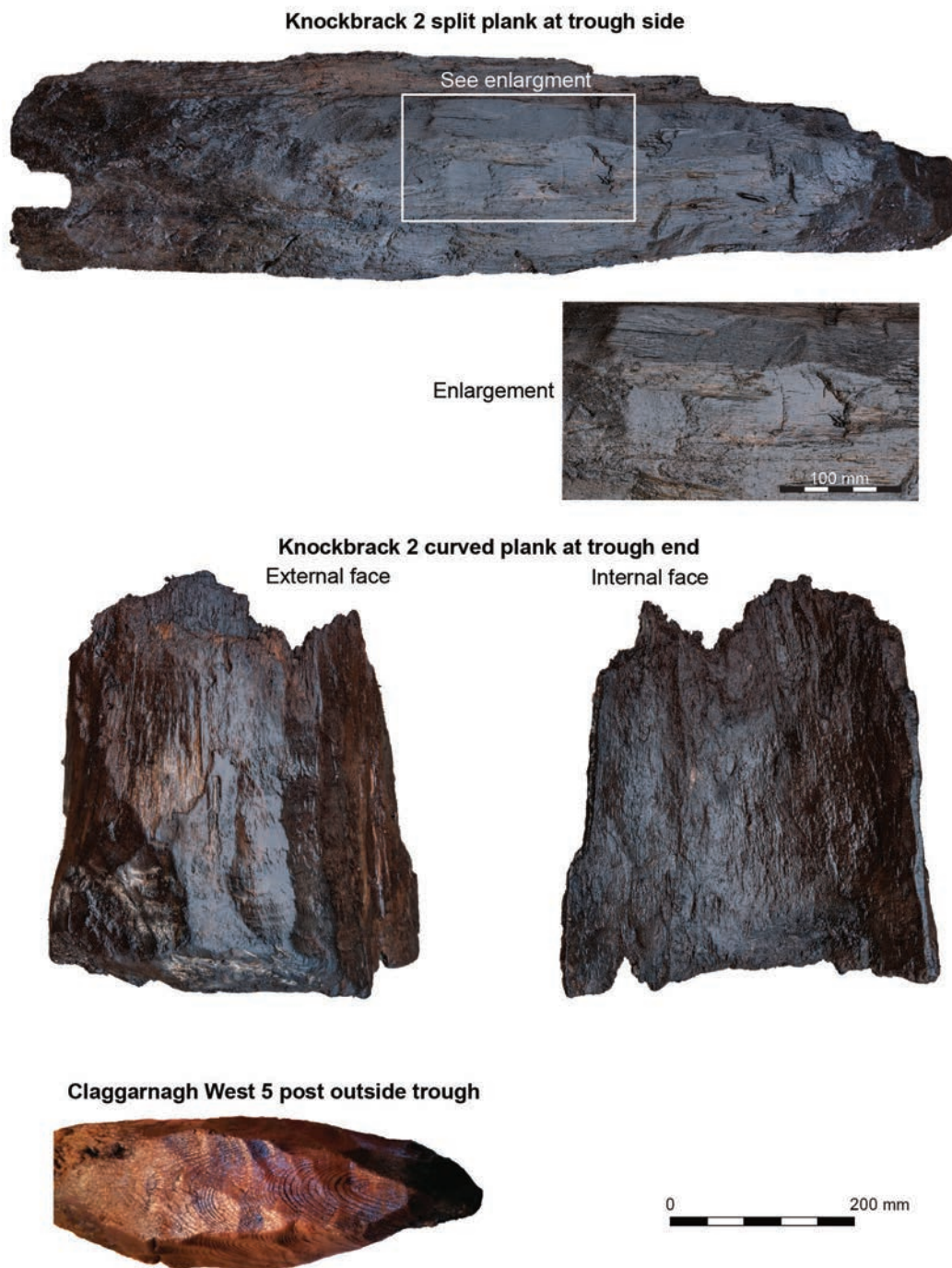
Wood-working

Evidence for wood-working techniques was preserved on some of the wood recovered from 10 burnt mounds on the N5/N59 project, largely from the preserved wooden linings of the troughs. The timbers were irregularly split, three-quarter split, half split, radially split and tangentially split. This would have been done using wedges and mallets, whereby half split timbers were produced first, followed by either radial or tangential splits. Stakes and posts were

pointed to chisel (one side worked), wedge (two sides worked) and pencil (point fully shaped) ends, which are the three main categories of points. The facets on many of the wood samples, as well as the junctions between them, were strongly diagnostic of the tools used to shape the timbers and indicate the use of small, flanged axes and larger adzes.

A hazel stake in the trough at Knockbrack 1, for example, had one small facet measuring 20 mm wide and 15 mm long, which was flat to slightly concave and also torn. This site was dated to the Chalcolithic period. Early Bronze Age facets were also flat and concave. The facet size-ranges at the Early Bronze Age site of Knockbrack 2, for example, indicated blade widths of between 20 mm and 81 mm and the maximum facet length recorded was 62 mm. The wider facets would have been made with an adze as opposed to an axe. A partial jam curve (i.e. the imprint of the blade width), which measured 38 mm in diameter, was recorded on a piece of alder wood recovered from the fill of the trough. This wood-working evidence suggests that an early version of a flanged axe may have been used at this site to prepare wood for the trough lining. Surface dressing was also present on two tangentially split oak planks lining the long sides of this rectangular trough. Multiple concave facets were also evident on the oak planks, indicating the use of a wide-bladed adze (81 mm in width) on the larger planks (Illus. 2.31, top) and a smaller blade (22 mm in width) on the smaller planks (Illus. 2.31, middle).

Wood-working evidence from a Middle Bronze Age burnt mound at Knockbrack 4 indicated a minimum blade width of between 20 mm and 33 mm. A smaller-bladed, flanged axe may have been used here. Similar-sized toolmarks were also noted at the Early



Illus. 2.31 Knockbrack 2 and Claggarnagh West 5. Wood-working evidence. Top: preserved adze facets on large plank. Middle: smaller blade facets on smaller plank (Ian Russell). Bottom: smaller blade facets on post (Ellen OCarroll).



Illus. 2.32 Bronze flanged axehead from Ballynatona, Co. Cork (NMI 1936:1780) (length 137 mm) (National Museum of Ireland).



Illus. 2.33 Bronze palstave axehead from Co. Clare (RIA 1881:161) (length 160 mm) (National Museum of Ireland).

Bronze Age site of Drummindoo 4, on an alder plank/roundwood timber lining the base of a rectangular trough. Comparable toolmarks were present on an ash post from a likely tripod structure adjacent to the trough at the Middle Bronze Age site of Claggarnagh West 5 (Illus. 2.31, bottom).

The axes used at these sites may have been similar to those of the Middle Bronze Age Killymaddy and Bishopsland metal-working phases, which include small, flanged examples with quite straight cutting edges, such as those from Kilnarnagh, Co. Sligo (Harbison 1969; Waddell 2000, 186). The flanged axe was introduced at the end of the Early Bronze Age and represents an attempt to improve the hafting mechanism of the axehead by creating a longitudinal flange combined with a latitudinal ridge that prevented the axehead from moving around on the haft (Illus. 2.32; Mount 2011).

Two possible saw marks were also observed partly cut across a large plank from the base of the trough at Claggarnagh East 4/5 (details below). There were also jam curves (70 mm in diameter) present on this timber, indicating the use of a wide-edged adze or axe in the Middle–Late Bronze Age. Similar possible saw marks were recorded at Claggarnagh West 5.

At Claggarnagh West 2, which was another Middle Bronze Age burnt mound, measurements of the facet sizes on a piece of alder wood, possibly displaced from a nearby rectangular trough, indicated a maximum width of 42 mm and a maximum length of 30 mm. The axe blade was rounded, suggesting a palstave or similar tool was used. The palstave was a development on the flanged axe, whereby the axehead was hafted using side flanges fused to the stop ridge, to grip the haft above the blade (Waddell 2000, 187). This piece of wood also had one

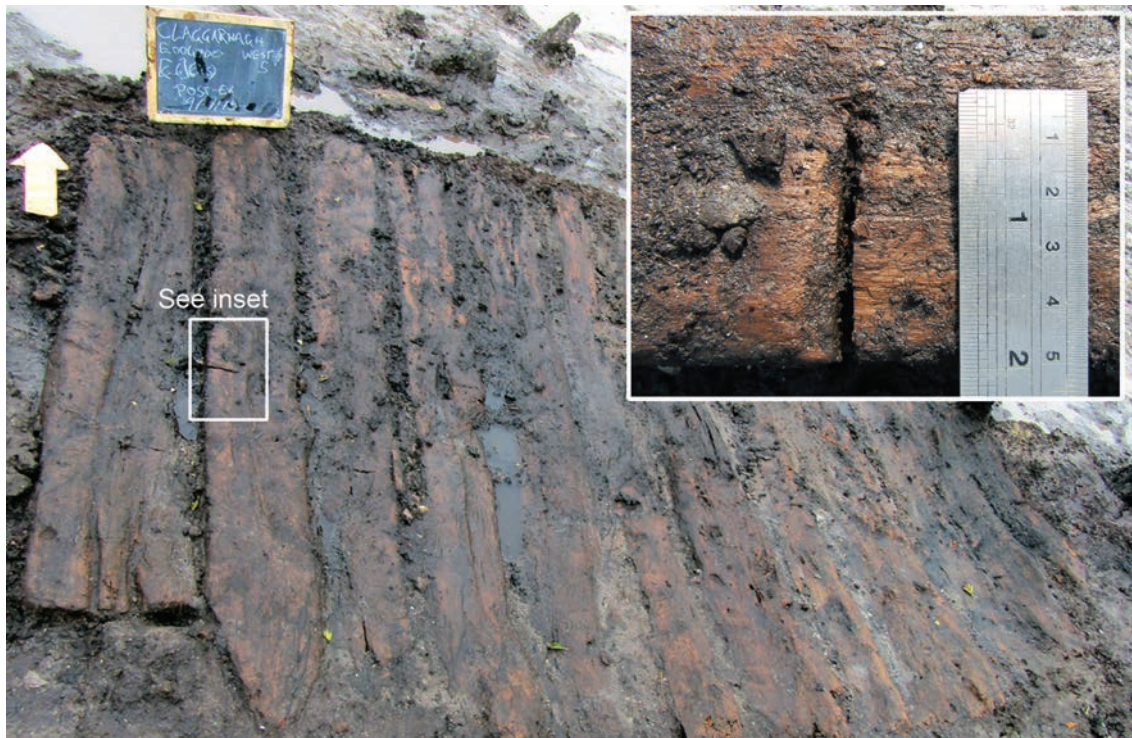
wide, flat, facet junction, measuring 41 mm in diameter, suggesting that a variety of axe types were used depending on the task being undertaken. Middle Bronze Age tool technology may have still been evolving from the wider flat axe to the smaller and more rounded palstave (Illus. 2.33).

Claggarnagh East 4/5 was the only burnt mound that had a wood-lined trough of likely Late Bronze Age date. This represented the relining of the slightly earlier, rectangular trough mentioned above. This relined base comprised seven planks, one of ash, five of alder and one indeterminate to species, none of which preserved any wood-working evidence.

No metal or stone axeheads were found at the burnt mound sites on the N5/N59 project. Chert scrapers, which could have been used to remove small amounts of wood and smooth a surface, were recovered from Claggarnagh East 4/5 and Deerpark East 4, but not in direct association with the burnt mounds. Indeed, few definite wood chopping tools have been recovered from burnt mound sites across Ireland, with bronze axeheads recorded at Ballynakelly, Co. Dublin, Camlin, Co. Tipperary, Ballynapark, Co. Wicklow and Ballynatona, Co. Cork, and polished stone axeheads at several more sites, including Clowanstown, Co. Meath and Aghnahunshin, Co. Leitrim (Hawkes 2018, 116–7, 129). The work of cutting and shaping is therefore best represented through the various jam curves, facets and marks that remain on the surviving wood.

Prehistoric saw marks?

In addition to the various wood-working techniques used for splitting timber and creating faceted points, mentioned above, two Middle–Late Bronze Age burnt mound



Illus. 2.34 Claggarnagh West 5. Possible saw mark on *in situ* plank lining in the base of a trough and detail recorded after lifting the planks (inset) (ACSU Ltd).

sites also yielded potential evidence for the use of saws. The possible saw marks were on alder planks lining the bases of rectangular troughs. They did not have any obvious purpose and, at both sites, appeared to have been no more than trial cuttings, as they did not cut through the full thickness of the wood. It is possible that the people who built the troughs were trialling the use of small saws, which were not big enough or robust enough to cut through large alder timbers.

At Claggarnagh East 4/5, the first phase of the trough comprised a base lining that survived as eight planks: five alder, two oak and one ash. The centrally positioned alder plank, which contained the potential saw marks, was the widest and longest plank. A sample from this plank returned a date of 1258–1020 BC (Poz-99288). The saw marks comprised two narrow, straight cuts across

the timber on opposite sides of the plank, one substantially longer than the other (below, Illus. 2.36). They appeared to be only partly finished as they did not meet in the middle or cut through the full thickness of the timber. The two cuts measured 100 mm long by 7 mm wide and 240 mm long by 16 mm wide. There were also faint curved jam curves present on the upper side of this alder plank, measuring 70 mm in diameter, but the type of chopping tool used to form them could not be determined.

At Claggarnagh West 5, the base of the trough was lined with 11 split planks, all of alder. The first two planks at the north-west end of the trough had possible saw marks and a sample from one of these planks returned a date of 1397–1128 BC (Poz-97697). Each plank had a single cut, measuring 210 mm long by 10–30 mm wide (zig-zag in profile)

and 50 mm long by 10 mm wide (Illus. 2.34).

These cuts on wood from Claggarnagh East 4/5 and Claggarnagh West 5 represent the earliest potential saw marks recorded on excavated timbers from Ireland. Small saws from Ireland and Britain, dated to the later Bronze Age (13th/12th century BC), give glimpses of the sorts of tool that might have produced them. Three bronze fragments from Ireland were recovered as part of the Bishopsland Hoard, discovered in Co. Kildare in 1942 (Eogan 1983, 36–8). Although

heavily damaged, the fragments have been interpreted as representing a double-edge saw that measured up to 20 mm in width, with a hole in at least one end. There are several examples from Britain. A fragment of a Middle or Late Bronze Age saw from Hampshire, in England, has an old break across the blade, which is oval and pointed in cross-section and measures 14.6 mm wide by 2.2 mm thick. The opposite, surviving end, is incomplete, possibly through wear, and is flatter in cross-section, measuring 15.5 mm

Capturing the Claggarnagh East 4/5 saw marks

Ken Williams



Illus. 2.35 Bronze saw from Priory Farm Cave, Pembrokeshire, Wales (Amgueddfa Cymru/National Museums Wales).

Reflectance Transformation Imaging (RTI) is a low-cost, high-resolution method for capturing, reproducing and visually analysing the texture and details of an object or surface. Objects captured using RTI can be viewed in specialist software under a variable and user-controlled ‘virtual’ light. This makes it possible to replicate on screen what can be seen while examining the physical object with oblique lighting, like a hand-held torch. High-resolution cameras allow the surface to be magnified, facilitating the close inspection of fine details. Additionally, objects captured using RTI can be visualised using different surface renders to reveal solid faces under monochromatic or false-colour textures. These are very useful in revealing details on discoloured and obscured surfaces, for example, on lichen-encrusted objects.

Compared to three-dimensional (3D) techniques like laser scanning or photogrammetry, RTI is less demanding on processing time and computer hardware, yet is particularly effective for rendering fine detail, such as incised carvings on stone (Williams 2022, 722). Since the recording process is fundamentally two-dimensional, however, each plane of an object with complex geometry may need to be recorded separately.

RTI recording of a surface involves taking many photographs with both the camera and subject in fixed positions. A single light source is placed at varying angles for each image. Unlike methods for 3D recording, RTI records a 3D object in two dimensions under varying lighting conditions, being most effective under low ambient lighting or screens. Software processing using dedicated RTIBuilder software creates a mathematical model of the light reflection or shadow for each individual pixel under every recorded lighting angle. A 3D object

wide by 1.3 mm thick. A copper-alloy saw from Priory Farm Cave in Pembrokeshire, in Wales, is irregularly toothed along one edge, with a loop at one end and a hole at the other (Illus. 2.35). The blade measures 141 mm long, 17–21 mm wide and up to 1 mm thick. This example formed part of a small Middle Bronze Age hoard, alongside a chisel, palstave axehead and bracelet (Grimes 1933). Similar saws from this period are known across Europe and have been synthesised most recently by Leclercq (2013), who

suggests that the Bishopsland fragments may represent three individual saws. Given the small size of the teeth, it may be that these saws were more commonly used to cut materials such as bone, antler, lignite or amber and were not primarily made for cutting wood (*ibid.*).

Bronze Age saws are not very common. Possible saw marks are quite rare. When these planks from Claggarnagh East 4/5 and Claggarnagh West 5 were initially exposed, the cut marks were immediately visible, with

will reflect light in different directions and intensities according to the contours of the surface: it is this information that is generated for the RTI model. Dedicated RTIViewer software uses this data to reproduce a model of the subject.

An assessment by Karsten & Earl (2010) of various techniques for recording waterlogged wood, both before and after treatment, had shown positive results using RTI when compared with several other methods, including laser scanning. Previous success in using RTI to record tool marks on prehistoric wooden objects (Jones & Díaz-Guardamino 2019, 55–6, 84–5) suggested that it could be a useful technique in detailing the potential saw marks from the Claggarnagh East 4/5 trough. This was undertaken prior to the wood undergoing the final stage of conservation (freeze drying). The wood had been stored in water for some time and then in a pre-conservation solution, meaning that it was wet when RTI was applied. Although the resulting wet surface conditions were less than favourable, a detailed photographic record was completed (Illus. 2.36). This highlighted the presence of faint lines or ridges along the proposed cutting edge but did not confirm whether the tool marks were from a saw or another implement, such as an adze or axe (Ellen OCarroll pers. comm.). Regardless, it illustrates the potential of applying RTI to archaeological material, including worked wood that may have evidence of cut marks, sanding and carving.



Illus. 2.36 Claggarnagh East 4/5. Possible saw marks on the *in situ* plank lining in the base of a trough (left; ACSU Ltd) and potential toolmarks/ridges on RTI generated image (right; Ken Williams).

their straightness and slightly zig-zag or serrated edges strongly suggesting the use of a saw. Following excavation, they were kept waterlogged in advance of being transferred to a conservation laboratory, by which time they had deteriorated considerably and the sharpness of the cuts was no longer retained. Accordingly, in an effort to determine if these cuts truly represent saw marks, several wood-working specialists were consulted and a novel approach to recording them was employed, using Reflectance Transformation Imaging (RTI) (Williams: text box). This method was successful in providing a very detailed photographic record of these unusual marks but did not support any definitive conclusion as to whether or not they were made by a saw in the Late Bronze Age. For now at least, the question remains, could these trough timbers represent the earliest scientifically dated evidence in Ireland for the use of metal saws on wood?

Understanding the landscape

Pollen records for this part of Mayo indicate that pine, birch and oak were the main components of the local woodland landscape in the early Holocene (c. 11,700–8,200 years ago). Woodland clearance can be seen throughout the Mesolithic and Neolithic periods but these episodes of clear-felling were never very extensive or long lasting. In contrast, the pollen records show a steady decline in arboreal (tree) pollen throughout the Bronze Age indicating large-scale clearance of the woodland landscape in this region (Coxon & Browne 1991; Hawthorne & Davis 2013). This clearance during the Bronze Age is particularly notable in the pollen sequence in a sediment core from Lough Aisling, c. 10 km north of Newport (Coxon & Browne 1991).

Analysis of the charcoal and wood samples recovered from the burnt mounds on the N5/N59 project suggests that semi-open, mixed woodlands of large canopy-forming trees, such as ash, oak and elm, were to be found alongside scrub species, such as pomaceous fruitwood (Maloideae), holly, blackthorn/cherry and hazel. As described, an increase in the use of ash wood as the Bronze Age progressed signifies clearings in woodlands. Alder and hazel remained the most frequent wood used for trough construction in all periods, demonstrating their widespread availability and suitability for this purpose. Alder can easily be split. Hazel is flexible and can produce even-sized small timbers that are easily worked into posts, stakes and ‘weavers’ for wattlework.

Both dryland and wetland resources were exploited by the people using the burnt mounds, which is a common trend for these sites located on the margins of wetland and dryland areas. Alder was the main component of the wetter woodlands, followed by willow and birch. In pollen cores from Nephin Beg, the maximum values for alder occur directly after the Elm Decline, post-3000 BC, and it remains a strong woodland component throughout the Bronze Age at Lough Aisling (Coxon & Browne 1991). This prevalence of alder may partly be as a result of peat growth in some areas (ibid.).

A wider variety of wood species, including pine and yew, was identified in samples from Early and Middle Bronze Age burnt mounds on the N5/N59 project. This is partly a reflection of the greater number of burnt mound sites and samples analysed from these periods, but also the more widespread occurrence of clearings, where extra natural light facilitated the growth of smaller trees and pioneering trees such as Maloideae, birch and ash.

In the last few decades, archaeological investigations associated with large public infrastructure developments, and also research projects, have resulted in many new charcoal and wood studies. From this evidence it is now possible to reconstruct Ireland's prehistoric woodland landscape with a high degree of confidence. In charcoal studies focused on the Bronze Age, in both Kilkenny (Austin 2007) and Tipperary/Cork (O'Donnell 2011), oak is the most frequently identified taxon from burnt mounds, followed by hazel, ash and alder. In the midlands (Offaly, Westmeath), hazel is the most common wood chosen as kindling at these burnt mound sites (O'Carroll 2010a). Charcoal results from further west, at Ross Island in Co. Kerry, show the presence of oak-yew-holly woods, indicating half-shadowed to open places and forest edges in the Chalcolithic and Bronze Age (van Rijn 2004). Charcoal patterns from the present N5/N59 project demonstrate a somewhat distinct pattern, whereby alder was more commonly selected initially, along with hazel and oak, but during the Middle Bronze Age ash was most frequently chosen. Woodland composition therefore varied to some extent across different areas and regions of Ireland in prehistory, in turn influencing local choices in timber selection for fuel. In comparison, the wood chosen to line troughs and construct dry platforms at burnt mound sites across Ireland follow similar patterns, based on the properties of specific wood types. Alder and oak were typically used for planks, while hazel and ash were preferred for wattle and stakes. Other wood taxa were used opportunistically, when the preferred wood species were unavailable or resourcing them was less convenient, particularly for stakes and platforms.

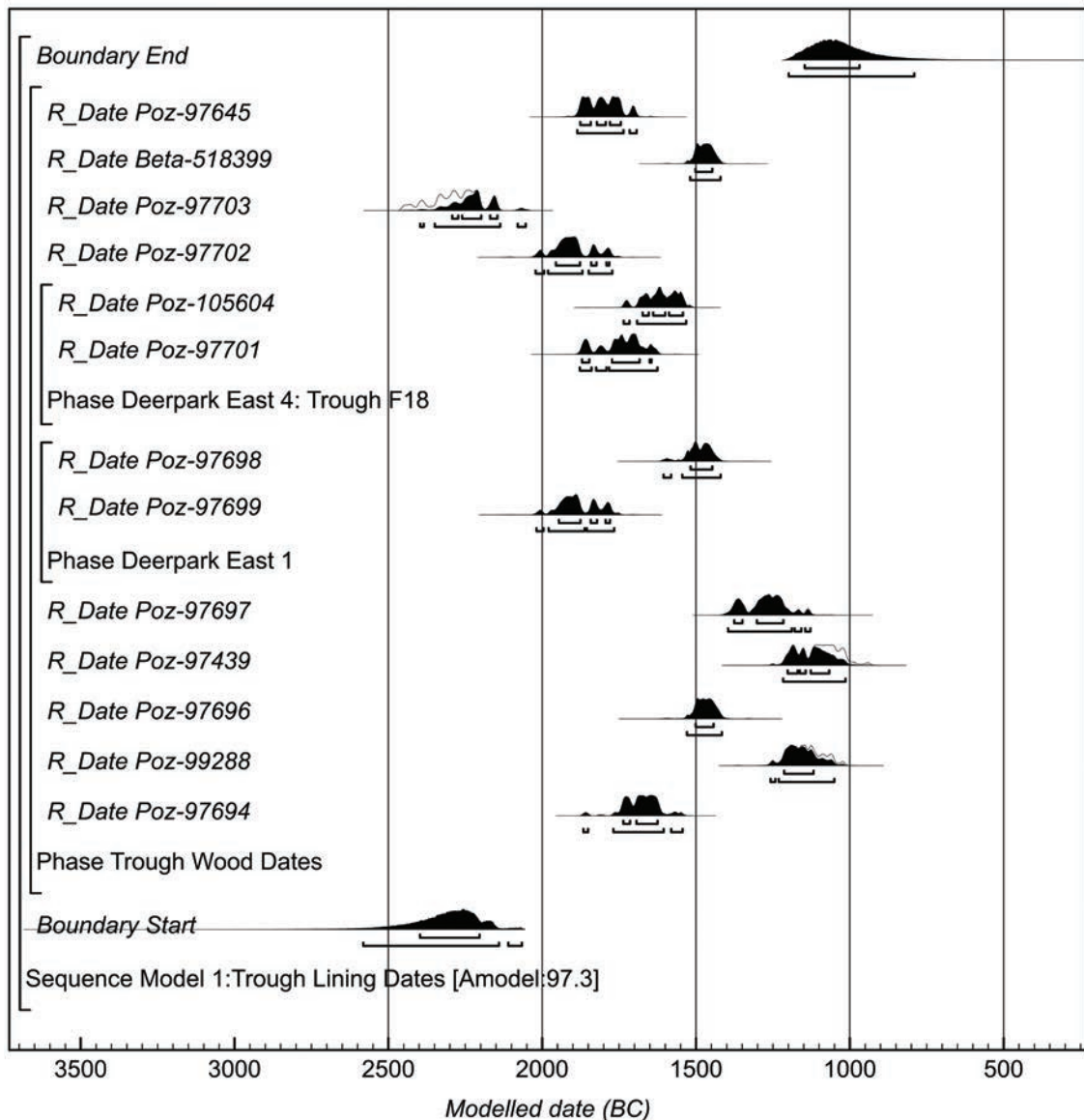
Bayesian analysis of burnt mound radiocarbon dates

Ben Spillane

One benefit of the large number of archaeological investigations carried out over the past 30 years, many of them in advance of road projects, is the corresponding increase in the number of scientific dates from excavated sites. This has facilitated a significant improvement in our understanding of Irish prehistoric and early historic chronologies. Archaeologists are primarily interested in the dates of events represented by the samples they select, such as the beginning and end of activity at an individual site or the duration of human activity across a given landscape or study area. However, relying on individual dates, or small numbers of dates, sometimes of uncertain stratigraphic security, has prompted archaeologists to look to new ways of interrogating their radiocarbon results. Bayesian chronological modelling has therefore become an important tool. It provides an interpretative framework in which radiocarbon dating information can be incorporated with existing archaeological knowledge (e.g. stratigraphic sequences, artefact typologies or site classifications) to provide empirically based estimates for specific events, some of which could not have been dated directly by scientific methods.

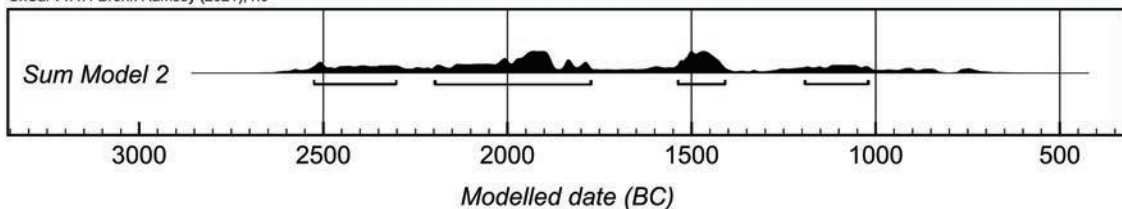
The results of a Bayesian methodology applied to 67 radiocarbon dates derived from 36 of the 40 burnt mounds excavated on the N5/N59 project are summarised here, with the details of the method, the radiocarbon dates analysed, and the importance of sample quality and security described in Appendix 3. Two models were constructed for this analysis, based on two principal questions: 1) When did the construction of burnt mounds

OxCal v4.4.4 Bronk Ramsey (2021); r:5 Atmospheric data from Reimer et al (2020)



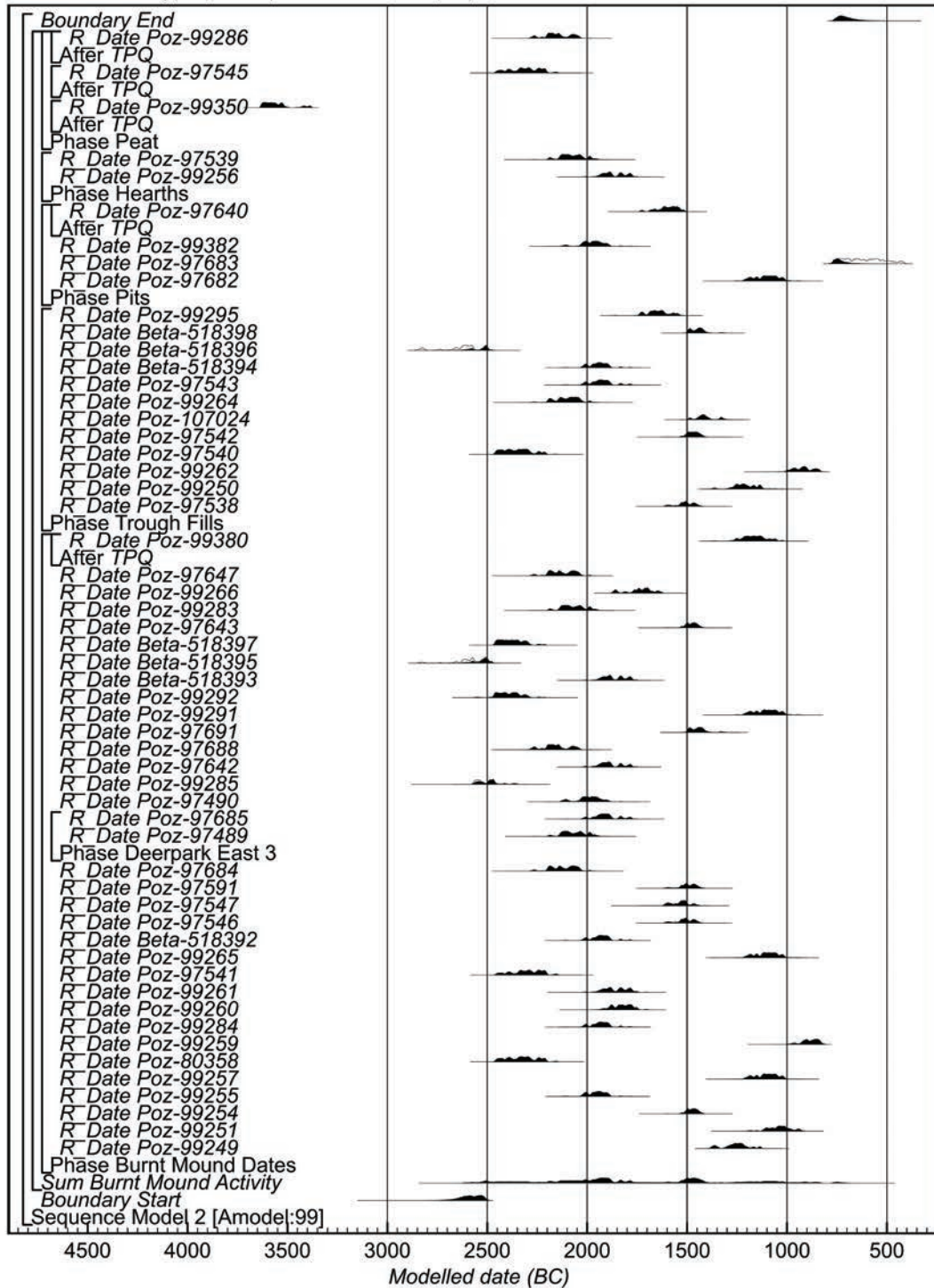
Illus. 2.37 Model 1: Chronological model of wood-lined troughs. Sub-phases within the model illustrate multiple dates derived from the same site, i.e. Deerpark East 1 and 4 (Ben Spillane).

OxCal v4.4.4 Bronk Ramsey (2021); r:5

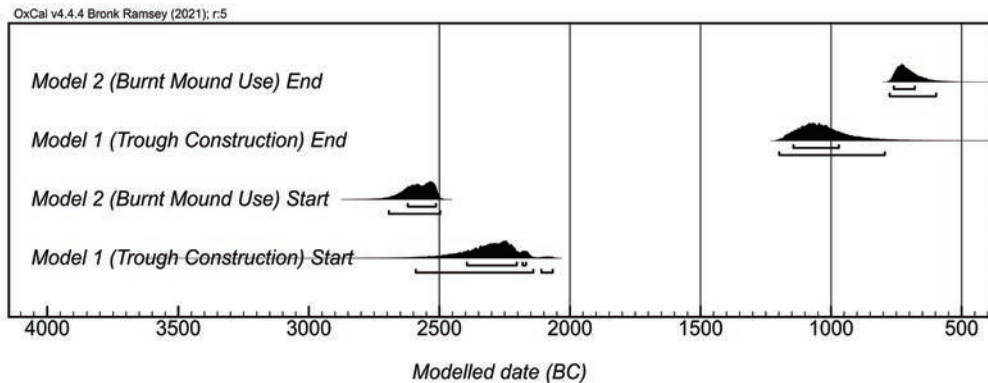


Illus. 2.38 Summed probability of the posterior density estimates derived from Model 2 (Ben Spillane).

OxCal v4.4.4 Bronk Ramsey (2021); r:5 Atmospheric data from Reimer et al (2020)



Illus. 2.39 Model 2: Chronological model of dates representing burnt mound use over time (Ben Spillane).



Illus. 2.40 *Posterior Density Estimates for the start and end of activity generated from Models 1 and 2 (Ben Spillane).*

in the areas excavated on the N5/N59 project start and end? 2) Over the course of burnt mound use, was the activity associated with these sites carried out consistently, or did it vary over time?

Model 1

This model included 13 dates derived from waterlogged trough linings, which can be used as a proxy for trough construction and therefore provide an estimate for the use of wood-lined troughs (albeit with the caveat that some may represent phases of relining that was not archaeologically visible, see Appendix 3). The model shows good overall agreement between the dates and the assumption that they were derived from a uniform phase of material, with an *Amodel* value of 97.3% (Illus. 2.37). The model estimates that these wood-lined troughs began at some time in the years 2590–2060 *cal BC*² (95.4% probability), probably in 2400–2200 *cal BC* (68.3% probability). The wood-lined troughs ended in 1200–790 *cal BC* (95.4% probability), probably in 1150–970 *cal BC* (68.3% probability). The span of dated activity associated with these

troughs covered 940–1300 years (95.4% probability), probably 1030–1200 years (68.3% probability).

Model 2

This model included 54 dates that were derived from contexts reflecting the use of burnt mounds across the N5/N59 project over time (i.e. charcoal from 36 sites, reflecting the accumulation of burnt mound material from stone-heating activity). The model shows good overall agreement between the dates and the assumption that they were derived from a uniform phase of material, with an *Amodel* value of 97.7% (Illus. 2.39). The model estimates that activity associated with burnt mounds began in 2690–2490 *cal BC* (95.4% probability), probably in 2620–2510 *cal BC* (68.3% probability). The activity ended in 780–590 *cal BC* (95.4% probability), probably in 760–680 *cal BC* (68.3% probability). A summed probability distribution (Appendix 3) of the modelled probabilities, however, shows that the dated activity associated with burnt mounds along the N5/N59 project was not consistent over time, but subject

² Any posterior density estimate produced by the model is expressed in *italics*, in order to differentiate it from non-modelled radiocarbon dates or other chronological measurements.

to significant fluctuation (Illus. 2.38). There are minor pulses in the distribution visible from 2550 BC to 2300 BC. The bulk of the dates are derived from three periods, the first from 2200 BC to 1750 BC, the second from 1550 BC to 1400 BC and the third, a less pronounced pulse, from 1200 BC to 1000 BC, followed by very minor fluctuations until the burnt mound activity ends altogether. Very few dates are derived from the points in between these pulses, suggesting that far less activity occurred at burnt mound sites along the N5/N59 project during those times.

Order of events

An interesting result from the two models was that the use of burnt mounds appears to have begun earlier and lasted longer than the wood-lined troughs. This can be demonstrated empirically by using an Order function in OxCal, which builds up a matrix of the relative order of the modelled chronological estimates from Models 1 and 2 (Table 2.4; Illus. 2.40).

The results of the Order function demonstrate that hot-stone activity had commenced in the landscape of the road project before the start of wood-lined trough

construction, and very likely continued after these troughs were built and lined. There are several possible explanations for this. One possibility is that hot-stone technology was employed for various purposes that did not include water-boiling in wood-lined troughs, such as roasting or steaming in small, shallow, unlined pits (Hawkes 2014a, 106). The earlier start date of hot-stone activity may therefore reflect a more general adoption of the practice, while the later start date from the wood-lined troughs could represent the beginning of the water-boiling tradition. Another possibility is that the surviving trough linings represent replacements for earlier troughs, which could have been lined or unlined. It was common that communities would return to burnt mounds, sometimes long after the site was established, and either reuse old troughs, repair them or replace them outright (Hawkes, below). The troughs represented in Model 1 therefore reflect the latest constructions/linings, before these troughs were abandoned.

Alternatively, it could be that the earlier start for the hot-stone technology relates to the nature of the fuelwood used. Brown et al. (2016, 285) demonstrated that Irish burnt mounds tended to be built in landscapes

Table 2.4—Percentage probabilities of the relative order of the start and end posteriors from Models 1 and 2. This is expressed as the probability of the ‘event’ in the left-hand column occurring prior to the ‘event’ in the top row.

Probability $t_1 < t_2$				
t_1	t_2			
	Model 1 Start	Model 2 Start	Model 1 End	Model 2 End
Model 1 Start		4%	100%	100%
Model 2 Start	96%		100%	100%
Model 1 End	0%	0%		98%
Model 2 End	0%	0%	18%	

that had previously been forested and then cleared of woodland as human activity intensified. The earliest burnt mound sites in the landscape of the road project may have been built in areas that were previously woodlands, where available fuel could have included decaying wood or the wood of mature trees. The charcoal used to date the hot-stone activity could therefore be derived from trees that were considerably older than the firing events. That said, most of the charcoal samples included in Model 2 were from short-lived wood species, and so this may not be the most likely explanation for the earlier start date for the burnt mounds.

The apparent cessation of wood-lined troughs before the end of hot-stone activity could indicate that people continued to use these sites in the Late Bronze Age or Early Iron Age without altering the existing troughs or building new ones. Alternatively, it could mean that water-boiling was abandoned at the end of the Bronze Age, while stone-heating continued into the Early Iron Age.

Discussion

The results of these models indicate that hot-stone activity, despite beginning in the Late Neolithic period during the early 27th to early 25th centuries BC, was primarily a Bronze Age phenomenon. The wood-lined troughs that survived on the N5/N59 project began in the 26th to 21st centuries BC and ended in the 12th to early eighth centuries BC. After wood-lined troughs ended, hot-stone activity continued until the early eighth to early sixth centuries BC, roughly corresponding to the end of the Late Bronze Age and the beginning of the Early Iron Age.

The intensity of activity derived from the summed probability in Model 2 suggests that

burnt mounds were present but in minimal use during the 27th to 24th centuries BC, roughly comparable to the Late Neolithic period. There was a significant pulse in activity during the Chalcolithic period and Early Bronze Age, during the 23rd to mid-18th centuries BC, which was followed by a period of low activity between the mid-18th to mid-16th centuries BC. During the Middle Bronze Age, between the mid-16th and 15th centuries BC, there was another significant pulse in activity, which was followed by a period of low activity from the 15th to the mid-13th centuries BC. Following this, during the Late Bronze Age, from the mid-13th to the 11th centuries BC, there was a further resurgence in activity, but not on the same scale as earlier periods. From 1000 BC until the end of the period, there was still some minor activity present, but on a much smaller scale than previously.

While the summed probability distribution generated by Model 2 provides useful information on the scale of human interaction with burnt mound sites in this area over time, it does not shed light on whether the periods of high or low activity were accompanied by increases or decreases in local populations. The spike in dated activity between the 16th and 15th centuries BC, for example, does not necessarily mean that there were more people in the area using burnt mounds at that time. It is just as likely that there was little change in the population level, but that burnt mounds were used more prolifically by the same communities during certain periods. This is not to say that there were no significant population fluctuations in this area over the course of the Bronze Age, but that the results of this analysis cannot be used to identify such trends. The results are simply chronological indicators of the periods during which more or less human

activity was occurring at these burnt mound sites. That being said, consideration of wider patterns can allow us to contextualise the chronology of burnt mound activity in the landscape of the road project and how it may relate to demographic developments in Bronze Age Ireland.

Hawkes (2014b, 232; 2018, 120) noted that hot-stone activity was particularly widespread during the Early to Middle Bronze Age throughout Ireland. This has also been observed on a regional scale, such as the high instance of Early to Middle Bronze Age burnt mounds on the N8 Cashel to Mitchelstown road project (McQuade et al. 2009, 94, 119). On the N5/N59 project, the pulse in activity seen during the Middle Bronze Age, and the subsequent lull, is reminiscent of recently established chronological trends. This period, particularly in 1700–1300 BC, saw a rise in archaeologically visible settlement activity across Ireland (Ginn & Plunkett 2020). This was followed by a ‘recessionary’ period in 1300–1100 BC, during which human activity dropped after the earlier ‘boom’, possibly as a result of population consolidation as society shifted from dispersed farmstead settlements towards more communal living (e.g. Corrstown, Co. Derry) and centralised power centres at hillforts (ibid., 48–50).

Following this, there was a further resurgence of settlement activity during the Late Bronze Age, in 1100–800/750 BC (O’Brien & O’Driscoll 2017, 340; Ginn & Plunkett 2020, 50). These patterns of occupation in the Middle and Late Bronze Age mirror the trends seen in Model 2: an intense period of activity during the Middle Bronze Age, followed by a decline in the transition to the Late Bronze Age. While there is a resurgence of activity in the Late Bronze Age, it is not to the same extent as

seen in the earlier periods. The diminished burnt mound activity in the early first millennium BC mirrors a general decrease in all forms of human activity towards the end of the Bronze Age and the beginning of the Iron Age (Ginn & Plunkett 2020, 52). Overall, the models suggest that while stone-heating and water-boiling were carried out in the landscape of the road project throughout the Chalcolithic and Bronze Age, the most intensive periods of activity were during the Early and Middle Bronze Age.

Returning, modifying and reusing: burnt mounds over time

Alan Hawkes

Burnt mounds are typically found in marginal locations with high water tables, and though usually separated from settlements, they were, nonetheless, places where people spent a lot of time. The process of boiling water with hot stones in earth-cut troughs (lined or unlined) took from three to eight hours, depending on the desired result and on variables that included the volume of water to be heated and the supply of fuel and stones (O’Kelly 1954, 115; Ó Néill 2009a, 197). Added to this was the time involved in preparing each site—from construction of a trough to collecting the required materials (Illus. 2.41). Because of this investment of time and labour, burnt mounds were more than merely functional places for occasional use. They formed part of the settled landscape of the Irish Bronze Age, where people engaged with one another on a regular basis, renewing their relationships and perhaps remembering previous gatherings at these same places.

There continues to be debate about the function of these sites. An association with cooking meat and other food is widely



Illus. 2.41 Considerable time was invested in building and using burnt mounds. This has been demonstrated through experiments, such as one at Rathbarry, Co. Cork, where it took 50 hours to line a trough with split planks, 90 minutes for the fire to burn to coals to heat the stones, and 150 minutes for a neck of mutton to cook, with hot stones rotated into the trough every 10 minutes (Hawkes & O'Driscoll 2012) (Alan Hawkes).

accepted (O'Kelly 1954, 115; Ó Drisceóil 1988, 671; Hawkes 2015, 47), though animal bones survived on only 20% of excavated sites to date (Hawkes 2018, 156). Alternative suggestions include bathing places or saunas, as well as brewing and textile processing (Barfield & Hodder 1987, 370; Quinn & Moore 2009, 43; Reilly & Brown 2012, 57). The focus of this discussion is not function, however, but the reuse of these sites over long periods and the significance this has on the social landscape of Bronze Age communities.

It is clear from the archaeological evidence that burnt mound sites were not quickly forgotten. They were remembered, revisited and reused over long time periods, sometimes extending over many generations. No doubt the siting, reuse and

clustering of burnt mounds was influenced by mundane environmental factors, such as the availability of fuel and stones, and by changing water levels. Even a long-abandoned burnt mound would have been recognised, by people who understood hot-stone water-boiling, as a signpost to the likely location of a freshwater spring, suitable for reuse (Illus. 2.42). But beyond these considerations, we must also acknowledge that prehistoric communities lived their lives with reference to the past and the traditions inherited from previous generations (Bradley 1993, 5). In this context, burnt mounds can be seen as permanent features in the social landscape, contributing to a sense of history and community, even if their use was infrequent or intermittent.

Indeed, it is possible that returning



Illus. 2.42 Two burnt mounds (KK008-183 and KK008-185) at Rathlogan, Co. Kilkenny. Even long-abandoned mounds would have been recognisable features in the landscape, resonant of previous episodes of use, and inviting reuse by later generations (Alan Hawkes).

to the same site, and reusing old troughs or constructing new ones, was one of the behaviours that legitimised a family's or a community's claim to the surrounding land and its natural resources. This might also explain some of the more unusual objects found at some sites, such as wooden musical pipes, human skull fragments, items of gold and other metalwork (Hawkes 2018, 183–6). At Coolroe, Co. Mayo, an 'iron-rich' deposit found at the centre of the trough was interpreted as fossilised organic matter, originally contained in a wooden vessel that was placed in the base of the trough after its final use (Gillespie 2021, 25). The wooden vessel did not survive but the fossilised contents retained its shape (Illus. 2.43). Such items have often been interpreted as 'closing deposits', marking the abandonment of burnt

mounds in a formal act of commemoration (Hawkes 2019, 351–2).

Burnt mound chronologies

Many burnt mounds had long use-histories, spanning hundreds of years. This aspect of burnt mound archaeology has received little attention when compared with more monumental sites, such as megalithic tombs, with similarly complex chronologies. This partly arises from the difficulty of teasing out different phases of use from the often limited stratigraphic evidence, and partly from the common perception of burnt mounds as a simple and largely homogenous site type. However, excavations in recent decades have resulted in greater numbers of sites with multiple radiocarbon dates and well-



Illus. 2.43 Coolroe, Co. Mayo. Fossilised organic contents of a wooden container placed in the centre of a trough as a 'closing deposit' (Richard F Gillespie).

preserved wooden troughs. These are two key elements in interrogating excavated burnt mounds for patterns of abandonment, reuse and modification, which, in turn, reveal sites to have been repositories of social memory and identity.

Multi-context radiocarbon dating from 36 burnt mound sites on the N5/N59 project, refined by Bayesian modelling (Spillane, above and Appendix 3), attest to their use throughout the Bronze Age, with the most intensive activity in the Early and Middle Bronze Age. The dating evidence is complex and varied, however. It is difficult to differentiate a phase of reuse after shorter periods of inactivity, such as a year, a decade or even a century. But, overall, we can say with confidence that some of the burnt mounds discovered on the N5/N59 project

saw only short periods of activity, others were used intermittently over longer periods, and some were modified and reused after very long periods of abandonment.

Dating evidence from stratified mounds and troughs

Burnt mounds accumulated over long periods of time from dumps of heat-shattered stone and fire debris. Site chronologies can sometimes be established by identifying these individual dumps in the mounds and sampling them for scientific dating. Cahircalla Beg, Co. Clare, provides a good example. Here, three phases

of activity were defined using radiocarbon-dated charcoal derived from distinct deposits in a mound estimated to comprise 400 tonnes of burnt stone (Bermingham et al. 2012, 31–5). The site was first used in the Chalcolithic period, with further water-boiling events in the Middle and Late Bronze Age.

Sites like Cahircalla Beg are the exception, however, because large, well-preserved mounds are seldom excavated. Mostly, burnt mounds are investigated in pre-development contexts, where they are discovered as levelled and sometimes dispersed spreads of burnt sediment. In these circumstances, recording and sampling the original stratigraphy of the mounds is seldom possible. Even in well-preserved examples, the tip-lines representing individual

dumps of waste material cannot always be recognised. Also, because burnt mounds are typically porous and coarse-textured, they can be subject to the internal movement of charcoal and other burnt residues (unless they are sealed by redeposited clays or alluvial silts), which makes sampling the stratigraphic profile for dating purposes doubly challenging.

On the N5/N59 project there were only limited opportunities for multiple dates from stratified mound material. At Deerpark East 3, Knockbrack 4 and Sheean 3, individual layers of burnt mound material were sealed, variously, by bands of marl, peat and upcast clay-silt, but none of the mounds at these sites was deeply stratified to a degree that permitted dates to be obtained from a series of mound deposits. At other sites, where dates were acquired from both the mound material and where it filled a trough, such as Aghadrinagh 3, Claggarnagh West 1 and Knockbrack 3, the radiocarbon dates were broadly in agreement. Elsewhere, where two or more dates were obtained from different contexts (variously mounds, trough linings and a fire), including Attireesh 1, Claggarnagh West 2 and Drummindoo 4, the radiocarbon dates for each site were also broadly in agreement.

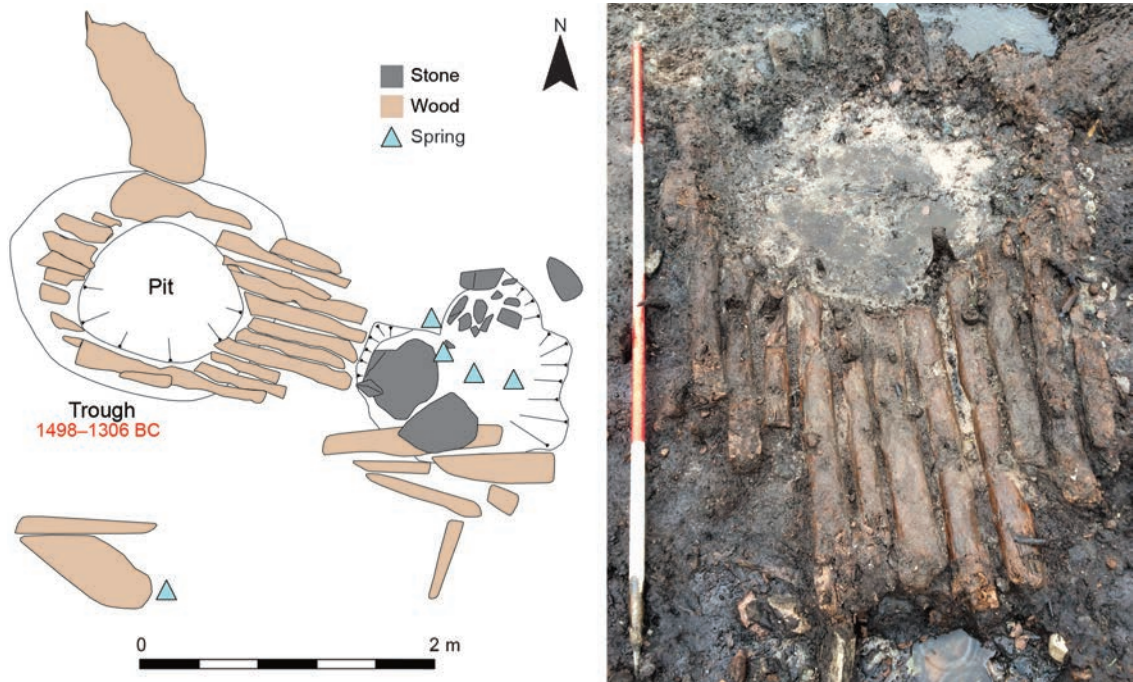
At other N5/N59 sites, there were obvious disparities in the dating. At Claggarnagh West 3, for instance, the trough lining was dated to the Late Bronze Age though the trough fill produced an earlier date, in the Early Bronze Age. At Claggarnagh West 5, the mound and trough lining produced Middle Bronze Age dates, but a sample from a mixed peat and burnt stone deposit on the site was dated to the Chalcolithic period. At Knockbrack 4, a Chalcolithic date from the burnt mound was at odds with two Middle Bronze Age dates obtained from the trough

(fill and lining). These various anomalous dates probably result from intrusive charcoal (i.e. charcoal from some earlier or later events) incorporated in the dating samples, or charcoal from old wood, which was either growing nearby or preserved in the surrounding peat, and used as fuel.

Trough replacement

Reuse of a burnt mound site is most clearly evident where an earlier trough was recut and relined, or where a new trough replaced the original one. The new troughs were often superimposed on the earlier troughs and could be of different type and size. Also, in some cases, there is evidence of timber-lined troughs having been modified for reuse after a long period of inactivity.

On the N5/N59 project, a disused wooden trough at Claggarnagh West 2 was cut by a smaller, circular pit, possibly to reach down to the water table or clay marl (Illus. 2.44). At Deerpark East 1, the mound overlay two wood-lined troughs, one superimposed directly on the other (Illus. 2.45). The earlier oval trough was made with wattlework and a moss lining. The later rectangular trough had a base lined with roundwoods and planks. The different shape and construction style of the two troughs is notable and radiocarbon dates (Appendix 1) indicate an interval of potentially up to 600 years between them, from the Early to the Middle Bronze Age. At Claggarnagh East 4/5 there were also two superimposed troughs but, in this case, they both had plank linings. The associated radiocarbon dates, in the Middle to Late Bronze Age, were not so widely separated (Appendix 1), but a deposit of clay-silt over burnt sediment in the lower trough confirms that it was abandoned for some length of time, however short this might have been.



Illus. 2.44 Claggarnagh West 2. A pit was cut through the original wood-lined base of the trough to access the water table or clay marl (ACSU Ltd).

These three N5/N59 sites can be added to an existing number of timber-lined troughs with evidence of reuse and replacement after periods of abandonment. They include Cahiracon, Co. Clare (Grogan et al. 2007, 185–7), Derryfadda, Co. Tipperary (Cross-May et al. 2005, 243–4), Gortaroe I (Area 3), Co. Mayo (Gillespie 2007, 75), Killeens, Co. Cork (O’Kelly 1954), Lisdornan 3, Co. Meath (Russell & Corcoran 2001), Moneycross Upper 7, Co. Wexford (Stevens 2010a), Perssepark, Co. Galway (Grogan et al. 2007, 231) and Ratalen 1, Co. Roscommon (Delaney & Coughlan 2014). The common thread among all these examples is that, although new troughs were superimposed on earlier ones, elements of the primary troughs were retained, in many cases the basal timbers.

For completeness, we should also note some examples where secondary

modifications corresponded with a change of function. At Cahiracon, Co. Clare, an earlier water-boiling trough was replaced by a stone-lined roasting oven (Grogan et al. 2007, 190–1). A similar change of use was recorded at Ballinaspig More 7, Co. Cork, where the trough was recut three times, with the final phase associated with either steam-bathing or dry-roasting (Danaher 2013a, 116).

Is it possible that inserting a new trough over an earlier one, within a burnt mound that had been unused or abandoned for a time, was a deliberate act with ritual intent? People in the past did not always make strict divisions between ritual acts and the tasks they performed in everyday life. From birth to death, doing things the ‘proper way’, to secure good outcomes, would have been deeply ingrained in all aspects of their lives (Bradley 2003, 20). In this context, we may ask whether one intention of trough



Illus. 2.45 Deerpark East 1. Upper wood-lined rectangular trough superimposed on lower wattle-lined oval trough (ACSU Ltd).

replacement was to acknowledge links with earlier generations and to give this a specific material expression? Accepting this, we may also ask whether parts of the original troughs were retained as ‘foundation deposits’ in burnt mounds that were reused in this way? The argument may seem tenuous but the evidence for this sort of trough replacement, as outlined above, is strongly defined at a small but growing number of sites. Furthermore, such practices can find comparisons in contemporary Bronze Age settlement sites, where commonplace objects such as quern stones, pottery, charred plant remains, animal and human bone are sometimes placed in round-houses to mark foundation and abandonment events (Cleary 2015, 59–61; 2018).

Clustered mounds

Clusters of burnt mounds along a watercourse or on the edge of peatland would have been highly visible in the landscape and created a distinct sense of place. Did these clusters arise from prolonged activity, over long time periods, resulting in a series of mounds? Or intensive activity, in shorter time periods, resulting in groups of more or less contemporaneous mounds?

On the N5/N59 project the dating evidence indicates that not all the mounds at clustered sites were used or reused at the same time. In the townlands of Attireesh, Claggarnagh West, Deerpark East and Knockbrack, where two or more burnt mounds were excavated, the scientific dating indicates intense activity in the Early Bronze

Age, but with the full range of dates from these sites spanning the Late Neolithic to the Middle Bronze Age. Conversely, at Aghadrinagh, several burnt mounds clustered along both banks of a former watercourse produced dates throughout the Middle Bronze Age, with only one site, on the east side of the stream, dated to the Late Bronze Age (Illus. 2.7). Elsewhere in Ireland this temporal pattern is repeated at many locations. For instance, at Curraheen 5, Co. Cork, there was a burnt mound of Chalcolithic date on the same site as two Late Bronze Age examples (Sherlock 2013, 143). At Ballyclogh, Co. Cork, where two burnt mounds were situated c. 10 m apart, one was dated to the Chalcolithic period and the other to the Late Bronze Age (Lehane 1988, 83). At Coonagh West 6, Co. Limerick, c. 800 years separated two closely spaced burnt mounds flanking the River Shannon, one dated to the Chalcolithic period and the other to the Middle Bronze Age (Bermingham 2013, 71). In some cases it can be argued that a single large burnt mound provided a focal point around which a series of mounds was subsequently established, as seems to have been the case at Cahiracalla More, Co. Clare (Bermingham et al. 2012, 36) and Sonnagh, Co. Mayo (Kerrigan & Gillespie 2010a, 61–98).

Among groups of burnt mounds, a shift in focus from an abandoned site to a new one nearby may sometimes have been due to local environmental factors. Some sites, for instance, may have been susceptible to fluctuating water tables or flooding. On the N5/N59 project a period of inundation is indicated by layers of peat and marl in the mound at Deerpark East 3. Seasonal flooding might have influenced the siting of the four troughs at Attireesh 1, one of which was on a

drier terrace on the face of a gentle hillslope. Possible examples elsewhere in Ireland include groups of troughs at Ballyadam, Co. Cork, and Kilmainham, Co. Meath, which were dug at different elevations close to seasonal ponds (Cleary & Hawkes 2013; Walsh 2021b, 129). Something similar can be seen at Gortaroe, Co. Mayo, where a new phase of activity began on higher ground as adjacent lake levels increased between the Late Neolithic and the Middle Bronze Age (Gillespie 2007, 63–76).

These are the prosaic explanations for multiple mounds occurring on one site, but we may also consider the possibility that creating new mounds on existing sites represents another way of expressing memory and tradition. This can be reflected in trough replacement (above), but also in groups of several burnt mounds in the landscape, often within a few metres of one another. Where these tight clusters occur, each mound often has only one trough. Such was the case on the N5/N59 project at Knockbrack 2, 3 and 4, and Aghadrinagh 2, 3 and 6/7. Some other examples in Ireland include Caheraphuca, Co. Clare (Delaney et al. 2012, 96–104), Errew, Co. Leitrim (Péterváry 2007) and Caherweelder, Co. Galway (Delaney & Tierney 2011b, 125). After periods of abandonment, the older mounds in these groups would still have been visible landscape features and perhaps understood as silent testimony to previous gatherings, in earlier generations. Seen in this way, burnt mounds can be understood as representing long-term engagement with particular ‘wet’ places in the landscape, often in the vicinity of settlements, and as spaces remembered for familial or communal gatherings for cooking, feasting and bathing.

Chapter 3

Drumneen and Drumaleheen: life and death in prehistory

**Kerri Cleary with contributions by
Killian Driscoll, Eoin Grogan, Linda G Lynch and Helen Roche**



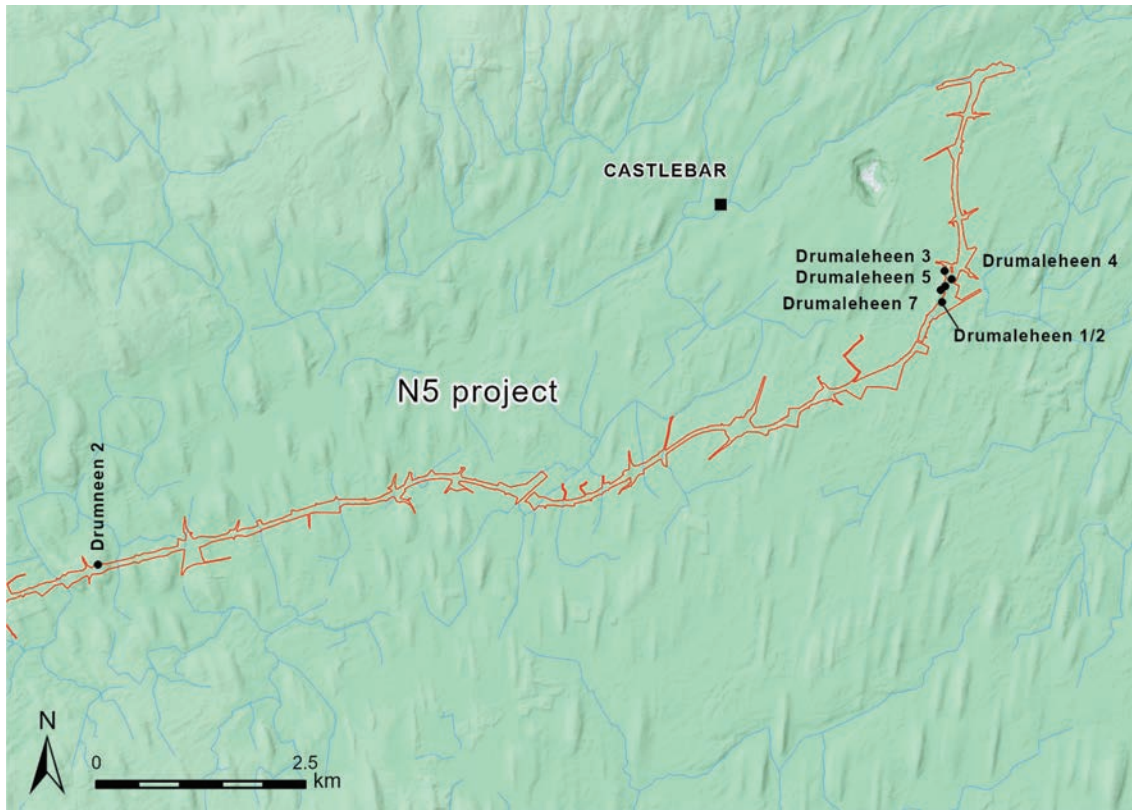
Drumneen and Drumaleheen: life and death in prehistory

Burnt mounds dominated the archaeological discoveries along the N5/N59 project corridor but there were also two areas that revealed evidence for other facets of prehistoric life and death in this region (Table 3.1; Illus. 3.1). South-east of Castlebar, in the townland of Drumaleheen, a cluster of sites on a drumlin ridge indicated occupation of this area from the Middle Bronze Age to the

Iron Age. Over 11 km to the south-west, in the townland of Drumneen, features from the Neolithic period to the Late Bronze Age were identified on the summit of another small drumlin. The evidence also spread into the surrounding lower land of wet grassland, where peat bog probably developed from the later Neolithic onwards.

Table 3.1 — Miscellaneous prehistoric sites investigated on the N5/N59 project

Site name	Features	Objects and plant remains	Radiocarbon dates (2 σ)
Drumneen 2	Occupation deposits, stake-/post-holes	Stone tools (chert, flint and quartz)	3640–3382 BC (Poz-99280)
	Cremation burial pit	—	1892–1699 BC (Poz-122786) 1890–1688 BC (Poz-99278)
	Four-post structure	—	1045–834 BC (Poz-99279) 1007–832 BC (Poz-99381)
Drumaleheen 1/2	Barrow, stake-/post-holes	Prehistoric pottery, stone tools (chert), charred cereal grains	1735–1516 BC (Poz-80368) 1687–1517 BC (Poz-99274)
Drumaleheen 3	Ring-ditch	—	162 BC–AD 17 (Poz-99275)
Drumaleheen 4	Pit, occupation soil	—	1212–983 BC (Poz-80375) 160 BC–AD 22 (Poz-99276)
Drumaleheen 5	Occupation deposit/hearth	—	1107–904 BC (Poz-80376)
Drumaleheen 7	Pit	—	1209–936 BC (Poz-80377)



Illus. 3.1 Miscellaneous excavated prehistoric sites (3600 BC–AD 20) on the N5/N59 project (ACSU Ltd based on *Taillte Éireann* mapping).

Drumneen 2: overlooking the wetlands

The excavated features at Drumneen 2 were found on the crest of a small drumlin (65 m OD), overlooking a landscape dominated by wet grassland and lakes, with unobstructed views of the surrounding area for some distance (Illus. 3.2), including north towards Black Lough and Drumneen Lough. While the chronology of the wetland and bog development in this area has yet to be refined, it appears from many of the burnt mound excavations (Chapter 2) that peat was already expanding across some of the low-lying hollows between the drumlins at the beginning of the

Bronze Age. Palaeoecological studies of north-west Mayo indicate that a period of intensive Neolithic farming was followed by widespread development of blanket bog by the Late Neolithic (c. 2700 BC), but that farming still continued in localised areas where peat growth was delayed, including upland areas (O’Connell 1990; Molloy & O’Connell 1995). Radiocarbon dating from Drumneen 2 suggests this drumlin was used during at least the Middle Neolithic, Early Bronze Age and Late Bronze Age. The only artefacts recovered from the site were seven stone tools made from chert, quartz and flint (Driscoll: text box). These were residual finds from topsoil and the fills of some post-holes and are undiagnostic of any particular period.



Illus. 3.2 Drumneen 2. Excavation in progress of prehistoric pits and post-holes on a drumlin ridge with extensive views (looking west) (ACSU Ltd).

Similarly, it is not possible to assign all of the excavated features to specific periods. Nonetheless, we can say that people were returning to this place intermittently over 2,500 years—to settle for a time during the Middle Neolithic period, bury their dead during the Early Bronze Age and store grain during the Late Bronze Age.

The surrounding landscape also saw intensive use that included burnt mounds with dates spanning the Early to Late Bronze Age, including examples 130 m to the south-west at Drumneen 1 and 800 m to the south-west at Kilbree Lower 2 (Appendix 2). In addition, during ancillary works associated with the construction of the N5, two further burnt mounds were identified at the base

of the drumlin ridge, 200 m north-east and east of Drumneen 2 (Chapter 1; Quinn & Moore 2021a–b). Associated with one of these burnt mounds was a trackway of compacted, heat-affected stone that extended westwards across the wet ground towards a limestone-rich knoll. A low, stone-built field wall was adjacent to the other burnt mound, with the size and arrangement of some of the stones suggestive of a possible wedge tomb. All of these features were avoided and remain preserved outside the road project, unexcavated and undated. However, they do illustrate again how low-lying hollows between the drumlins offered suitable places for hot-stone water-boiling and perhaps other activities related to everyday life in

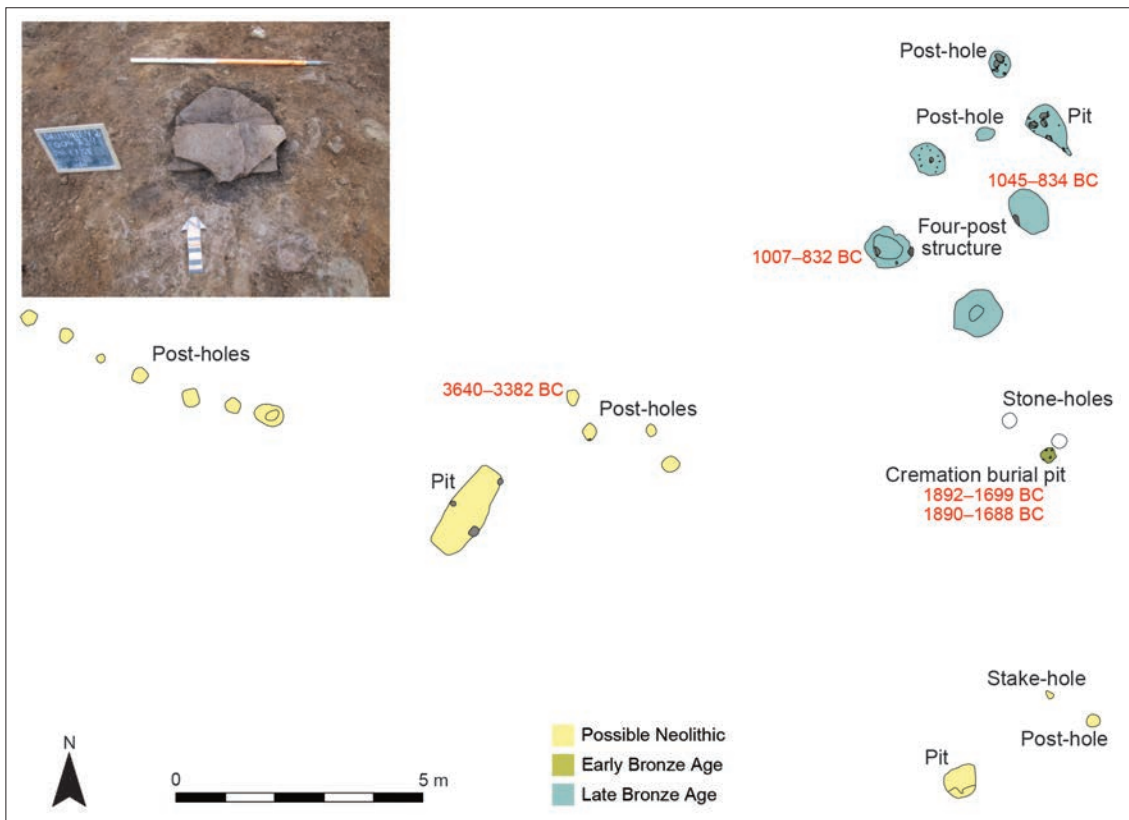
prehistoric Mayo.

Notably, a Late Bronze Age riveted spearhead was found in this low-lying area, in shallow water at the edge of Drumneen Lough in 1916 (NMI 1966:150; Lucas 1969, 102; Lineen 2017). This was probably a deliberate deposit as many Bronze Age spearheads have been found in watery places in Ireland, where the shallows or margins may have been seen as ‘liminal’ zones at the boundaries to another world (Becker 2013).

Neolithic pits and post-holes

At Drumneen 2, a Middle Neolithic date of 3640–3382 BC (Poz-99280) was obtained from hazel charcoal from the fill of a small

post-hole that also included two chert flakes, some charred hazelnut shell fragments and two charred grains, indeterminate to species. This post-hole was located in the centre of the site, within a cluster of three other small post-holes, a pit and a spread of compacted, black, silty clay with occasional pebbles (Illus. 3.3). Further south-east there was another charcoal-rich deposit and a pit, which was covered by a flagstone and contained a high quantity of oak charcoal; there was also a stake-hole and a post-hole. In the north-west part of the site, near the brow of the hill, seven post-holes extended in a NW/SE alignment for a length of nearly 6 m (Illus. 3.4). This post-alignment, and the other nearby post-holes, appeared to define the



Illus. 3.3 Drumneen 2. Excavated features on the drumlin with (inset) a flagstone sealing a pit that contained a high proportion of oak charcoal (ACSU Ltd).



Illus. 3.4 Drumneen 2. A linear group of seven post-holes (undated) may be a remnant of a palisade surrounding the summit of the drumlin (looking north-west) (Richard F Gillespie).

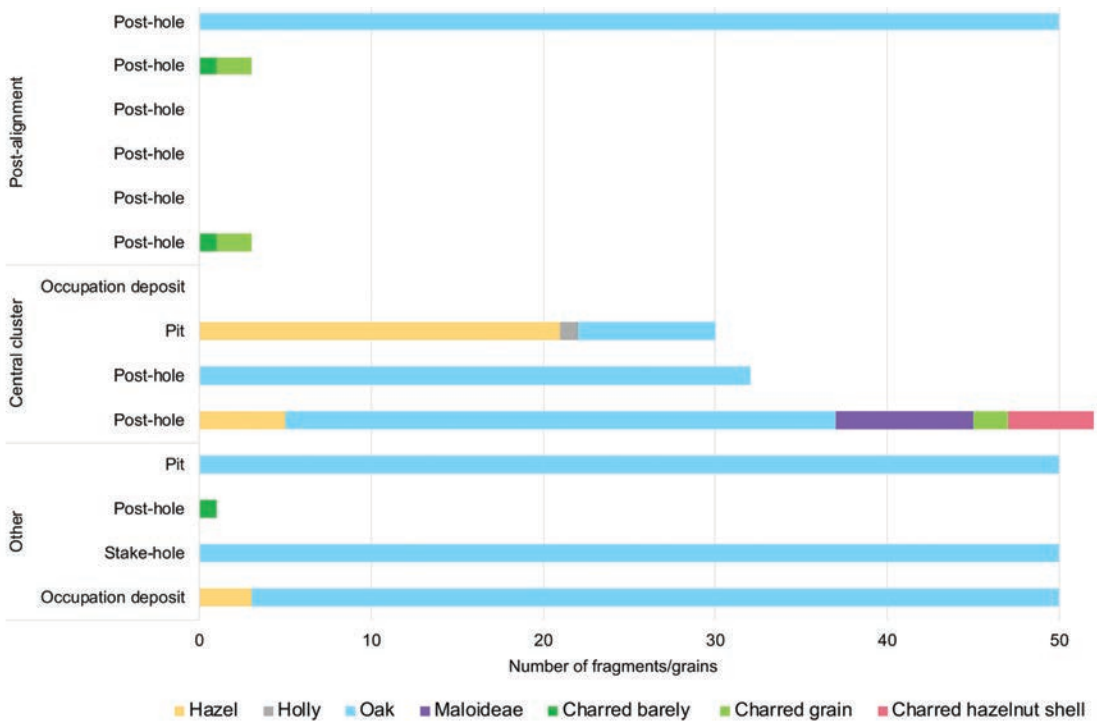
top of the drumlin. If they were remnants of a large palisade, then more evidence for this may survive outside the area of excavation.

A very small number of charred barley grains was recovered from Drumneen 2, from three undated post-holes, two of which were part of the possible palisade (Illus. 3.5). Evidence for arable farming in Ireland first appears in the archaeological record in the Early Neolithic, around 3750 BC, when grain assemblages are dominated by emmer wheat but with some barley also present (McClatchie & Potito 2020). Both wheat and barley continue to be cultivated throughout the Neolithic and Bronze Age, though a shift towards barley occurred during the Middle

Bronze Age (Ginn 2016, 108–11), beginning around 1500 BC.

Other than one post-hole containing chipped stone tools and charred plant remains (above), none of the occupation deposits, pits, post- and stake-holes on this site has been scientifically dated. They contained no chronologically diagnostic artefacts. Some of them had large quantities of oak charcoal but, mostly, they contained assemblages of mixed charcoals and plant remains (Illus. 3.5). Accordingly, we can only tentatively assign these features to a Neolithic phase of activity on the drumlin, though it is possible that other periods of occupation are also represented.

As described in Chapter 1, Co. Mayo has extensive evidence for occupation during the Neolithic period, including megalithic tombs spread across the county and excavated settlement sites in the environs of Charlestown, Ballycastle, Ballina and Westport. An Early Neolithic house at Gortaroe would have been contemporary with the occupation of Drumneen 2 and was located less than 7 km to the west, on the south-facing slope of another drumlin (Gillespie 2007, 103). The building at Gortaroe is an example of the ‘big house’ phenomenon in the Early Neolithic period in Ireland, when large numbers of very substantial, rectilinear houses were built in the period 3720–3620 BC (McSparron 2003; 2008; Smyth 2014, 41–50). Less substantial settlement evidence also occurs on sites of this period, and in the following centuries, including stone tool scatters, metalled (stony) surfaces, ditches, pits, post- and stake-holes, either clustered or in isolation (Smyth 2014, 99–118). The excavated features at Drumneen 2 are of a similar character and may represent a short-stay occupation of the ridge or features peripheral



Illus. 3.5 Drumneen 2. Palaeoenvironmental material from pits, occupation deposits, stake- and post-holes of possible Neolithic date (ACSU Ltd).

to more substantial buildings outside the excavated area. The Gortaroe house was sited on the sloping face of a drumlin, for example, while at Monanny, Co. Monaghan, three Early Neolithic houses were sited at the base of a drumlin (Walsh 2006). At Drumneen today the low ground surrounding the drumlin comprises wet grassland and peat bog, but this might only have begun to develop during the Neolithic period. Notably, the charcoal assemblage from Drumneen (oak, hazel, pomaceous fruitwood and holly) has no wetland species (O'Carroll 2018a). So, taken all together, the evidence allows the possibility of other Neolithic settlement features on the slopes and around the base of the drumlin at Drumneen, prior to the onset of peat.

Equally, the Neolithic occupation of the drumlin ridge at Drumneen 2 may have

been transient or temporary. Cooney (2000, 77) suggests that beyond their home bases, Neolithic people would have visited other places for specific purposes or at certain times of the year, including short-stay sites while in transit. Drumneen 2 might have been such an 'in-between' place—an elevated area of dry ground that was occupied sporadically or seasonally, and possibly associated with summer grazing by livestock, similar to the more upland (transhumance) sites found throughout Ireland in the post-medieval period.

A hilltop palisade enclosure?

If the post-alignment on the brow of the hill at Drumneen 2 was part of a Neolithic occupation site, what form might it have taken? Irish Neolithic enclosures range from

large bank-and-ditch structures to wooden palisades (Carlin & Cooney 2017). Some of these contain traces of settlement, while others have been interpreted as purely ceremonial places. At Thornhill, Co. Derry, on a ridge overlooking the mouth of the River Foyle, a series of palisades enclosed the remains of at least five Neolithic buildings (Logue 2003). Some other Neolithic settlements have evidence for less substantial fence-lines that may demarcate plots for crop cultivation, such as Cloghers, Co. Kerry, and Kilgobbin, Co. Dublin (Smyth 2014, 52).

Again, however, we must acknowledge that the post-alignment at Drumneen is

undated and might also be of Bronze Age date or later. There is ample evidence for enclosures during the later Bronze Age, when palisades and fence-lines were used to enclose settlement sites, control the movement of livestock and demarcate land-use or ownership. At Treanbaun 1, in neighbouring Co. Galway, a Middle Bronze Age palisade enclosure stood on an island of slightly elevated ground within the confluence of two streams (Muñiz-Pérez & Bermingham 2014). Unlike Treanbaun, where the palisade was very well defined by a footing trench with packing stones, there is only vestigial evidence for an enclosure at Drumneen 2,

Drumneen 2 and Drumaleheen 1/2: stone tools

Killian Driscoll

At the multi-period site of Drumneen 2, seven flaked stone tools were recovered, four manufactured from chert, two from flint and one from quartz. Three of these were recovered from the topsoil: a flint disc scraper (Illus. 3.6), a quartz platform flake and a chert bipolar flake. Three other pieces came from two different post-holes—a chert platform flake and a chert bipolar flake from one, and a chert bipolar flake from the other. The remaining object, a flint bipolar flake, was recovered from the upper fill of the southern post-hole in the Late Bronze Age four-post structure.

While almost all of the lithics from Drumneen 2 are non-retouched flakes, they do not necessarily represent ‘waste’, as a large corpus of research demonstrates the use of non-retouched flakes and blades as tools (Driscoll et al. 2014). Therefore, some or all of these flakes may reflect the use and deposition of tools rather than tool-manufacturing waste.

The artefacts demonstrate the use of both bipolar and direct percussion techniques of manufacture. Both techniques were used throughout the later prehistoric period (after c. 4000 BC) (Woodman et al. 2006): bipolar percussion is seen from the Early Neolithic period (Driscoll 2016) but became more prevalent during the Bronze Age (O’Hare 2005). While the disc scraper can be assigned to the Chalcolithic/Early Bronze Age (c. 2500–1900 BC), bipolar flakes have a potentially long duration of use, from the Early Neolithic period to the Bronze Age. These objects were probably only incidental finds in the contexts from which they were recovered (i.e. residual inclusions from earlier periods), but they still reflect activity on the drumlin over a long period of time.

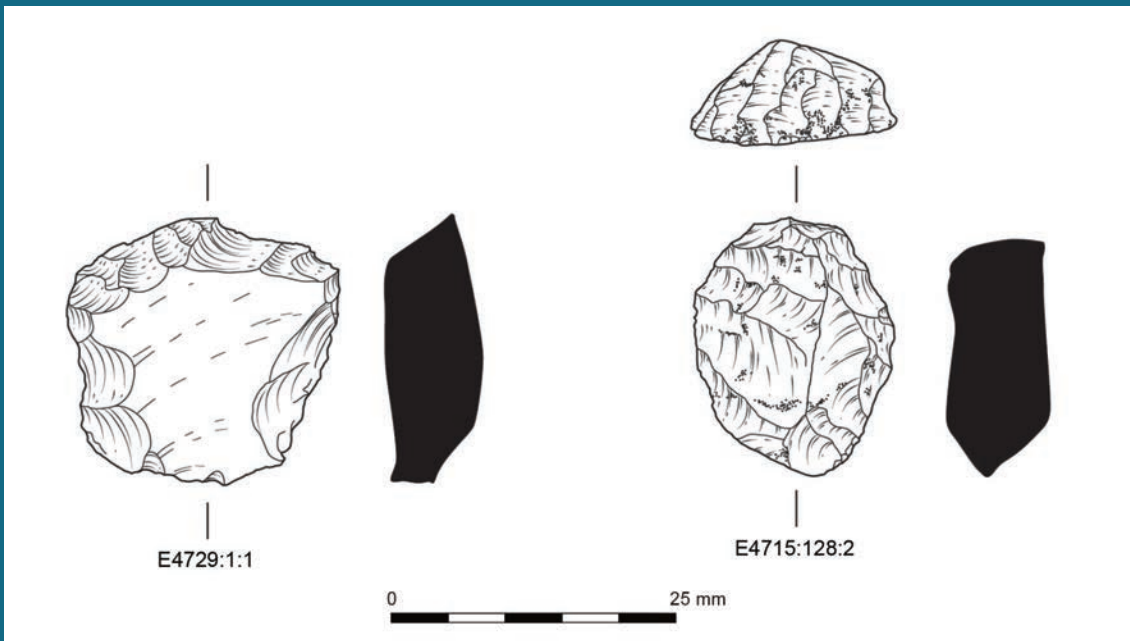
At Drumaleheen 1/2, two flaked chert tools were recovered from the primary fill of a large ditch that traversed the site (Illus. 3.12). One is a small, complete, bipolar core and the other is a small platform flake, formed as a disc scraper (Illus. 3.6). In the absence of any associated diagnostic material or scientific dating, these tools have a wide potential date range, although the disc scraper can probably be assigned to the Chalcolithic/Early Bronze Age. They may have been associated with a nearby barrow and post-hole cluster on the same site, which

but both sites have evidence for activity from the Early Neolithic period to the Late Bronze Age, including cremation burials and possibly sporadic settlement.

Early Bronze Age cremation

A single pit on the crest of the Drumneen ridge contained cremated bone representing at least one adult, possibly female (Lynch: text box; Illus. 3.7). This person died sometime towards the end of the Early Bronze Age: a fragment of bone was dated to 1892–1699 BC (Poz-122786). Hazel charcoal, probably gathered from the cremation pyre,

provided a corresponding date of 1890–1688 BC (Poz-99278). The burial pit was small and shallow with near vertical sides (0.34 m wide by 0.10 m deep) and was probably truncated by later agriculture. The quantity of bone recovered was relatively small (571.4 g), and only a fraction of what might be expected from a full adult cremation, but it is not unusual for only part of the cremated remains of an individual to be found in a burial pit. Based on an assessment of 21 Bronze Age funerary sites excavated on the Gas Pipeline to the West project (from Dublin to Galway and south into Limerick), Lynch & O'Donnell (2007) proposed that cremated



Illus. 3.6 Flint disc scraper from Drumneen 2 (left) and chert disc scraper from Drumaleheen 1/2 (right) (Sara Nylund).

were scientifically dated to the late stages of the Early Bronze Age (c. 1730–1515 BC). Alternatively, they may reflect prehistoric occupation on the summit of an adjacent drumlin, which is suggested by sherds of Early Neolithic and Middle Bronze Age pottery recovered from migrating topsoil that accumulated at the base of the ridge (Grogan & Roche: text box).

remains were often separated out into more than one ‘token’ deposit. Some bone deposits on the gas pipeline project also had evidence for further processing of the remains after cremation, by crushing or breaking them into smaller fragments.

Charcoal recovered with a deposit of cremated bone is most likely to represent fuelwood from the funerary pyre and was probably sourced from local woodlands. The Drumneen 2 burial pit included a low level of charcoal, with just 41 fragments from the entire fill. These were mainly ash (73%) with a smaller amount of hazel (24%) and just one fragment of oak (3%) (O’Carroll 2018a). The small quantity of charcoal suggests the bone was carefully separated from the pyre debris. Ash and oak are large, primary woodland

trees, with hazel often occurring as an understory tree or located at the woodland margins. The hazel charcoal here could represent kindling for a pyre largely built of ash. Ash is an excellent fuel choice for a pyre because it can be burned relatively soon after felling and can reach high temperatures and therefore ensure the successful cremation of a human body (Timpany 2012; O’Donnell 2016). Various wood taxa have been documented from Bronze Age cremation burials across Ireland and while local availability and burning capacity were no doubt important factors, the selection and preparation of the fuel may also have formed part of the ritual of pyre cremation at this time.

Typically, Early Bronze Age burials were



Illus. 3.7 Drumneen 2. Stages in the excavation of an Early Bronze Age cremation burial pit: A) before excavation; B) after removal of the upper 5 cm of fill; C) concentration of bone in lower 5 cm of fill; and D) the fully excavated pit (ACSU Ltd).

placed in cemeteries rather than occurring as individual or 'isolated' burials, although single unaccompanied cremation deposits, especially in simple pits, do occur throughout prehistory and certainly became more common in the Middle and Late Bronze Age (Grogan 2017, 61–3). Waddell's (1990, 113–22) corpus of Bronze Age burials describes 28 sites from Co. Mayo, which includes individual cists or stone-lined graves, cemeteries containing both pits and cists, and various types of barrow monuments. Waddell's corpus was compiled, however, at a time when few sites had been scientifically dated. As radiocarbon dating became more accessible, and was also applied directly to burnt bone, more isolated cremation burials, lacking associated grave goods, were also radiocarbon dated. At Ballynabanoge, Co. Limerick, for example, charcoal from an isolated pit that contained cremated bone (798 g), representing at least one adult and a child aged 4–7 years, returned a date of 1873–1624 BC (UB-6055) (Grogan et al. 2007, 252–3). In contrast to Drumneen 2, however, this site was located at the base of a hill on the edge of a river floodplain. At Mahanagh, Co. Galway, excavation on an elevated piece of ground uncovered a single small pit containing cremated bone (324.4 g) representing at least one adult, possibly female (Troy 2012). A fragment of bone from this site was dated to 1736–1540 BC (UBA-16585) (Moloney 2015b, 38). Ash was the only species identified in the charcoal assemblage at this site. Cremated bone (966.6 g) representing a male aged 13–17 years was deposited in a pit at the multi-period site of Lowpark, Co. Mayo (Gillespie 2010b, 195–205). This burial was also found on an elevated site with earlier Neolithic associations but, unlike Drumneen 2, it was accompanied by a type of pot (vase food vessel) that can be broadly dated to 2140–

1760 BC (McSparron 2020, 49).

Non-funerary sites, broadly contemporary with the Early Bronze Age cremation burial at Drumneen 2, have also been recorded across Co. Mayo, mainly in the form of burnt mounds. They include examples excavated within distances of 2–9 km, in the townlands of Claggarnagh East to the north-east, Knockbrack, Deerpark East and Attireesh to the south-west and Drumard to the north-west (Chapter 2). This wealth of burnt mounds across Co. Mayo provides evidence for occupation during a period when domestic architecture did not always leave a strong footprint in the archaeological record. As such, while the cremation burial is the only feature at Drumneen 2 definitively dated to the Early Bronze Age, it is possible that some of the other undated pits and post-holes scattered across the site could also belong to this phase of activity, as could the Chalcolithic/Early Bronze Age flint disc scraper (Driscoll: text box) recovered from the topsoil.

Cremations were short-term events but required competency in building an effective pyre, predicting the impact of weather, and obtaining the right fuelwood in a timely manner after a death had occurred. There was no archaeological evidence for a pyre on the drumlin at Drumneen 2 but this is not unusual. Cremations leave only minimal traces of soil-burn and a thin layer of ash and charred wood, which does not survive once abandoned to the elements (Fülöp 2018). The pit does not therefore represent a cremation ceremony on the hill but was only the final stage in a funerary ritual that may have commenced elsewhere. If so, this would have involved a portion of the bones being gathered from a pyre site at another location and brought to a final resting place on the drumlin ridge.

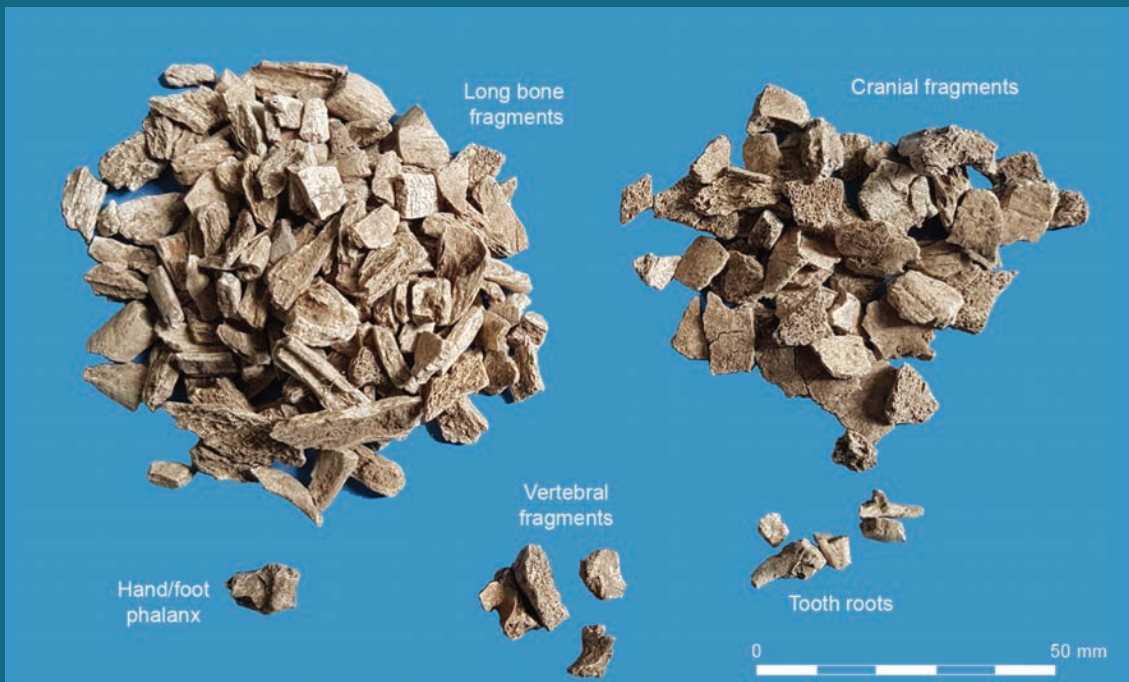
Drumneen 2: cremation burial

Linda G Lynch

A pit at Drumneen 2 contained 571.4 g of cremated bone, representing a single adult, possibly female. This is far less bone than an adult cremation should produce and may reflect a cultural choice, where collecting and burying the entire cremation was not important to the community. This is not unusual in a prehistoric context. A similar pattern is seen in the numerous Middle to Late Bronze Age cremation burials found on the Gas Pipeline to the West project, all of which were less than 1,000 g in weight (Lynch & O'Donnell 2007).

Just over half of the cremated remains from Drumneen 2 could be identified to bone type, representing the limbs (68.5%), skull (29.3%) and torso (2.2%) (Illus. 3.8). This is typical of a prehistoric cremation, where limb bones are generally over-represented due to their strength and robustness, while the torso bones are under-represented due to their fragile nature. The presence of all of these elements, as well as bones of the hands and feet, and concentric cracking on some of the long bones, indicate that a complete body was burnt on the pyre. It also indicates that what was placed into the pit, while representing just a portion of the original cremation, was not biased by the deliberate selection of preferred skeletal parts.

The cremated fragments were generally white, indicating cremation temperatures of 700–1,000°C (McKinley 2000, 404; Ubelaker 2015). Evidently, the complete cremation of the bones was important and the pyre was probably tended carefully by people who were familiar with the challenge of burning a body in this way (Illus. 3.9).



Illus. 3.8 Drumneen 2. Selection of the cremated human bone representing an adult, possibly female, from a single pit burial (Linda G Lynch).



Illus. 3.9 Reconstruction of a prehistoric cremation pyre at Knowth, Co. Meath, in 2010 (Ken Williams).

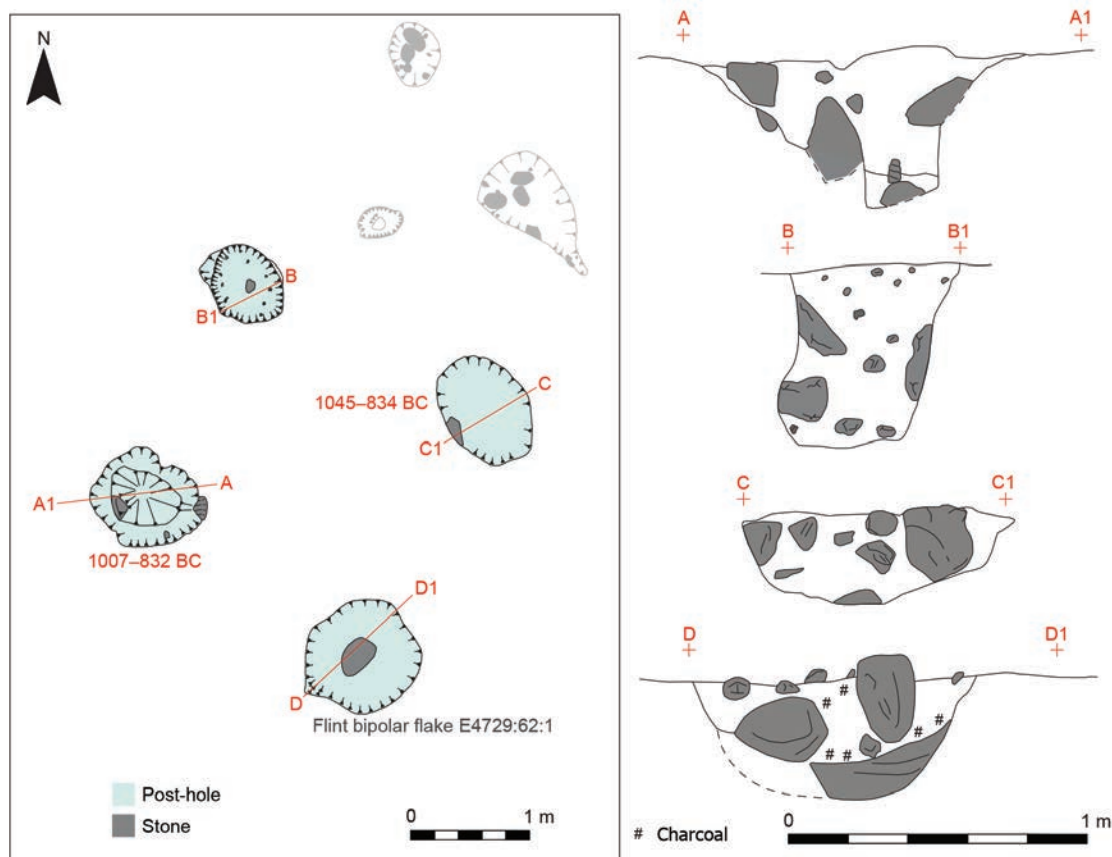
Just over 30% of the bone fragments measured more than 10 mm. Fragment size can be affected by factors such as deliberately raking the pyre and the subsequent methods of collecting and depositing the remains. Further fragmentation can occur in the ground, and during archaeological excavation and post-excavation processing, even with the most careful handling. A major study in Britain of over 4,000 cremation burials from different periods found that, on average, over 50% of the bone fragments in each cremation burial measured more than 10 mm: this was interpreted as evidence for a lack of deliberate crushing or pounding before the bone fragments were buried (McKinley 1994, 340–42). In contrast, just under a third of the cremated bone fragments from Drumneen 2 were greater than 10 mm, which is tentative evidence that the bones may have been subject to some deliberate processing after they were recovered from the pyre and before they were buried in the pit.

Extensive research on prehistoric cremations in Europe has found that the remains of the dead could be subject to very varied treatments following cremation. Burying only a selection of the bone fragments remaining on the pyre was just one of the options. This was often the only stage in the cremation mortuary process that left any trace in the archaeological record, as indeed we found at Drumneen 2.

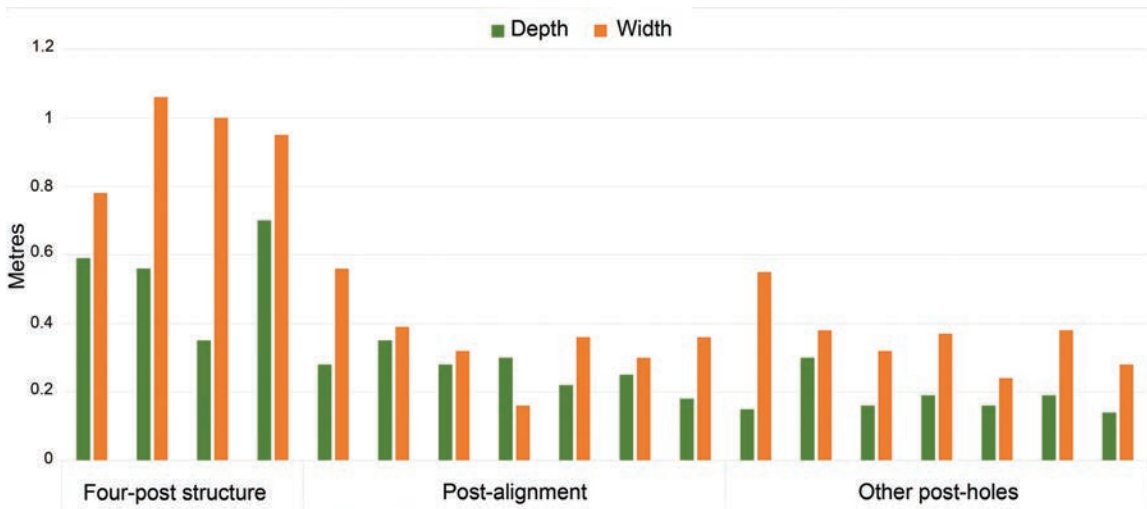
Late Bronze Age four-post structure

In the north-east part of the Drumneen 2 site, four large post-holes, set c. 2 m apart, formed a roughly square arrangement measuring approximately 4 sq m (Illus. 3.10). They were much deeper and wider than other pits and post-holes on the site (Illus. 3.11). They contained quantities of stone, some of which were quite large and probably used as packing around the posts. There were no visible 'post-pipes' (i.e. humic soil resulting from decayed wood), which may mean that the posts were removed before they could rot *in situ*—a practice observed in the record of other Late Bronze Age four-post structures

in Ireland (below). A flint bipolar flake was recovered from the upper fill of one post-hole but this cannot be closely dated and was probably a residual object (Driscoll: text box). The fills in two of the post-holes included only very small quantities of charcoal (unsuitable for analysis), but the other two post-holes had high levels of oak charcoal, as well as small amounts of hazel and ash (OCarroll 2018a). Charcoal samples (hazel and ash) from two post-holes were dated to 1045–834 BC (Poz-99279) and 1007–832 BC (Poz-99381) in the Late Bronze Age. When archaeologists attempt to calculate the height of a load-bearing post-built structure, the broad rule is that about one-third of the



Illus. 3.10 Drumneen 2. Plan and section drawings of the post-holes forming a four-post structure, interpreted as an elevated grain store (ACSU Ltd).



Illus. 3.11 Drumneen 2. Surviving depths and widths of all post-holes excavated on the site (ACSU Ltd).

post would have been buried in the pit (e.g. Bourke 1997). Based on that assumption, but cognisant of limitations in the archaeological data, including issues of truncation and collapse (both of which can distort the original depth and width of a post-hole), the four-post structure could have reached a height of at least 1.40 m above ground, as calculated on the measurement for the deepest pit.

There were two nearby post-holes and a pit. One post-hole contained a high quantity of oak charcoal, a chert bipolar flake (Driscoll: text box) and a single charred cereal grain, which could not be identified to species (Stone 2017). This was the only charred cereal grain recovered from the area, but a paucity of plant remains is not uncommon at four-post structures, despite the widespread interpretation that they were raised grain stores, particularly when found in association with round-houses.

The suggestion that these four-post structures are silos or granaries is mainly based on ethnographic analogy, with the post-holes representing the supporting

posts for an elevated platform that carried some form of superstructure, such as a thatch-roofed structure or container built of wood, clay or wattle-and-daub (Bersu 1940; Reynolds 1979, 80). Whatever the form of the superstructure, it was designed to provide long-term storage of grain by keeping it dry and safe, using the raised platform and ventilation to prevent damage by heat, moisture and vermin (van der Veen & Jones 2006). If sealed, this type of storage could have been used to keep cereal seeds alive and stable for sowing the following year, but it could also have been accessible and suited for storing crops for consumption throughout the year. Experimental work at Castell Henllys in Wales has found that such platform granaries can have a long duration of use if maintained. An experimental replica built in 1989, using a raised floor and a conical roof, was still standing in 2019, albeit that some timber elements had been replaced (Mytum & Meek 2020, 77). Bulk grain storage would have been essential for food security in prehistoric Ireland, in order to cope with natural seasonal fluctuations in

food production, such as annual shortages in the months before the next harvest, but also periods of crop failure arising from adverse weather, plant diseases and pests, or disruption in the agricultural cycle arising from conflict.

Alternative explanations for four-post structures have also been put forward over the years, such as ‘watchtowers, exposure [excarnation] platforms, houses, stables, fodder barns, shrines and sheds’ (Bradley 1978, 43; Ellison & Drewett 1971). They could also have had multiple purposes over their lifespan. High phosphate levels detected in the vicinity of two four-post structures at Tober, Co. Offaly, led the excavator to suggest that the space under the elevated grain silos may have been used by animals for shelter (Walsh 2011a, 26). One of the difficulties in interpreting four-post structures in the archaeological record is the paucity of associated cereal remains. This is not uncommon at these sites as any left-over grain was likely to have been consumed quickly by birds, mice and other animals. Indeed, cereal grains are only preserved in the archaeological record where they have been charred or waterlogged—and therefore

rendered inedible—which, in the absence of a fire or extreme flooding event, is unlikely to occur at a four-post granary site.

In Ireland, four-post structures are most commonly found on Late Bronze Age settlements, from 1100 BC onwards, although they are quite rare and not always easily identifiable (Johnston et al. in prep.) (Table 3.2). The two four-post structures at Tober, Co. Offaly, mentioned above, were defined by large post-holes and found in association with two round-houses enclosed by a fence (Walsh 2009; 2011a). Like the example at Drumneen 2, charcoal assemblages recovered from the Tober post-holes varied considerably, ranging from very small quantities for one structure to much higher densities for the other (O’Carroll 2009). A greater variety of species was identified at Tober, however, including oak, alder, ash, hazel, willow, holly, pomaceous fruitwood and *Prunus*. Late Bronze Age pottery sherds, burnt animal bone fragments including sheep/goat, and small amounts of carbonised cereal grains including barley and emmer wheat, were also recovered from the Tober structures (Walsh 2009).

Another four-post structure was identified

Table 3.2—Dimensions of Late Bronze Age four-post structures discussed in the text

Four-post structure	Post-holes			Area sq m
	Length (m)	Width (m)	Depth (m)	
Ask (Stevens 2011b)	0.83–1.20	0.73–1.00	0.32–0.42	10.50
Camlin 4 (Stevens 2011a)	0.19–0.32	0.16–0.28	0.10–0.55	2.25
Drumneen 2 (Nunan et al. 2021)	0.78–1.06	0.63–0.94	0.35–0.70	5.29
Kilmainham 1C (Walsh 2011b)	0.42–0.67	0.43–0.61	0.11–0.40	5.76
Knockgraffon (Moriarty 2007)	0.32–0.60	0.22–0.32	0.21–0.47	2.38
Lismullin 1 (O’Connell 2009)	0.46–0.88	0.45–0.80	0.27–0.50	9.00
Tober (Walsh 2009)	0.32–0.65	0.31–0.40	0.44–0.59	6.25
Tober (Walsh 2009)	0.44–0.63	0.38–0.60	0.52–0.66	6.25

outside the doorway to a Late Bronze Age round-house at Knockgraffon, Co. Tipperary, in an area of relatively flat arable farmland (McQuade et al. 2009, 76–8). A second four-post structure from Co. Tipperary was identified at the Late Bronze Age site of Camlin, south of Roscrea, between two round-houses within a ditched enclosure, on the gentle slope of an upland ridge (Stevens 2011a). It was defined by post-holes somewhat smaller than at the other sites. There were no associated artefacts, bone or palaeoenvironmental remains recovered from either of these structures.

In Co. Meath, two Late Bronze Age four-post structures were discovered on the M3 motorway project. One, at Kilmainham, was positioned on the brow of a gravel ridge (Walsh 2011b, 218). Nearby pits contained sherds of Middle–Late Bronze Age pottery and there was evidence for a Middle Bronze Age round-house c. 100 m to the south-west. The other example from the M3 was at Lismullin in the Gabhra Valley. It was defined by large, stone-packed post-holes, and was positioned in the base of a sheltered hollow (O’Connell 2013b, 55–7). It was located close to three pits and a hearth that returned comparable radiocarbon dates and included Late Bronze Age pottery, burnt animal bone, burnt clay, heat-shattered stone and a small assemblage of charred grains of oats, barley and wheat. This area of the Gabhra Valley contained evidence for a range of secular, burial and ceremonial sites, dating from the Neolithic period to the Iron Age. They included another four-post structure, of Early Neolithic date, built on the edge of the same natural hollow. The spatial relationship between this earlier structure and pits containing Neolithic cremation burials led the excavator to suggest that it may have been a mortuary structure, not a granary,

perhaps for the excarnation of bodies on a platform prior to cremating them (ibid., 28–9).

A similar interpretation was put forward for a four-post structure excavated at Ask, Co. Wexford, which was found on the lower slope of a hill, beside a Bronze Age ring-barrow cemetery and standing stone (Stevens 2011b, 49–52). It was defined by large post-holes that contained some burnt bone (unidentifiable to species), oak charcoal, a mixed assemblage of pottery ranging from Late Neolithic Grooved Ware to later Bronze Age coarseware, and a large assemblage of stone tools including knapping debris and scrapers. Other pits and post-holes were also clustered in this area. The four-post structure surrounded an area of heavily oxidised soil, suggesting the site of a cremation pyre.

Selected unburnt bones have been found in Ireland at settlement sites, some burnt mounds, in bogs and in caves, particularly from the Middle and Late Bronze Age (Cooney 2023, 233–7). These bones could have been obtained by disinterring burials, but another possible source is from open-air excarnation platforms. Such platforms would have allowed the dead to be displayed and visited prior to burial or cremation and would have facilitated defleshing and dismemberment of their bodies, if that was the preferred mortuary treatment (Brück & Booth 2022). Platform-like structures may also have been used to build cremation pyres but, as discussed above, in the absence of evidence for *in situ* burning and traces of burnt bone, pyre sites are very difficult to recognise in the archaeological record.

How are we to interpret the four-post structure at Drumneen 2? The drumlin, elevated above the surrounding land by up to 25 m, would certainly have been a suitable location for a grain silo, providing

better drainage than much of the adjoining land and an elevated position to ensure good ventilation. Contemporary arable farmland was likely to have been nearby. A palaeoecological study of north Mayo indicated that, by the Late Bronze Age, there was considerable pastoral farming but with an arable component, with agriculture also extended into areas where blanket bog was widespread but not ubiquitous (Molloy & O'Connell 1995, 221). Haughey's Fort, Co. Armagh, is a Late Bronze Age hillfort that is also positioned on a drumlin, elevated above the surrounding land by approximately 20 m. Isotopic analysis of a large, charred cereal assemblage recovered from storage pits there indicated that the grain came from a variety of environments, suggesting the hillfort was used for collective storage and possibly communal feasting (McClatchie 2014).

Ethnographical and archaeological studies have long highlighted the variety of storage strategies developed by early farming communities. These include storing produce at inaccessible places to ensure protection (Synnott 2010; 2014; Peña-Chocarro et al. 2015). Drumneen 2 may represent Late Bronze Age grain storage on an elevated, dry site in an otherwise wet landscape. It could perhaps reflect collective storage from arable cultivation on the fertile slopes of the surrounding drumlins. If this was a communal storage site, then perhaps the drumlin was also a place for gatherings. In the absence of any definitive settlement evidence, however, the same arguments could be made to support an interpretation of the four-post structure as a mortuary platform, on an elevated site where bodies were displayed, excarnated and possibly cremated, and where the community assembled to witness the transition between living and dying.

Drumaleheen: the grey ridge

A cluster of sites in the townland of Drumaleheen was focused on a NE/SW drumlin ridge (Illus. 3.12) and provides a glimpse of how people interacted with this hilly landscape between the Middle Bronze Age (c. 1600–1100 BC) and the Middle Iron Age (c. 400 BC–AD 1). The earliest dated site was a Middle Bronze Age barrow monument at Drumaleheen 1/2, positioned at the south-west base of the ridge (Illus. 3.13). Also found in this area, in topsoil slippage that may have derived from further up the ridge, were nine worn pottery fragments, from an Early Neolithic carinated bowl and Middle Bronze Age domestic vessels (Grogan & Roche: text box). Late Bronze Age occupation was suggested by a hearth or fire at Drumaleheen 5 and a pit at Drumaleheen 7, both on the summit of the ridge. Iron Age activity comprised a pit at Drumaleheen 4, at the base of the ridge to the north-east, and a ring-ditch at Drumaleheen 3, on the slope of the ridge further north.

Middle Bronze Age barrow at Drumaleheen 1/2

Remains of a barrow monument at Drumaleheen 1/2 were discovered by test-excavations along the project route—i.e. there were no visible traces of the monument above ground. It was defined by an annular ditch with a maximum external diameter of 7.82 m (Illus. 3.14 and Illus. 3.15). The ditch was U-shaped in profile, measuring 1.20 m in width and up to 0.43 m in depth. This enclosed an internal area of 5.50 m (NW/SE) by 5.15 m (NE/SW). Traces of a layer of compacted brown clay and stone, 0.04 m thick, were all that remained of an internal mound. The ditch contained a primary fill



Illus. 3.12 Drumaleheen (looking west). Locations of several excavated sites on the summit, slope and base of a drumlin ridge (Firefly Photography for Mayo County Council).



Illus. 3.13 Drumaleheen 1/2. Aerial view (looking west) of the excavation site, showing the circular ditch defining a Bronze Age barrow and also medieval/post-medieval ditches (ACSU Ltd).





Illus. 3.15 Drumaleheen 1/2. Excavation of the barrow in progress, looking north-west (ACSU Ltd).

with very few inclusions, though some pomaceous fruitwood and hazel charcoal were identified from samples. A fragment of the hazel was dated to 1687–1517 BC (Poz-99274). Above this was a secondary fill that may be mound material pushed into the ditch when the site was levelled. No human remains were present at the site.

Barrow monuments are common across the Irish landscape and they have a wide date range from the Bronze Age into the Iron Age. They are formed by a circular area of raised or embanked earth, usually with an associated ditch, and represent funerary and ceremonial sites that often, but not always, contain and cover burials. The associated ditch is sometimes referred to as a ring-ditch, particularly when no mound or bank

survives. This term is also used to describe any circular ditch, usually less than 20 m in diameter, and so can equally reflect the truncated remains of a round-house, any other monument or building that included a circular ditch, or even a modern designed landscape feature such as a tree-ring. (We will return to the problems around this nomenclature and the interpretation of ring-ditches below.)

In the late 1990s, a pioneering study of barrows at Tara, Co. Meath, attempted to classify these barrow monuments based on their morphology, size and whether material dug from the ditch was used to build up a central mound or create a bank (Newman 1997, 155–68). This work also emphasised the difficulty of identifying and

interpreting natural and redeposited soil horizons, as well as the vulnerability of the burial 'surface' in the central area to being removed. A subsequent study of excavated later prehistoric burials found that, where only the ditch was present, it averaged 11 m in external diameter, but varied considerably in size, with a large number also measuring less than 7 m (McGarry 2009). This study also confirmed that burials can equally be found in ditches and in central mounds and pits, most often in the form of cremated bone (*ibid.*, 418). While some of these bone deposits were widely dispersed in the ditches, perhaps because they were redeposited from a central burial, others appeared to be deliberate, discrete deposits. Others still were placed in pits cut into ditch fills, as secondary interments.

Over 150 barrows are recorded across Co. Mayo but only a small sample of these has been excavated. Investigations in the 1930s at Carrowjames I, located 8 km south-east of Castlebar, revealed three bowl-barrows, with evidence for surrounding ditches and central mounds but no banks (Newman 1997, 166; Raftery 1939). These barrows were all about 15 m in diameter, with mounds up to 0.55 m high and ditches that averaged 2 m wide. The combined evidence of associated cremation burials, pots and bronze razors indicated a date of c. 1700–1500 BC (Brindley 2007, 291–2), comparable to the date from Drumaleheen 1/2. Much of the cremated bone was scattered within the mounds or placed in pits in and under the mounds, with the stratigraphy suggesting that the mounds were at least partly built before some of the pits were dug (Raftery 1939, 162). A further three bowl-barrows were excavated at the adjacent site of Carrowjames II and are probably of a similar date (Raftery 1940; Cooney 2023, 268–70). They were all

about 8 m in diameter, with low mounds of between 0.2 m and 0.5 m high and ditches that averaged 1.1 m wide. The remaining barrows excavated at this site indicate that these monuments continued to be built and used into the Iron Age. At Drumaleheen 1/2, the survival of some mound material, but no external bank, suggests there may have been a bowl-barrow here too, but this is tentative given the level of truncation of the site.

Approximately 25 km north-west of the Carrowjames cemetery, another barrow was excavated in 1934, in the townland of Burren (Waddell 1990, 114). It was 14 m in overall diameter with a mound 1.5 m high and a ditch 1 m wide. Small deposits of cremated bone were found in the mound, some of which overlay a layer of carbonised wood. Kavanagh (1991, 94) identified part of a bronze razor from the site, indicating it may have been contemporary with many of the Carrowjames barrows.

In the same year, another bowl-barrow was excavated in the townland of Carrowlisdooaun, 13 km south-east of Carrowjames. This measured 8.5 m in overall diameter with a mound 1.4 m high surrounded by a ditch 1.2 m wide, and an external bank (O'Neill Hencken 1935; Waddell 1990, 117). A small deposit of cremated bone was recovered from the mound and traces of a fire, perhaps from a pyre, were recorded beneath the mound. A bronze flat axe, some small sherds of pottery and a flint point were found in the ditch.

As at Drumaleheen 1/2, the absence of burial evidence at barrow monuments has been observed elsewhere. For example, no explicit evidence for funerary practices came to light during the excavation of four barrows within a cemetery at Mitchelstowndown West, Co. Limerick (Daly & Grogan 1992). Soil acidity was excluded as the reason,

prompting the suggestion that these sites may have been cenotaphs or ‘empty tombs’. Cenotaph barrows may be the ultimate expression of a decline in the practice of burying all of the dead person’s remains in one place. This mortuary ritual is commonly seen after 1600 BC with an increase in the deposition of small or ‘token’ amounts of cremated bone, as well as the inclusion of unburnt, disarticulated bones.

If burials were only placed in the mound, however, as at Carrowlisdoonaun (above), they would have been more vulnerable to being lost through ploughing and land improvements over time. McGarry (2008, 122) observed that, even when placed in a central pit, burials can be destroyed by truncation that would not obliterate the deeper, surrounding ditch. It is possible, therefore, that any associated burial deposits at Drumaleheen 1/2 may have been lost when the mound was destroyed. It is not known when the barrow was levelled, although it may have eroded away over time as a result of repeated tillage, as evidenced by the cultivation furrows traversing the site (not illus.) (see Chapter 5 for early modern land improvements and tillage practices).

A cluster of at least 11 post-holes, a single stake-hole and a charcoal-flecked occupation deposit (not illus.) were situated 25 m south-west of the barrow. Alder charcoal from one of the post-holes was dated to 1735–1516 BC (Poz-80368), corresponding to the date from the barrow monument. These features had no obvious structural pattern, but as the area was heavily ploughed they may be all the evidence that survived of an occupation area or funerary activity associated with the barrow. Charcoal from nine post-holes included mixed species of hazel, alder, oak, ash, furze brushwood and pomaceous fruitwood (O’Carroll 2018b). A

very low quantity of carbonised barley grain was present in two post-holes (Stone 2018b). During the test-excavations phase of the project, nine sherds of prehistoric pottery were recovered in this area, from topsoil that had accumulated at the base of the drumlin (Grogan & Roche: text box). The pottery sherds may have derived from features higher up on the ridge, outside the area of the road project, hinting at prehistoric activity on the summit (Russell et al. 2015, 27), perhaps similar to that seen at Drumneen 2. Two stone tools—a disc scraper and a bipolar core (Driscoll: text box)—were recovered from a later field boundary ditch that cut through the site. It is possible, therefore, that the barrow and post-hole cluster are evidence of a larger prehistoric landscape in this area, much of which is yet to be discovered.

Late Bronze Age occupation at Drumaleheen 4, 5 and 7

On the summit of the same drumlin ridge, the remains of a hearth or fire were found at Drumaleheen 5 (not illus.). A deposit of compacted, black, silty clay, 0.03 m thick, with charcoal inclusions and oxidised clay, was spread over an area 1.25 m in diameter. A fragment of hazel charcoal was dated to 1107–904 BC (Poz-80376). This site may have been a temporary camp, with a hearth for heat and cooking—though there were no burnt animal bones or charred plant remains present—or possibly a signal fire, in a highly visible location on the ridge.

Drumaleheen 7 was 25 m north-east of the hearth at Drumaleheen 5, also on the summit of the same ridge (not illus.). It comprised an isolated pit, with hazel charcoal dated to 1209–936 BC (Poz-80377). The pit was 0.32 m in diameter and 0.27 m deep, with almost vertical sides and a flat base.

Prehistoric pottery from Drumaleheen

Eoin Grogan and Helen Roche

Test-excavations in 2015 recovered nine sherds of prehistoric pottery from topsoil slippage at the site of Drumaleheen 1/2, at the base of a ridge that lay outside the road corridor. These sherds represent at least three vessels—two sherds from a single Early Neolithic carinated bowl and seven sherds from at least two, and probably three Middle Bronze Age domestic vessels (Illus. 3.16).

The Neolithic vessel is represented by two bodysherds, from close to the base of a bowl, of a distinctive early fabric that includes calcite and quartzite inclusions. Current evidence indicates that this pottery style was used in the period c. 3800–3600 BC and perhaps even earlier (Grogan & Roche 2010; Cooney et al. 2011). Pottery such as this has previously been found in court tombs at Ballyglass, Rathlackan and Behy, on the north coast of Co. Mayo (Roche 2004; 2010; 2011), but there has been little pottery of this type from the central part of the county, traversed by the present road project.



Illus. 3.16 Drumaleheen 1/2. Middle Bronze Age rim sherd (Ian Russell).

Of the Middle Bronze Age vessels, one is a bucket-shaped pot represented by a large rim sherd where the neck is decorated with wide, horizontal, false cordons formed between wide, irregular channels (Illus. 3.16). Another is a much finer vessel but with a similar channel and a low, rounded cordon. The neck of the large rim sherd has a black accretion and sooting is visible on the internal surfaces of both vessels, indicating that they may have been used for cooking. These pot types belong to a very late stage of the Cordoned Urn Tradition with comparable vessels from Corrstown, Co. Derry, suggesting a date range of c. 1300–1100 BC (Roche & Grogan 2012). Closely spaced, slight cordons, or channels to form ‘rilling’, also occur on vessels from Knowth, Co. Meath, and Lough Gur, Co. Limerick (Grogan & Roche 2009; Eogan 1984, 260, figs 89 and 91, pl. 75:418; Ó Ríordáin 1954, 340—‘finger corrugations’, figs 17: 1 and 18: 10). Prior to this discovery, pottery of the Cordoned Urn Tradition has only rarely been reported from this region, with some sherds recovered from secondary deposits in the Rathlackan court tomb, in coastal north Mayo (Roche 2010).

While the pottery assemblage from Drumaleheen is small, it is regionally important. Neolithic pottery has only rarely been identified in Co. Mayo, while the Middle Bronze Age vessels are among only a few examples from this period in north-west Ireland (Grogan & Roche 2010, illus. 2 and 10). Furthermore, the context from which these sherds were recovered suggests the presence of a prehistoric complex on the ridge top, perhaps similar to the multi-period occupation site on the summit of a drumlin at Drumneen 2.

There was no evidence for its use, such as artefacts, human or animal bone, or the humic remnants (post-pipe) of a decayed timber post.

At Drumaleheen 4, 120 m north-east of the pit at Drumaleheen 7 but at the base of the same ridge, a charcoal-flecked soil deposit in a shallow, natural hollow was dated to 1212–983 BC (Poz-80375) (not illus.). Although this deposit was beside a pit dated to the Iron Age (below), it is another glimpse of Late Bronze Age occupation in this area.

While these small, isolated sites can be difficult to interpret and date, they are important in helping archaeologists to reconstruct how a landscape was occupied over time. They may be vestigial evidence of settlements, or of transient places away from settlements, used by people moving around the landscape, perhaps for the seasonal movement of their livestock. For whatever purpose, the evidence from Drumneen 2 indicates that these drumlin ridges could attract people intermittently over long periods in prehistory.

Iron Age activity at Drumaleheen 3 and 4

Drumaleheen 3 was a ring-ditch situated on a slight elevation, on the western slope of the same ridge as Drumaleheen 1/2, approximately 345 m apart. While not intervisible today, they may have been in the past, when the mounds were still upstanding and if the tree cover was favourable. Again, there were no visible surface indications of the monument at Drumaleheen 3 and the site was discovered by test-excavations. The ring-ditch had an overall diameter of 7 m enclosing an area 5.4 m in diameter (Illus. 3.14). There were no traces of a bank or an internal mound. The ditch was mostly

U-shaped in profile though the base was flatter in some areas. It survived to a depth of only 0.15 m and varied in width from 0.39 m on the north-east side to 0.87 m on the west side (Illus. 3.17). In the base of the ditch, a primary fill of compacted yellow/brown clay, 0.12 m thick, included small amounts of alder, ash and oak charcoal (O'Carroll 2018c). A sample of alder was dated to 162 BC–AD 17 (Poz-99275). Overlying this fill was a charcoal-rich layer up to 0.08 m thick. This may represent burnt timber posts or planks, though there was no evidence of burning in the form of fire-reddened (oxidised) soil within the ditch. The wood was mainly alder, with a small amount of pomaceous fruitwood (*ibid.*). Again, as at Drumaleheen 1/2, there was no evidence of burials. It is evident from the shallowness of the ditch that this site was heavily truncated, however, possibly resulting in the loss of any associated human remains.

Located 90 m south-east of Drumaleheen 3, on the opposite side of the drumlin ridge, a single pit with a U-shaped profile was excavated at Drumaleheen 4 (not illus.). The pit was 0.52 m wide by just 0.12 m deep, suggesting it was truncated. A fragment of alder charcoal from the fill returned an Iron Age date of 160 BC–AD 22 (Poz-99276). As described above, this pit was adjacent to a charcoal-rich deposit dated to the Late Bronze Age. Other than general proximity, neither feature has any known association with other features on the ridge.

The ring-ditch conundrum: funerary or domestic?

In their morphology, funerary and domestic ring-ditches can be very similar. Wider ditches, relative to the external diameter, is a characteristic of many funerary ring-ditches (McGarry 2009, 415–6). But, as we saw at



Illus. 3.17 Drumaleheen 3. Ring-ditch (looking north-west) before excavation with charcoal concentrations clearly visible in the fills (ACSU Ltd).

Drumaleheen 3 (above), this is not always the case. The landscape siting and clustering of ring-ditches can sometimes help us to identify them as funerary monuments. But many ring-ditches appear as ‘isolated’ sites in elevations and at locations where we might also expect to find round-houses, singly or in pairs (Newman 1997, 160; McGarry 2009; Ginn 2016, 82). In the absence of burials or, conversely, the absence of domestic occupation evidence, it may be impossible to distinguish the remains of a funerary monument from the footprint of a round-house. This dichotomy between funerary and domestic can be unhelpful, however, as we know that burnt and unburnt human remains are sometimes found in association with round-houses and that food remains and everyday tools are often incorporated into burials.

Within the category of barrow monuments, the term ring-ditch is generally applied to annular and penannular ditches

where no mound or bank survives, averaging 11 m in diameter, with many measuring less than 6 m in diameter but some with diameters of up to 15 m (Newman 1997, 157; McGarry 2009). These dimensions are broadly comparable with Bronze Age round-houses, where the surviving remains (post-rings and footing trenches) typically suggest 6–7 m in internal diameter but can measure up to 16 m (Cleary 2015, 59). Some of these may also have outer wall lines that leave little or no archaeological trace, suggesting larger houses with diameters of 9–12 m (Walsh 2021b, 113–15). While these dimensions represent a variety of round-house construction forms, it includes those defined by footing trenches for walls, or ring-gullies for drainage, where no other structural supports are evident or have survived. This is epitomised by Ó Néill’s (2009b) GP4 type houses. These were stone and/or clay-footed structures where the walls directly supported the roof, leaving only a penannular wall

footing trench in the archaeological record. Furthermore, Ó Drisceoil & Devine (2012, 263) proposed that when digging drip-gullies in particular, the upcast was often placed external to the trench, to facilitate the water flowing off the roof and into the gully. This, they argued, would make them identical in the archaeological record to many funerary ring-ditches.

Charcoal-rich fills can be another characteristic of both funerary ring-ditches and domestic footing trenches and have resulted in varying interpretations. At Magheraboy, Co. Sligo, the base of a penannular ditch, 0.54–0.70 m wide, with an internal diameter of 4 m, was lined with charred, split planks of oak, one of which was dated to 366 BC–AD 1 (Beta-186485) (Danaher 2007, 135–6). This feature was interpreted as a small hut for shelter or storage and the charred planks were seen as an attempt to waterproof the load-bearing elements of the structure. A section of curvilinear ditch, 0.24–0.40 m wide, at Ballinaspig More, Co. Cork, similarly suggested a hut or shelter less than 4 m in diameter that included charred, upright, split planks of oak, one of which was dated to 760–404 BC (Beta-178209) (Danaher 2013b). Some charred cereal grains were recovered from this ditch, and it was located 60 m north-west of a post-built round-house that was similarly dated to the Iron Age, albeit a few hundred years later.

As mentioned in Chapter 1, at Lislackagh, Co. Mayo, three circular ditches, ranging from 0.5–0.7 m wide, were identified by the excavator as small Iron Age round-houses or huts (Walsh 1993; 1995a). These had internal diameters of 3.6–4.6 m, and spreads of charcoal in the ditches were interpreted as the remains of burnt structural timbers. The small size of the structures later led to

the suggestion that they could represent the remains of barrow monuments (O’Sullivan et al. 2013, 70). A subsequent reassessment of the ditches, their associated radiocarbon dates and artefacts, however, reiterated the suggestion of an Iron Age settlement (Becker et al. 2017, 93–6).

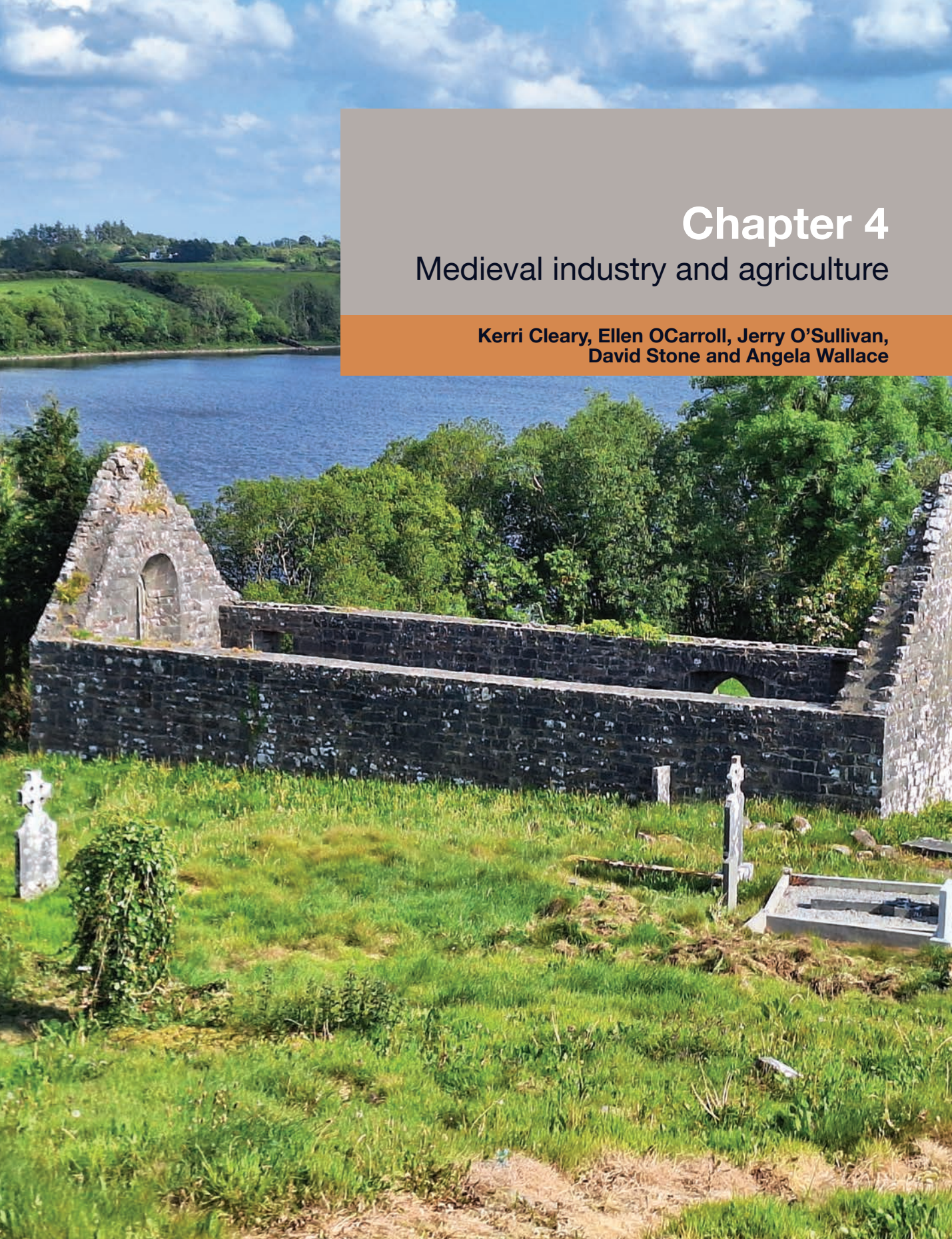
Morphologically similar sites to Magheraboy and Lislackagh, but where human remains have been discovered alongside burnt timbers or dense concentrations of charcoal, are largely interpreted as funerary ring-ditches with pyre remains. At Ask, Co. Wexford, one penannular ditch measured 0.8 m wide and enclosed an area 3.5 m in diameter. The ditch contained two large, charred birch planks, charcoal representing multiple wood species, a small deposit of cremated human bone, several pieces of worked flint and chert and a blue glass bead (Stevens 2011b, 68–70). The human bone was dated to 351–52 BC (SUERC-31617). The cremated bone was found both on top of and dispersed around the birch planks, which were lying end-to-end in the south-west side of the ditch and interpreted as the remains of a pyre.

At Ferns Lower, Co. Wexford, a ditch averaging 0.5 m wide enclosed an area c. 4 m in diameter. It included four separate deposits of cremated human bone, found both above and below a thick charcoal layer representing completely and partly charred planks and blocks of oak and birch timber (Ryan 2012). Some of these timbers were held together with iron nails, which, along with several stake-holes, suggests a temporary structure, either a large pyre or a mortuary house, that had been burnt *in situ* and consequently collapsed.

Considering all of the above, it can be challenging to determine the function of these various ‘ring-ditch’ sites, especially

in the absence of a distinctly funerary or domestic assemblage of finds and palaeoenvironmental materials, or distinctive structural features. The problem is further exacerbated at sites heavily truncated by tillage, which is very often the case. But perhaps we need to recognise that this ambiguity in archaeological terms mirrors a deliberate ambivalence in cultural terms.

It can be argued that building barrow monuments and mortuary structures to the same proportions as domestic round-houses was a deliberate choice. Circular forms of architecture certainly maintained their importance in Ireland for longer than anywhere else in Europe (Bradley 2012, 217), long being used for the realms of both the living and the dead.



Chapter 4

Medieval industry and agriculture

**Kerri Cleary, Ellen OCarroll, Jerry O'Sullivan,
David Stone and Angela Wallace**

Medieval industry and agriculture

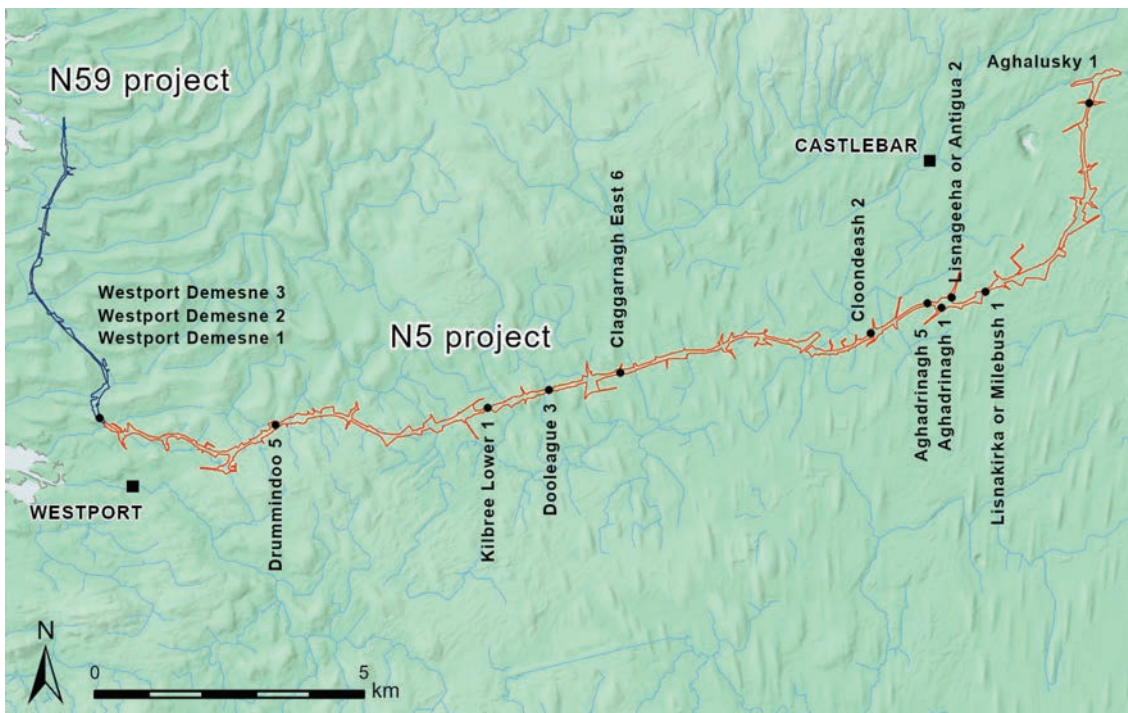
Across the landscape of Co. Mayo, remains of numerous standing archaeological monuments, such as raths, crannogs, churches and castles, demonstrate the intensity of population increase, settlement and land-use in the medieval period (AD 400–1540). New sites (Table 4.1; Illus. 4.1) discovered on the N5/N59 project offer evidence for less visible aspects of everyday life in the period, relating especially to crop-processing, iron smelting and smithing. Thus, they add another layer of information to the

landscape of previously known archaeological sites with upstanding remains.

A settled early medieval landscape (AD 400–1100)

Kerri Cleary and Jerry O'Sullivan

In the hinterland of our road project, the early church sites at Turlough, Aghagower and Ballynew would have been major focal points for people living and working in the surrounding landscape. Turlough was



Illus. 4.1 Excavated sites of the medieval period (AD 400–1540) on the N5/N59 project (ACSU Ltd based on Tailte Éireann mapping).

Table 4.1 — Medieval sites investigated on the N5/N59 project

Site name	Features	Objects and plant remains	Radiocarbon dates (2 σ)
Aghadrinagh 1	Charcoal kilns	—	AD 1027–1166 (Poz-80370)
Aghadrinagh 5	Land clearance (stone sockets and burnt sediment)	—	AD 994–1157 (Poz-99253)
Aghalusky 1	Hearth	—	AD 1039–1210 (Poz-80374)
Claggarnagh East 6	Smithing hearths	Metallurgical waste	AD 1325–1440 (Poz-99263)
Cloondeash 2	Pits (possibly for stone extraction)	Iron nail	AD 1480–1640 (Poz-97646)
Dooleague 3	Charcoal kiln	—	AD 895–1035 (Poz-97686)
Drummindoo 5	Smithing hearth, charcoal kiln, pits and stake-holes	Metallurgical waste	AD 987–1153 (Poz-97689)
Kilbree Lower 1	Sunken smithing settings, water troughs, pits, drain	Metallurgical waste and iron artefacts	AD 1221–1281 (Poz-99282)
			AD 1222–1285 (Poz-99290)
			AD 1296–1400 (Poz-80369)
			AD 1301–1408 (Poz-99281)
Lisnageeha (or Antigua) 2	Field boundary ditch, drying kiln, pit	Animal bone and plant macro-remains	AD 1167–1269 (Poz-99293)
			AD 1175–1275 (Poz-99294)
Lisnakirka (or Milebush) 1	Hearth	—	AD 995–1158 (Poz-80372)
Westport Demesne 1	Charcoal kilns	Metallurgical waste	AD 1054–1267 (ICA-16C/0950)
Westport Demesne 2	Charcoal kiln	—	AD 890–1017 (Poz-97692)
Westport Demesne 3	Charcoal kilns	—	AD 580–655 (Poz-97693)

believed to have been founded by St Patrick, but little is known about the monastery there, only that it was under the jurisdiction of the primate (bishop) of Armagh from early times until the 13th century (Gwynn & Hadcock 1988, 408). Tírechán's seventh-century Life of St Patrick claims that he also founded the monastery at Aghagower and appointed St Senach as the first bishop (ibid.,

28). Documenting this association with St Patrick would have furthered Armagh's ambition to build a federation of monasteries under its own aegis; nonetheless, the foundation claim may well be true. The monastery at Aghagower was strategically positioned, mid-way along an ancient routeway that became the Tóchar Phádraig, a pilgrim route between Ballintober Abbey

and Croagh Patrick. Round towers were built at both Turlough and Aghagower, probably in the late 11th or 12th century, attesting the continuing wealth and status of these monasteries at the threshold of the later medieval period. Little is known of the early church site at Ballynew, but, as at Turlough and Aghagower, it too is connected to St Patrick. From as early as the 13th century there are references to the church of Slán Pádraig, linked to the holy well of Tobar Finnmuighe, and Nicholls (1967) has convincingly argued that this equates with Ballynew and the adjacent holy well named Tobaratran, probably from an Irish name, Tobar an tSlán.

Secular settlements in the district were mostly dispersed homestead enclosures—earthen raths (alias ‘ringforts’) and stone cashels—typically sited near lake shores and on low hills (Illus. 4.2). Within a sample area of c. 450 km² around the N5/N59 project, there are 183 recorded early medieval enclosures, representing a well-settled landscape in this period. Thirty-four lake settlements or ‘crannogs’ lie within the same 450 km² sample area. Overall, there are over 260 lake settlements scattered across Co. Mayo. Many of them are situated on the cluster of lakes between Westport and Castlebar, from Ballin Lough in the west to Tuckers Lough in the east. In general,



Illus. 4.2 Aerial view of an interchange on the new N5 Westport to Turlough road with earthen raths (or ringforts) visible in the surrounding townlands of Cloonagh, Aghadrinagh and Drumneen (ACSU Ltd based on Google Earth Pro 2024).

ringforts/settlement enclosures can be dated to the early medieval period, with multivallate (more than one ditch) enclosures producing the earliest dates of AD 400–800, univallate enclosures becoming the dominant site type from AD 600–800 and raised raths and cashels belonging to the latter part of the period, AD 800–1100 (O’Sullivan et al. 2013, 65). There is growing evidence that raths and cashels continued to be occupied, and perhaps even built, in the West of Ireland well into the later medieval period (ibid., 333; FitzPatrick 2009; McKeon & O’Sullivan 2014, 26; Curley 2024, 238–42). Crannogs have a very long pedigree (Fredengren 2002). Some occur on sites previously occupied in prehistory; in Ulster they were still in use as defensive strongholds in the Elizabethan wars of the 16th century.

Archaeological excavations undertaken within the last 30 years, in advance of road projects around Charlestown, Crossmolina, Turlough and Claremorris, have added significantly to our knowledge of the early medieval period in Co. Mayo. A large, complex site excavated at Lowpark, south of Charlestown, provided a unique record of iron-working technology spanning AD 560–970. This work was done initially in an unenclosed space on a small hill, and latterly in a large, ditched enclosure on the same site (Gillespie 2010b). The evidence comprised at least three semi-underground workshops, iron-working pits with anvils/crushing stones, some of the ceramic bellows nozzles known as *tuyères*, and 1,360 kg of iron waste, commonly referred to as slag. The site also produced evidence for at least one round-house, well-preserved souterrains (underground chambers) and a stone-lined pit that was probably used for storage. On the same road project, a bivallate ringfort and souterrain, which produced dates in

the period AD 565–860, were excavated at Cloonaghboy (Gillespie 2010c), while a drying kiln, dating to AD 901–1181 (GrN-30745), was recorded at Ballyglass West (Gillespie 2010b, 277–80). A univallate enclosure excavated at Carrowkeel, west of Crossmolina, comprised a ditch with an inner bank, an internal pit furnace with iron slag, pits and a post-hole (Zajac 2011). (This site was reused in the 19th century as a children’s burial ground.) A cashel defined by a 1.5 m-thick stone wall was partly excavated at Aghalusky, north-east of Castlebar, on the road to Turlough, with associated artefacts including a broken quern stone decorated with a cross, iron slag and animal bones (Walsh 1988, 3–37). Another univallate enclosure was partly excavated at Castlegar, just north-east of Claremorris. The large, deep ditch, and part of a blue glass bangle and the millstone from a horizontal watermill found there suggest a site of some status (Zajac & Scully 2004). We can add to this record of recent work some earlier excavations, undertaken in the 1950s, on settlement enclosures at Letterkeen, north of Newport, and Ardcloon, east of Strade. The enclosure at Letterkeen was formed by a ditch with an internal stone-revetted bank and a low external bank. In the interior there was a palisade trench, a souterrain, a drying kiln, a post-built round-house and a second structure, perhaps a workshop (Ó Ríordáin & MacDermott 1952). Ardcloon also had a ditch with an internal stone-revetted bank. Limited excavation in the interior recorded two hearths and several post-holes (Rynne 1956).

Excavations on crannogs in Ireland record long intervals of building and rebuilding, occupation and abandonment. Several crannogs have evidence of outdoor industrial areas for iron-working and other

craft activities (O'Sullivan et al. 2013, 58–64). In Co. Mayo there are some early reports on crannogs by Wood-Martin (1886, 230–32), and Knox (1902; 1908b) and, in 1852, the newspapers reported that two crannogs and several log boats were exposed during extensive land reclamation works around Lough Lannagh (Chapter 1; Kinahan 1879, 474), close to the route of the present road project. But, despite the large number of crannogs in the county, relatively little attention was paid to these sites until the 1980s and 1990s, and very few have been scientifically investigated. A dendrochronology (tree-ring) date of AD 609–610 (Q7885) was acquired from an oak plank in a palisade on a crannog site in Levallinree Lough, north of Turlough (Lawless et al. 1989, 24). At another palisaded site, in Lough More near Bofeenaun (Illus. 4.3), a sampled oak timber

returned a dendrochronology date of AD 795–813 (Q9127; Keane 1995). This site was used for the production of iron.

A strongly defined picture of daily life in this period emerges both from documentary sources and the archaeological record (e.g. Kelly 1988; 1997; O'Sullivan et al. 2013). The bigger monasteries were first and foremost places of worship, but they were also centres of trade, manufacturing and public gatherings. Ordinary people lived in dispersed rural homesteads, most of them enclosed by banks or walls that sheltered their dwelling houses and formed stockyards for their cattle. The enclosures occupied by kings, queens and lords were bigger, but essentially no different in character. Cattle were of the utmost importance, not only for subsistence purposes but as a measure of wealth and status, and as a means of binding 'clients' to their royal and



Illus. 4.3 Archaeologists excavating a crannog in Lough More near Bofeenaun, west of Foxford, Co. Mayo, in October 1992 (Irish Archaeological Wetland Unit).

ecclesiastical estates. Sheep and pigs were common too, but less important. Wheat, oats, barley, rye, flax, legumes and herbs were all grown. Wheat was the most valued crop but barley, being hardy and versatile, was more common. Most farmers would have had one or more kilns to dry their crops. Some wealthier estates and larger monasteries had simple water-powered mills. Clergy, kings, craftspeople and jurists might travel freely across the landscape but most people probably never left the territory of their kin group or *túath*—unless perhaps to take part in a cattle raid or military campaign, or participate in social arrangements such as marriage and fosterage. Their farm tools, clothes and domestic equipment were all made at home. There is little or no evidence for long-distance trade and imported, exotic goods are extremely rare, other than at major church sites and royal or high-status sites.

Cattle raids and royal rivalries

Early medieval society in Ireland was divided into various tiers of kingship and local lordship. The kinship groups known as *túatha* probably comprised several thousand people, occupying patrimonial lands (Dillon 1994, xiv; MacCotter 2008, 45–8). A number of *túatha* formed a sub-kingdom and, in turn, these sub-kingdoms owed allegiance to provincial kings, or sometimes queens when these women survived their husbands (Connon 2005, 393). Clan rivalries and the

succession wars of kings were a constant feature of life in this period. Cattle-raiding, against rivals, was the duty of every king and lord (Lucas 1989, 125–99). It is difficult to know to what degree these conflicts affected the day-to-day lives of families living in the many raths, cashels and crannogs that can still be seen in the landscape of Co. Mayo. The early Irish annals do mention devastation of lands and settlements by military campaigns and major cattle raids, so it seems the ordinary people did suffer, from time to time, from the violent interactions of their lords, kings and queens.

The chief rivalry within Connacht was between the northern Uí Fiachraidh (Uí Fiachraidh Muaidhe, later Ó Dubhda/O'Dowd), whose heartlands were along the Moy River valley, and the Uí Briúin Aí (later Ua Conchobhair/O'Connor and Mac Diarmada/McDermott), who were settled further east, in north Roscommon.³ Ultimately the Uí Briúin Aí got the upper hand in this rivalry when they and their descendants, the Ua Conchobhair, consolidated their position as the provincial kings of Connacht from the late eighth century, and became high kings of Ireland too, in the decades before the Norman conquest. Interprovincial power struggles were common and often bloody. The Ua Conchobhair kingship of Connacht was troubled, in particular, by intermittent warfare with the Ua Briain kings of Munster (O'Sullivan: text box).

3 The southern Uí Fiachradh, or Fiachraidh Aidhne, settled on the limestone lowlands of south Co. Galway. Similarly, there were two other branches of the Uí Briúin. The Uí Briúin Bréifne occupied Cavan and part of Leitrim; the Uí Briúin Seola occupied east Galway until the 12th century and afterwards, as the O'Flahertys, were lords of Conamara.

Interprovincial warfare in the Irish annals

Jerry O'Sullivan

Interprovincial conflicts and internal dynastic disputes are recounted in the Irish annals from as early as the first century AD. One of the major rivalries in the West, towards the end of the early medieval period, was between Ruaidhraí Ua Chonchobhair, king of Connacht, and Muirchertach Ua Briain, king of Munster and Dublin. (As a great-grandson of Brian Boru, Muirchertach also styled himself high king of Ireland.) The annals record that Muirchertach was as ambitious and belligerent as any provincial king. Among other campaigns, he led a naval fleet on the Shannon towards Connacht in AD 1088 but was stopped near Clonfert, north of Lough Derg, by Ruaidhraí Ua Chonchobhair. Subsequently, he turned his attention to the east and led his army into Leinster. Taking advantage of this, Ruaidhrí Ua Chonchobhair led the Connacht men on a devastating raid into the Ua Briain heartlands of north Munster. The record of these events in the *Chronicon Scotorum* in AD 1088 (CELT 2010; Illus. 4.4) offers a vivid sketch of interprovincial warfare in the period and its bloody consequences.

A defeat inflicted by Ruaidhrí ua Chonchobuir on Muirchertach ua Briain at Inis Ardachaidh [near Clonfert] where many Munstermen were killed. Another slaughter of Munstermen by Ruaidrí ua Chonchobuir. Corco Mruad [Corcomroe] was attacked by Ruaidrí ua Chonchobuir and they hardly left a cow or man undestroyed ... The Connachta and the men of the North then went into Mumu [Munster] and ravaged to Imlech Ibair [Emly] and Loch Gair [Lough Gur] and Brugh Rígh [Bruree] and Dún Aiched [near Croom] and Drumain Clérchin [Drumin, near Kilmallock], and broke down the walls of Luimnech [Limerick] and brought away the head of the son of Caillech from Cnocoib Sainngil [in Limerick City] and stormed Cenn Coradh [Ua Briain seat of Kincora, near Killaloe] and left eight score warriors there both foreigners [Vikings] and Irish and took hostages of them, taking the son of Matudán ua Cendétigh from it and the son of Congalach ua Ócáin and the son of Eochu ua Loingsigh, and cows and gold and horses and silver and horns were given for them by Murchad ua Briain.

A grim aspect of these bloody interprovincial wars is that they were often prosecuted by near relatives. Muirchertach Ua Briain died in AD 1119 and was ultimately succeeded as high king, in AD 1120, by his nephew Toirdhealbhach Mór Ua Chonchobhair, who was already king of Connacht, as a son of the same Ruaidhraí Ua Chonchobhair who led the devastating raid into Munster in AD 1088. Toirdhealbhach Mór's own son, another Ruaidhrí, in turn became king of Connacht in AD 1156 and high king of Ireland in AD 1166. Toirdhealbhach Mór was the first O'Connor to become high king of Ireland. Ruaidhrí was the last high king, as the title was effectively extinguished by the Norman invasion and its sequel.

Illus. 4.4 Extract from a 17th-century transcription of an original manuscript of the *Chronicon Scotorum* (Digital Collections Trinity College Dublin). >

Anglo-Norman conquest and colonisation

Kerri Cleary and Jerry O'Sullivan

The arrival of the Anglo-Normans in Ireland in AD 1169 brought new struggles as land was 'divided into a number of colonies or colonial regions, each defined in political terms as an earldom or a lordship' (O'Keeffe 2000, 12). Native kings, even those in lands outside the Anglo-Norman reach, were required to recognise whatever Norman lord or baron was now their nominal overlord, and to pay homage and tribute to the English king. Connacht was originally granted to Willam de Burgo by King John, c. AD 1195. de Burgo became involved in the internal struggles of O'Connor rivals for the kingship of Connacht but, in spite of his successes elsewhere in Ireland, he never sought to effectively establish himself as Lord of Connacht. It was not until AD 1235 that his son, Richard de Burgo, exploited the civil war among the O'Conors by organising a major military campaign that was to result at last in the conquest and occupation of the province. de Burgo gave land to the knights and barons who had supported him. In turn, they rapidly founded manorial centres, monastic settlements and walled towns, and built castles in strategic locations, often on or near to former Irish strongholds. The O'Conors, formerly provincial kings of Connacht and sometimes high kings of Ireland, retained only their traditional heartlands in north Roscommon, which were now redesignated as five royal cantreds held from the king of England. The conquest of Connacht was never absolute, however, and, throughout the 13th to 15th centuries, some of the boundaries between lands under colonial Norman lordship and Gaelic-Irish control remained in flux. The de Burgos

themselves succumbed to internal feuding in the mid-14th century. This resulted in the loss of much of their lands in Ulster and the establishment of the Mac William Íochtar Burkes, also known as the Mayo Burkes, in northern Connacht (Moody et al. 1984, 170–72).

Locally, in the wake of the conquest, we can see some unfolding changes in the control of lands and fortified places in the area traversed by our road project. The barony of Burrishoole, for instance, is based on the ancient Gaelic sub-kingdom of Umall. This was settled by the de Burgo lords of Connacht and became the cantred of Owyl (Knox 1908a, 300; MacCotter 2008, 145–6). The various estates within this territory were held by the O'Malleys, Bourkes of Sliocht Ulick, MacPhilpins, MacTibbotts, MacMeylers and others. The MacPhilpins held castles at Doon, Aille and Aghle, all in the barony of Burrishoole, as well as Bellabourke and New Castle, in the barony of Carra (Knox 1908a, 301). Doon Castle was built on high ground, probably on the site of an ancient 'fort'. *The Annals of Loch Cé* record in AD 1133 'a hosting by Cormac Mac Carthaigh and Conchobhar Ua Briain, into Connacht, when they killed Cathal, son of Cathal Ua Conchobhair, royal heir of Connacht, and demolished Dun-Mughorn and Dun-mór, and plundered a great part of the country' (Hennessy 1871, 1133.1). Knox (1908a, 45) believed that the 'Dún Mughdhord' destroyed in this raid was on the hilltop site eventually occupied by Doon Castle. Kilbree Lower is a townland in Burrishoole barony, where, c. 2.5 km north-east of Doon Castle, a medieval metal-working site (Kilbree Lower 1) was excavated on this road project. The site, which probably manufactured large iron objects like weapons, produced radiocarbon dates in the period c. AD 1200–1400 that

probably corresponds with the early years in the life of the castle. History records the movements of armies and their battles: archaeology finds the smith nearby, at work in his forge.

Medieval iron-working

Kerri Cleary

Sourcing raw materials, smelting, smithing, and working a variety of metals were important everyday activities in medieval times. They are typically represented in the archaeological record by charcoal kilns, smelting furnaces, metal-working residues (slag and hammerscale), and associated ceramic artefacts like *tuyères* (ceramic bellows nozzles) and crucibles. Early Irish laws and accounts of saints' lives tell us that craft production was intertwined with social rank and gender in the early medieval period. Copper-workers and blacksmiths were portrayed as high-status individuals and metal-working was generally depicted as a male activity (O'Sullivan et al. 2013, 215–6). Later medieval sources record that smiths in Anglo-Norman society also enjoyed a relatively high social status (Rondelez 2014, 131–51).

In early medieval Ireland, some craftworkers in fine metal-working—in bronze, silver and gold—would have had specialised workshops and enjoyed the patronage of aristocratic or ecclesiastical clients. In contrast, the archaeological evidence indicates that iron-working on a small scale was commonly performed on or near settlement sites, as a routine activity for the production of knives, nails, tools and other domestic equipment. Evidence of iron-working has been found on hundreds of early medieval sites across Ireland (O'Sullivan et al. 2013, 217). This may represent the

work of trained ironworkers, who moved between settlements and territories, but is more often interpreted as evidence of a basic knowledge of iron-working by people who were primarily farmers and not specialist craftspeople (Carlin et al. 2008, 110–12; Dolan 2012, 171).

In the later medieval period, the demand for iron and steel would have fluctuated, locally and regionally, in response to military campaigns and major building projects—such as castles, monasteries, mills and town walls—which generated short bursts of high demand for these metals (Rondelez 2014, 25–38). Everyday activities such as transport, farming and domestic building work would have required a more limited, but continuous, supply of iron for objects including ploughshares, axes, shears, knives, keys and locks, horseshoes and nails. Evidence for iron-working is commonly found during excavations at sites of manorial farmsteads, which were the basis of the later medieval rural economy in areas under Anglo-Norman control, largely in the east and south-east of Ireland (O'Keeffe 2000, 104–6; Gardiner & O'Connor 2017). Recent excavations suggest that iron-working was especially important in John de Cogan's manor of Claregalway, in Co. Galway, possibly under the patronage of the Carthusian order, which had a tenement there (Rondelez in prep.). Although excavations of settlement sites in Irish-dominated areas remain limited, some evidence for both ferrous and non-ferrous metal-working has been identified at Caherconnell cashel in the Burren, Co. Clare, which was initially built and occupied between the 10th and 13th centuries, before being reoccupied between the 15th and 17th centuries (Comber & Hull 2010).

Mining ore

The evidence for mining in Ireland prior to the 19th century is meagre. This is because extracting ores is destructive and can obliterate the traces of earlier workings of the same sources. Some references to mining can be gleaned from early documentary sources. According to early Irish laws, for example, the presence of a mine increased the value of land and the laws prescribed penalties for the unauthorised removal of ores (Kelly 1988, 105; Scott 1990, 177). In Co. Mayo, sites of potential copper, sulphur and iron mines have been identified through various 16th- to 20th-century written sources, such as the Westport Estate Papers, Lewis' Topographical Dictionary of Ireland and various travelogues, as well as work by the Geological Survey of Ireland (Rondelez 2014, 78). They include sites at Corraun Hill, near Achill Island, at Derrassa to the south and Cuillalea to the east, as well as further afield across the county at Cloonalison, Clydagh and Cross. The Geological Survey of Ireland also records bog ores at Gortnahurra Lower, Bellagelly South, Tawnaghmore and Atticloghy, while bog ores at Ballintadder, Barroe, Corragooley and Cloonmore, all in the vicinity of Carracastle, are recorded in *The Irish Times* in 1860 (14 November), in relation to the sale of an estate (ibid.).

In February 1580, a letter from the lord president of Connacht, Sir Nicholas Malby, to Sir Francis Walsingham, principal secretary to Queen Elizabeth I, records both mining and iron smelting at Burrishoole, near Newport (Rondelez 2014, 101). At that time, this was the residence of Richard Burke, also known as 'Richard an Iarainn' or 'Iron Dick', due to the deposits of iron ore on his lands (Calvin 2009). Malby mentions a 'pec' of 40 lb (about 20 kg) from the Newport mine,

which may have been a measure of refined bloom (i.e. the primary product of smelting iron ore) (Rondelez 2014, 101–2). Trade in refined blooms of this weight would help to explain the exceptionally large slag cakes (the waste products of smelting) found at Kilbree Lower 1, on the N5/N59 project (below).

Making charcoal

Charcoal-making sites are closely linked to iron-working. Large quantities of charcoal were required for iron smelting and smithing, as well as for working non-ferrous metals, glass and enamel. Charcoal was produced by carbonising smouldering wood ('pyrolysis') in a controlled environment with a limited supply of oxygen ('reduction'). It is still practised across the world today (Illus. 4.5). In Ireland, the method traditionally involved stacking or layering the wood in a large pit (the 'clamp' or kiln), then covering it in straw or bracken and an overlying layer of earth or sods. Gaps in the covering layers allowed ventilation of the fire to be controlled so that, in effect, the wood was roasted rather than burned. Sometimes the wood was stacked around a central post or stake, which was removed before firing to form a chimney/firing space. As the wood was transformed into charcoal it shrank and subsided, causing cracks in the earthen covering layer. Such cracks required immediate repair as an uncontrolled ingress of air could cause the whole kiln to combust explosively. Eventually, the kiln was sealed completely and the fire allowed to die out. After a cooling period of two or three days, the kiln was dismantled and the charcoal extracted. Kenny's (2010) review of the archaeological evidence for medieval charcoal kilns in Ireland found that they are typically earth-cut pits, circular, oval or rectangular in plan,



Illus. 4.5 Modern charcoal-making in Egypt, including a temporary windbreak (by Elshamy78 (2015) CC BY-SA 4.0, <https://commons.wikimedia.org/wiki/File:ELSHAMY10.jpg>).

not less than 0.7 m long and up to 0.33 m deep. Normally they have evidence for *in situ* burning on the base and sides and often have a charcoal-rich layer in the base. Oak is the wood most often found in medieval charcoal kilns. Oak woods can be coppiced and, if managed in this way, would have produced a reliable, renewable supply of fuel. But oak was not the exclusive raw material and many other wood species have also been identified from medieval kiln sites in Ireland (Kenny 2010, 108; Rondelez 2014, 179).

Smelting and primary smithing

In Ireland, from the eighth century BC until the tenth century AD, smelting iron ore was mostly carried out in slag-pit furnaces, where a hot, spongy iron ‘bloom’ formed at the base

of a clay shaft and some of the waste slag was captured by flowing vertically into a pit beneath the shaft (Illus. 4.6; Garstki 2019; Rondelez 2017). This furnace type gradually gave way to shaft furnaces, where slag was removed through an aperture at ground level, resulting in large horizontal flows of waste material. These furnace types were ultimately superseded in Europe by the ‘blast furnace’, in which air was pumped into the base of the furnace, but this type of furnace was not used in Ireland until the 16th century.

The iron bloom produced by smelting needed ‘primary smithing’ (or ‘bloom-smithing’) to produce forgeable iron stock. In this part of the process a smith expelled the remaining slag by hammering the bloom on an anvil while the slag was still molten. This left behind more or less pure iron and



Illus. 4.6 Iron smelting at the Caherconnell Furnace Festival, August 2024 (Irish Iron Heritage Foundation CLG).

resulted in waste in the form of a large slag cake, typically bun shaped and often over 1 kg in weight (Wallace & Anguilano 2010, 71). This initial stage of refining could be carried out at the smelting site, so that both smelting and refining residues are sometimes found together. However, many smelting sites produce no evidence for bloom-smithing, which suggests that smelting and primary smithing were often carried out in different places, possibly in response to the availability of fuel (Young 2012a, 38–9). Another contributing factor is that small amounts of slag in the bloom would have resulted in correspondingly small bloom-smithing slag cakes; and slag-free blooms, because they required no primary refining, would obviously have produced no bloom-smithing slag cakes (Rondelez 2014, 50–2).

Secondary smithing

‘Secondary smithing’ was the manufacture

and repair of iron objects (Illus. 4.7).

This resulted in the tiny waste flakes and droplets known as ‘hammerscale’, and in the formation of smaller slag cakes known as ‘smithing hearth cakes’. By heating iron, the smith increased the risk that it would oxidise and become useless; this was prevented by careful control of the fire and also by ‘fluxing’ the metal surface with sand or clay (Wallace & Anguilano 2010, 71, 77). The smithing hearth was often partly or fully surrounded by a clay bank or wall. A blow-hole in the wall allowed a bellows to be inserted. Among other evidence, this arrangement can be represented on archaeological sites by vitrified clay hearth lining and fragments of the *tuyère* or bellows nozzle (Rondelez 2014, 173–6). Also, smithing hearths were sometimes screened by wooden windbreaks, or other more substantial structures, such as those excavated at Lowpark near Charlestown, and from the 12th century onwards smithing was more frequently



Illus. 4.7 Forging in a sunken smithing setting at the Lisheen Furnace Festival, July 2024 (Paul Rondelez and Irish Iron Heritage Foundation CLG).

conducted in specially constructed buildings (ibid., 53).

Smithing tools and water troughs

The standard tools of a smith were the hammer, anvil and tongs, used to handle and shape the iron, with many more tools used to fashion and finish the objects, such as chisels, punches and files (Rondelez 2014, 54). Simple anvils consisted of no more than blocks of stone, while iron anvils came in various forms, depending on the work carried out on them (Pleiner 2006, 93–6). Only limited evidence for anvils has come to light on early iron-working sites in Ireland, including a single iron anvil from a ringfort at Garryduff 1, Co. Cork, and a small number of stone anvils, with examples from

a hilltop ringfort at Clogher, Co. Tyrone, a cashel at Rinnaraw, Co. Donegal, and a ringfort at Lisleagh 1, Co. Cork (Dolan 2012, 101–3). At Lowpark, Co. Mayo, several stones appear to have been used as anvils, including a reused saddle quern, while a large boulder supplied the socketed base for a metal anvil (Gillespie 2010b, 310–11). Post-holes inside forge buildings and around smithing hearths are often interpreted as evidence for the wooden anvil block in which an iron anvil was inserted (Crew 1996, 2). In a medieval church and cemetery site at Ballykilmore, Co. Westmeath, a fractured, iron-stained anvil stone was found in the base of a smithing hearth (Channing 2012; Rondelez 2014, 326). This 14th-century site produced evidence for smelting and smithing, exceptionally large *tuyères* and

dense smithing hearth cakes ranging up to 4 kg in weight (Young 2012b).

Water troughs near furnaces/hearths were used to cool blooms and tools and to submerge or 'quench' objects in the course of manufacturing. Quenching a hot, high-carbon object resulted in a more even distribution of the carbon, a practice typically followed by tempering to reduce hardness (Rondelez 2014, 58). There is little evidence to date for troughs on smithing sites in Ireland, making those at Kilbree Lower 1 on the N5/N59 project (below) a particularly important discovery. A wood-lined pit beside a 13th-century hearth at Francis Street/Lamb Alley in Dublin may also have been a smithing trough; there was a large stone nearby, possibly an anvil (Hayden 2000; Rondelez 2014, 172, 425). Wooden buckets could also have been used for quenching.

Smithing sites on the N5/N59 project

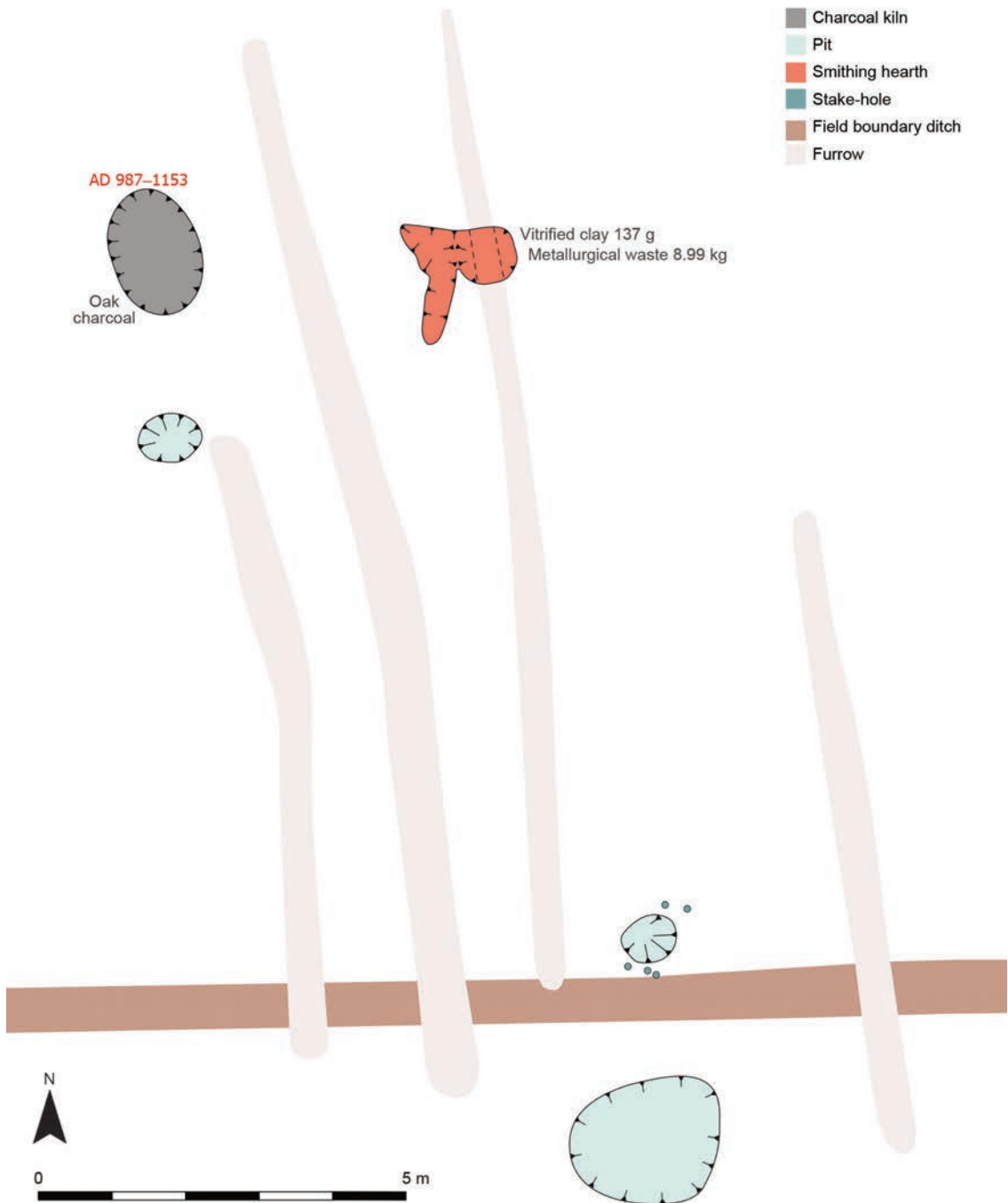
As we have seen above, there has been a big increase in recent decades in the primary evidence from excavated archaeological sites for iron-working in medieval Ireland, and a corresponding increase in writing on the subject. This provides the background to our understanding of the iron-working evidence from excavated sites on the N5/N59 project. There were smithing hearths at Drummindoo 5 and Claggarnagh East 6, probably for the manufacture and repair of everyday iron objects (secondary smithing). At a third site, at Kilbree Lower 1, there was a smithy where unusually large blooms were being refined (primary smithing) and large objects were being made (secondary smithing).

Smithing hearth and pits at Drummindoo 5

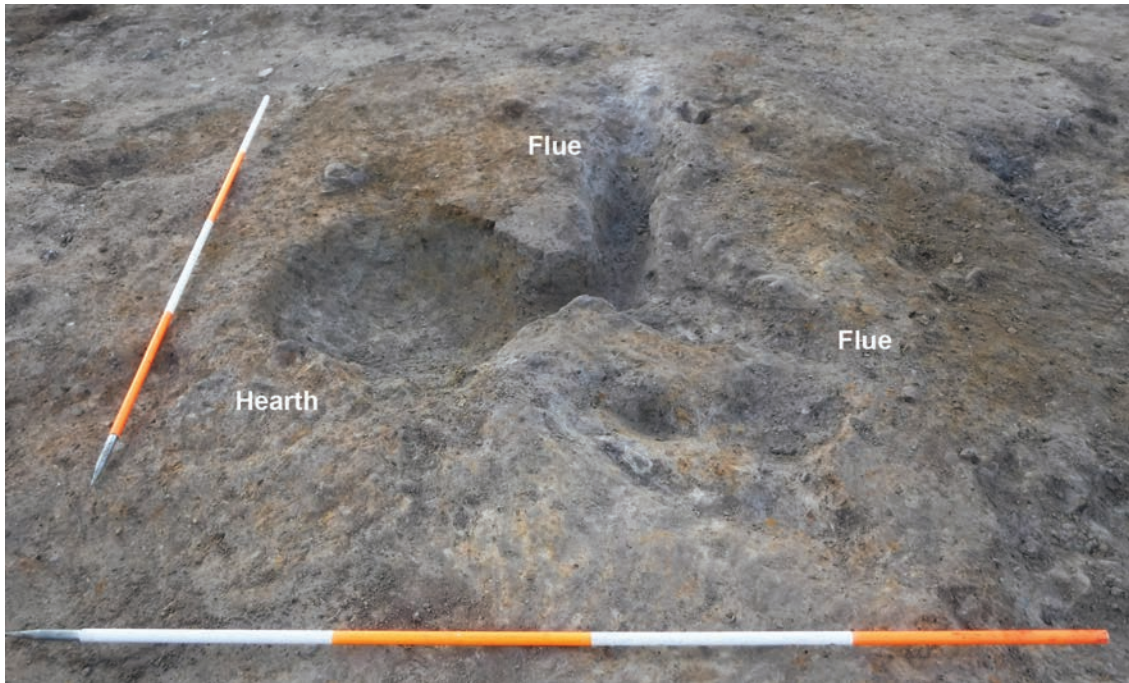
At Drummindoo 5 there was evidence of small-scale iron-working in the late 10th to mid-12th century represented by a smithing hearth and a charcoal kiln; there were also three pits of varying size (0.76–2.10 m wide max.) (Illus. 4.8). The smithing hearth was roughly circular in form, 0.8 m wide (max.) and 0.2 m deep. It had two earth-cut flues, one extending south-west and the other north-west (Illus. 4.9). These probably channelled air from a bellows to heat charcoal embers in the hearth. There were traces of orange, oxidised clay around the upper circumference of the hearth, indicating *in situ* burning at high temperatures. Samples from around the hearth were examined for hammerscale but none was found. Metallurgical residues (8.19 kg) and vitrified clay (137 g) were, however, recovered from the hearth. The charcoal kiln was 2.7 m west of the smithing hearth. The charcoal-rich fill in its base included some small fragments of burnt bone (3.09 g), unidentifiable to species (below). The function of the three pits is not known. The smallest pit had stake-holes on opposite sides. The stakes may have been used to support a cover, to suspend something over the pit, or to secure a wooden anvil block inside it.

Smithing hearths at Claggarnagh East 6

The smithing hearths at Claggarnagh East 6 were much later than at Drummindoo 5 and were dated to the early 14th to mid-15th centuries (Illus. 4.10). There were two hearths, with scorched sides and bases. Again, they were roughly circular and measured up to 1.52 m wide (max.)



Illus. 4.8 Drummindoo 5. Plan of excavated features including a smithing hearth and charcoal kiln (ACSU Ltd).



Illus. 4.9 Drummindoo 5. Smithing hearth (view from north-east) with flues extending to south-west and north-west (ACSU Ltd).



Illus. 4.10 Claggarnagh East 6. One of two small smithing hearths from the site; both contained metallurgical waste (ACSU Ltd).

by 0.6 m deep. Metallurgical residues (37 kg) were collected from both hearths and from deposits of charcoal-rich hearth debris dumped nearby.

Bloom-smithing at Kilbree Lower 1

Features at Kilbree Lower 1 were dated to the 13th to early 15th centuries (Illus. 4.11). There were two large, subrectangular pits, set 1 m apart, measuring up to 4.14 m long (max.) by 3 m wide and 0.6 m deep. The sides and bases were scorched (oxidised) and the fills represented successive episodes of *in situ* burning and accumulating ash. These were large, sunken smithing settings where people would have crouched to work the bloom into usable iron (Paul Rondelez pers. comm.). Here, charcoal would have been burned to an intense heat in the smithing hearth so the iron could be hammered and folded to remove any impurities (Illus. 4.7). A later pit, cut into one of the two large smithing settings, contained a large sandstone boulder, probably an anvil, propped up by smaller stones (Illus. 4.12).

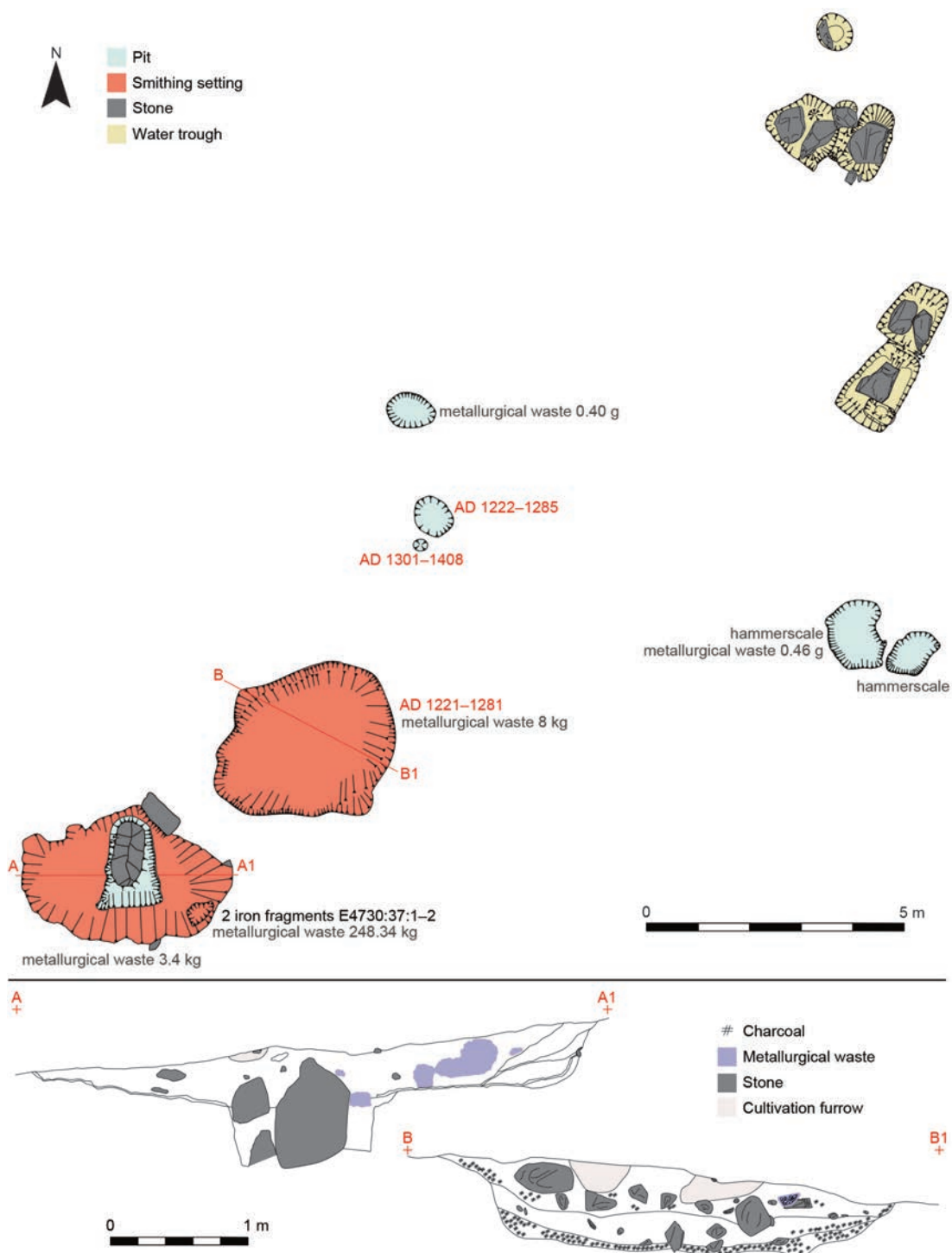
Over 10 m north-east of the sunken smithing settings there were three pits, two of which were elongated double pits (Illus. 4.11 and Illus. 4.13). These were positioned at the base of a steep hill, in an area where water pooled naturally, so that the pits may have been cisterns or troughs for quenching objects during the manufacturing process. These pits also contained large sandstone blocks, possibly displaced or dumped here after use elsewhere on the site. Despite a lack of distinctive fracturing and iron-staining, it is possible that at least some of these boulders had been used as anvils or anvil blocks. There were five other pits across the site. None of them had signs of

in situ burning although they did include charcoal and small quantities of metallurgical waste. One may have been a post-hole. Two were described in the field as containing 'iron filings', which suggests some flake hammerscale was present in their fills, but this was not confirmed by examining soil samples from the pits for iron residues.

A large volume of metallurgical waste was recovered from the sunken smithing settings and pits at Kilbree Lower 1, including several, unusually large, smithing hearth cakes (Wallace, below). This suggests a rural smithy engaged in refining large blooms and the production of iron 'billets' to be transported for trade, or possibly engaged in the manufacture of large iron objects, such as weapons and wheel rims. Two pieces of iron were recovered from one of the sunken smithing pits, but they were heavily corroded and offer no insight into what might have been manufactured here.

Charcoal kilns on the N5/N59 project

There were six sites with charcoal-making pits or 'kilns' on the road project: Aghadrinagh 1, Dooleague 3, Drummindoo 5 and Westport Demesne 1–3 (Table 4.2; Illus. 4.14). There were single kilns at four of the sites, two at Aghadrinagh 1 (2.3 m apart), and two at Westport Demesne 3 (3 m apart). Most of the kilns had scorched, red (oxidised) bases and sides, and all had charcoal-rich fills in the base (Illus. 4.15). At Dooleague 3, a post-hole cut into the base of the kiln probably represented a post around which the fuelwood was stacked. This post would have been extracted before firing, in order to leave a chimney, and perhaps to allow kindling to be inserted and lit.



Illus. 4.11 Kilbree Lower 1. Plan of the excavated features including sunken smithing settings and double pits (ACSU Ltd).



Illus. 4.12 Kilbree Lower 1. Sunken smithing setting with a large sandstone boulder probably used as an anvil (ACSU Ltd).



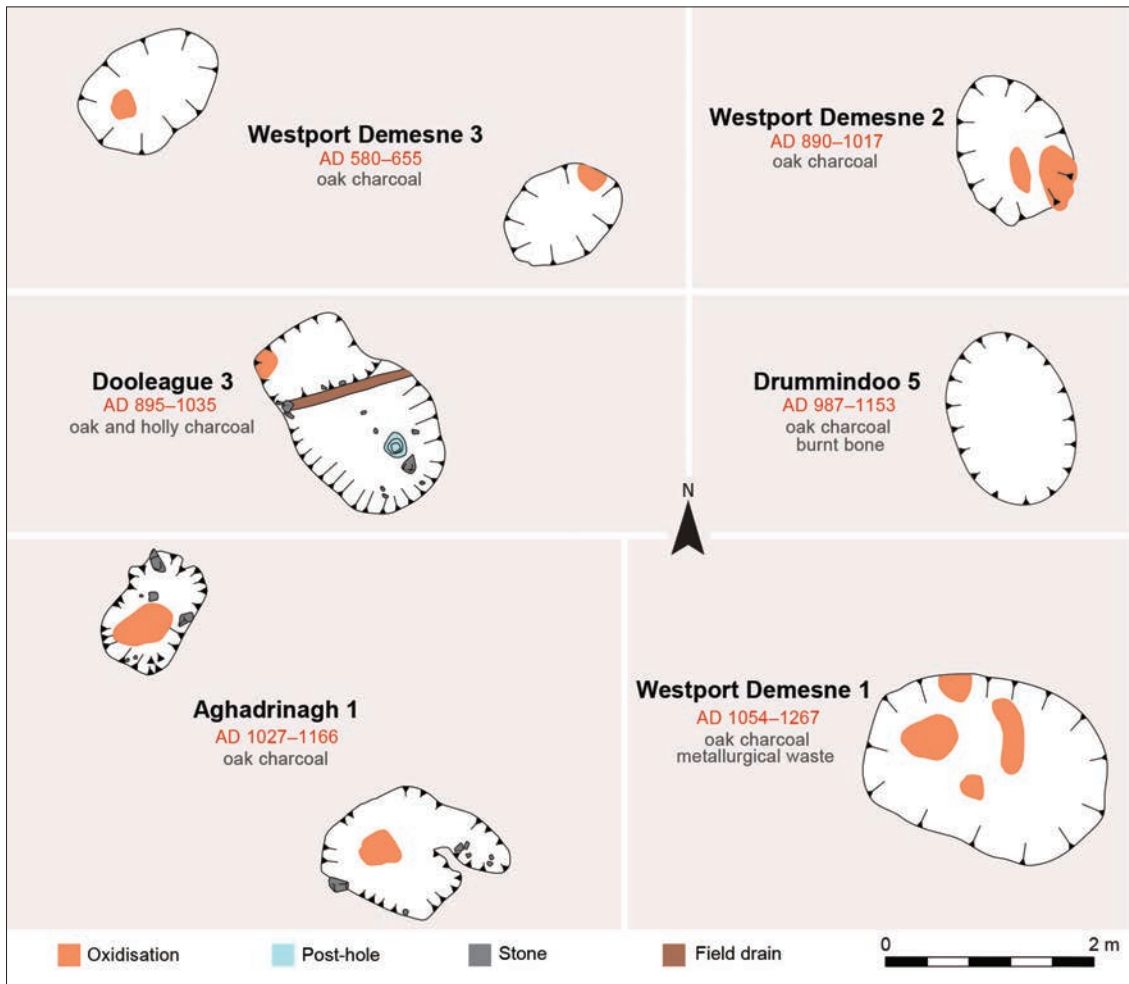
Illus. 4.13 Kilbree Lower 1. One of three double pits at the base of a steep hill and containing large boulders. The pits may have been water troughs, with anvil stones dumped into them when the smithy ceased to be worked (ACSU Ltd).

Table 4.2—Medieval charcoal kilns on the N5/N59 project

Description	Charcoal fragments	Radiocarbon date (2 σ)
Westport Demesne 3		
Oval pit with concave base; scorched (oxidised) base and sides L 1.1 m x W 0.95 m x D 0.1 m	Oak (50)	AD 580–655 (Poz-97693)
Oval pit with flat base; scorched (oxidised) base and sides L 1.4 m x W 1.15 m x D 0.18 m	—	—
Westport Demesne 2		
Oval pit with uneven base; scorched (oxidised) base and sides L 1.5 m x W 1.1 m x D 0.1 m	Oak (50)	AD 890–1017 (Poz-97692)
Dooleague 3		
Subrectangular pit with concave base; scorched (oxidised) sides L 2.11 m x 1.4 m x D 0.24 m	Oak (30) Holly (3)	AD 895–1035 (Poz-97686)
Drummindoo 5		
Oval pit with flat base; no scorching L 1.8 m x W 1.2 m x D 0.18 m	Oak (50)	AD 987–1153 (Poz-97689)
Aghadrinagh 1		
Subrectangular pit with uneven base; scorched (oxidised) base L 1.2 m x W 0.76 m x D 0.11 m	Oak (50)	AD 1027–1166 (Poz-80370) Charcoal-rich soil redeposited from charcoal kilns
Irregular (truncated) pit with uneven base; scorched (oxidised) base L 1.24 m x W 1.2 m x D 0.12 m	Oak (50)	
Westport Demesne 1		
Suboval pit with uneven base; scorched (oxidised) base L 2.3 m x W 1.5 m x D 0.2 m	Oak (50)	AD 1054–1267 (ICA-16C/0950)

As described above, the kiln at Drummindoo 5 was 2.7 m west of a smithing hearth and the charcoal-rich fill in its base included several small fragments of

burnt bone (3.09 g). Although these were unidentifiable to species, they may represent animal bone discarded into the kiln while it was still burning or perhaps bone used as a



Illus. 4.14 Plans of medieval charcoal kilns excavated on the N5/N59 project (ACSU Ltd).

fuel. Archaeology and ethnography record the use of animal bone, fat and dried dung as kiln fuels across Europe, Asia and beyond, from prehistory to early modern times (Heizer 1963). Experimental studies have demonstrated that fires with a mixture of bone and wood are longer lasting than those with wood only; fresh, complete bones are especially effective at extending combustion (Théry-Parisot et al. 2005; Costa 2016).

The four charcoal kilns found at three sites in Westport Demesne were dispersed along the slopes of a NE/SW ridge over a

distance of 106 m. Charcoal kilns are often found on gently sloping ground, perhaps because it allowed better run-off of surface water (Kenny 2010, 110). Oak charcoal from the three sites provided radiocarbon dates ranging from the early to later medieval period (Table 4.2), beginning at Westport Demesne 3 sometime in the late sixth to mid-seventh century, followed by Westport Demesne 2 in the late ninth to early 11th century, and finally Westport Demesne 1 in the mid-11th to late 13th century. The early date from Westport Demesne 3 is notable as

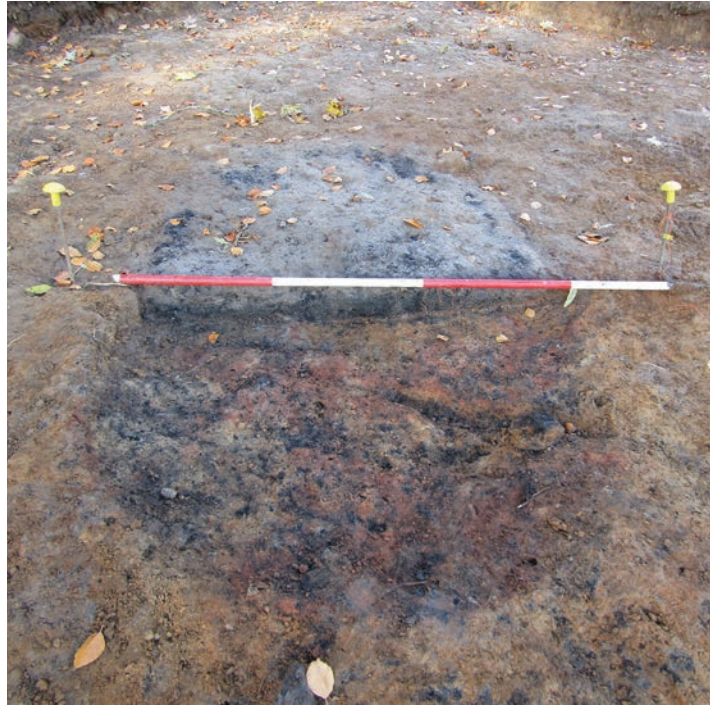
there are few charcoal kilns in the Irish archaeological record pre-dating the later eighth century AD (O'Sullivan et al. 2013, 220). We can say with confidence that this early date does not reflect an 'old wood effect' because the charcoal sample selected for dating was identified as young oak (2–12 rings) (O'Carroll 2018d). At Westport Demesne 1 (Illus. 4.15), the charcoal-rich fill in the base contained five small fragments of smithing hearth cake, indicating metal-working in the immediate area.

Metal-working residues

Angela Wallace

Most of the metal-working sites identified in the Irish archaeological record are linked to primary (bloom refining) or secondary smithing (artefact manufacture, repair or recycling). Sites with evidence for extraction of ores and initial smelting of ores are less common. The raw material was either mineral or bog ore and their availability was a significant factor in the locations of smelting and smithing sites. Availability of fuelwood and charcoal were also important factors (O'Carroll, below). Large quantities of charcoal would have been required for both processes and the charcoal kilns recorded on the N5/N59 project probably related to iron-working.

Charcoal samples from the three medieval metal-working sites discovered on the N5/N59 project, at Drummindoo 5, Claggarnagh East 6 and Kilbree Lower 1, were dated, variously, to the 10th to 15th centuries, while associated metallurgical waste was linked to



Illus. 4.15 Westport Demesne 1. Charcoal kiln with scorched base (and autumn leaves) (ACSU Ltd).

various stages of the iron-working process. There was no evidence for any non-ferrous or precious metals.

Much of the evidence from these three sites points to iron smithing or secondary iron-working, while bloom-smithing or primary iron-working was also likely at Kilbree Lower 1. The metallurgical residues comprised 'smithing hearth cakes' and 'smithing slag lumps'. Smithing hearth cakes are roughly circular- or oval-shaped cakes of iron slag that form at the base of a hearth during the smithing process. Hearth slags do not always have a distinctive shape, however, and the remainder of the waste pieces are termed smithing slag lumps. They can result, for instance, from a hearth being cleaned out while still hot, so that the slag shape becomes distorted (Crew 1996).

A total of 9.87 kg of iron metallurgical

residue was recovered from Drummindoo 5, where a charcoal sample was dated to AD 987–1153 (Poz-97689). Most of the iron-working material comprised small to medium-sized smithing slag lumps. The relatively small quantity of material from this site suggests a short episode of smithing work. This may have been small-scale repair or manufacture by a travelling smith.

A total of 37 kg of iron metallurgical residue was recovered from Claggarnagh East 6, which was dated to AD 1325–1440 (Poz-99263). Most of the waste (68%) was found in a smithing hearth and was primarily smithing slag lumps, some with fuel impressions and others with evidence for flow patterns. There were also six smithing hearth cakes. Five were broken fragments ranging from 0.44–1.0 kg in weight, and one was a large lump that consisted of two conjoined cakes weighing 1.88 kg.

At both Drummindoo 5 and Claggarnagh East 6, the larger proportion of small smithing slag lumps and the small to average weights for the broken smithing hearth cakes point to secondary smithing being the main activity on these sites. This was probably for the repair or manufacture of small, everyday objects such as iron nails, knives and pins.

A total of 263.23 kg of iron metallurgical residue was recovered from Kilbree Lower 1, where charcoal samples were dated to between AD 1221–1281 (Poz-99282) and AD 1301–1408 (Poz-99281). Almost all (248.34 kg or 95%) of the slag from secure archaeological contexts at this site came from one of the two sunken smithing settings that would have contained a smithing hearth. The remainder (5%) of the assemblage was from four features—the second smithing setting and three other pits—in quantities ranging from 0.4 kg to 8 kg. A total of 136.54 kg or 52% of the assemblage consisted of smithing

slag lumps. The remainder comprised very large and large smithing hearth cakes, in a variety of forms (Illus. 4.16).

The very large slag cakes (nine pieces) ranged from 4.6–10.0 kg in weight. At the heaviest end of the scale there were two slag cakes weighing 9.0 kg and one weighing 10.0 kg. These are some of the heaviest iron slag cakes in the archaeological record for medieval Ireland. The average weight from the nine cakes in the very large range is 6.45 kg. These very large cakes represent 22% in weight of the overall metallurgical residue assemblage from the site. The large slag cakes (16 pieces) had very irregular shapes and profiles. Many had a roughly convex shape but also contorted surfaces with fuel impressions. Any broken pieces showed very little porosity in the internal matrix. Slag cakes in this category ranged from 2.3–4.6 kg with an average weight of 3.29 kg. These slag cakes accounted for 20% in weight of the overall assemblage. This collection of exceptionally large, heavy smithing hearth cakes from Kilbree Lower 1 is unique in the Irish archaeological record. A more typical weight range for smithing hearth cakes from medieval iron-working sites in Ireland is 0.5–2.0 kg.

Kilbree Lower 1 also has features in common with other excavated medieval smithy sites, however, such as large rectangular sunken settings, oval elongated pits, anvil stones, charcoal pits and water troughs. These elements, together with the substantial amount of waste material, indicate an organised and specialised iron workshop. There are some parallels with an 11th to 12th-century rural smithy at Templenoe, Co. Cork (Laidlaw 2017; Wallace 2017), and the early medieval site at Lowpark, Co. Mayo (above), where 1,360 kg of metallurgical residue included some

slag cakes weighing 1.9–3.9 kg (Gillespie 2010b; Wallace 2010). An excavated site at Borris, Co. Tipperary, which was roughly contemporary with Kilbree Lower 1, produced a consolidated iron bloom or billet, very regular in shape and weighing 3 kg (Stevens 2010b; Wallace 2009). This provides strong evidence that some of the medieval sites with larger smithing hearth cakes (usually 1–2 kg) were used for

refining blooms to trade further afield. Large smithing hearth cakes may also be linked to the manufacture of larger iron objects, such as weapons, wheel rims or, as at Clonfad, Co. Westmeath, which was interpreted as a specialised bloom-smithing site, iron handbells (Stevens 2006; 2007).

As described above, a source from 1580 mentions a ‘pec’ of 40 lb (about 18 kg) from Burrishoole near Newport. This points to



Illus. 4.16 Kilbree Lower 1. About half of the metallurgical waste from this site consisted of very large (above) or large (below) smithing hearth cakes, up to 10 kg in individual weight (Angela Wallace).

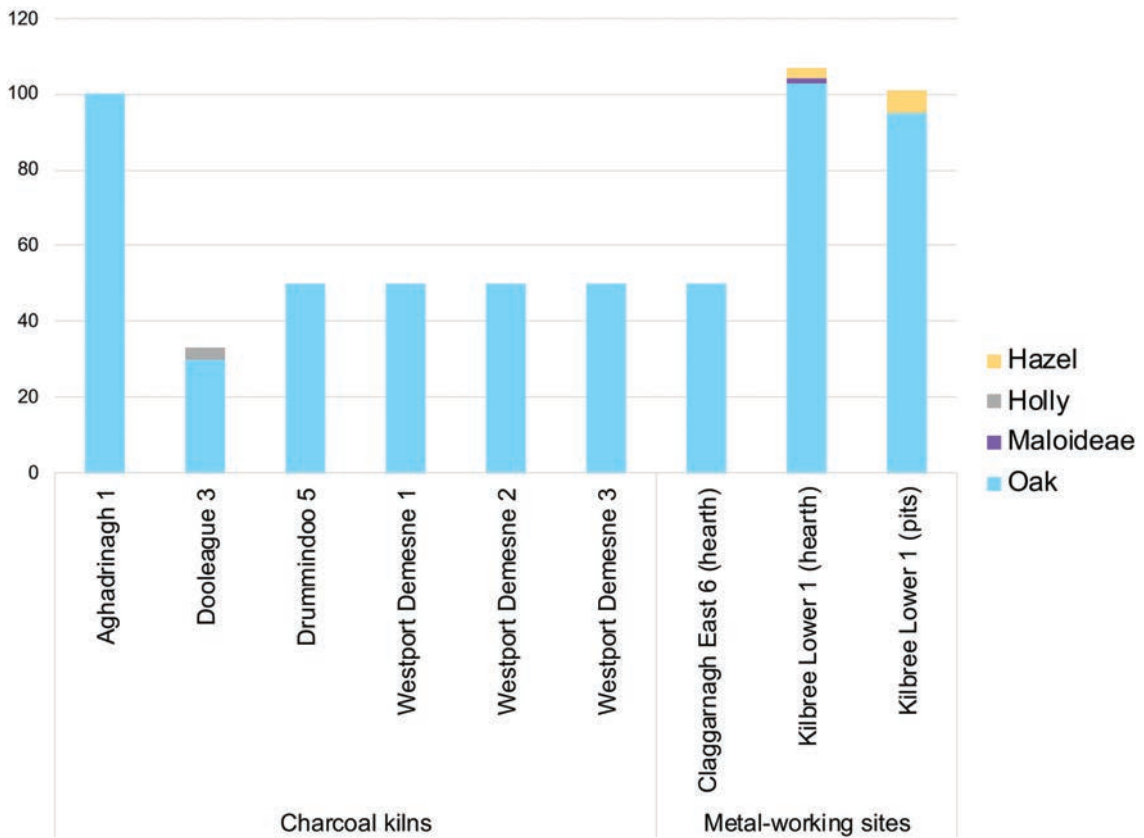
very large blooms being traded from the region. If refined blooms of this weight were also being manufactured 200 years earlier, it might explain the exceptionally large slag cakes that were found at Kilbree Lower 1. The Topographical Dictionary of Ireland (Lewis 1837, vol. 2, 27) refers to ironworks in the parish of Islandeady, Co. Mayo, where ‘formerly large iron-works existed, of which great quantities of the scoria still remain’. No doubt the ironworks seen by Lewis were modern, but they do attest to accessible, commercially viable sources of iron ore in the district, other than bog ore.

Metal-working fuelwood

Ellen OCarroll

Charcoal samples from metal-working sites allow us to identify the types of wood selected as fuel in smelting and smithing work, help to reconstruct the environments from which the wood was sourced, and help to identify the functions of some of the excavated features on these sites. Excavations on the N5/N59 project afforded the opportunity to analyse wood taxa from seven charcoal kilns and two smithing sites (Illus. 4.17).

The dominance of oak across all sites, and particularly in charcoal kilns, concurs



Illus. 4.17 Wood taxa from metal-working sites on the N5/N59 project. Metal-working sites include two smithing hearths, one in a sunken smithing setting, and two other pits (Ellen OCarroll).

with other evidence for woodland resource use in medieval Ireland (e.g. Kenny 2010, 108; Kerrigan & Gillespie 2010b, 349). Oak wood can burn for a long time and can reach very high temperatures—which would have been necessary for smelting iron ore—but oak charcoal burns hotter and cleaner than wood and was considered a superior fuel. The charcoal kilns sampled and dated in Westport Demesne townland span 700 years (sixth to 13th centuries AD) demonstrating an undeviating preference for oak in the medieval period in this part of Mayo.

There are two native species of oak in Ireland: sessile oak (*Quercus petraea*) and pedunculate oak (*Quercus robur*). The latter grows on heavy clays and loams, particularly where the soil is of alkaline pH, while the former is found on acid soils, often in pure stands, and although it thrives on well-drained soils it is also tolerant of flooding (Beckett 1979, 40–1). Both species of oak grow to be very large trees (30–40 m in height) and can live to an age of about 400 years. The history, exploitation and management of Ireland's medieval woodland have largely been reconstructed using historical records and pollen analysis. Despite these sources, much remains to be known about woodland cover in the Irish landscape prior to the 17th century. This is because changes to local woodland were rarely recorded unless they had a social or economic impact. The eighth-century law tract *Bretha Comaithchesca* (Laws of the Neighbourhood) was designed to protect woodlands and regulate their use, specifying the fines for damaging or cutting down trees without permission, with oak bearing the highest fines (Kelly 1988, 144). This suggests a high demand for oak wood during this period. Charcoal analysis by Lyons (2018) has demonstrated a decline in available oak

from the late seventh century AD onwards. The *floruit* of the horizontal mill, which is the principal source of dendrochronology dates from early medieval oak timbers in Ireland, seems to have passed by the end of the ninth century (see for example dates in Rynne 2013, table 6.1).

In view of this increasing scarcity, oak woodlands must have been considered a valuable resource during the medieval period in Ireland and were likely to have been coppiced, managed and controlled to prevent the total loss of semi-natural woodland reserves (McCracken 1971). A coppiced tree is cut down at its base resulting in several new shoots or straight-growing trees that grow out of the stump. Coppicing would have generated a steady, renewable supply of even-sized, fast-growing oak rods for charcoal production. The oak wood from the charcoal kilns on the N5/N59 project ranged in age from 2 to 35 years and some were recorded as 'brushwood'. While the total sample size is too small to say definitively that oak was being coppiced, the fast growth and brushwood nature of much of the oak at least indicates relatively open and possibly managed woodlands in the surrounding landscape.

The small quantity of holly (*Ilex aquifolium*) identified in a charcoal kiln at Dooleague 3 may have been brought to the site incidentally, along with the oak wood that dominated the sample from this kiln; alternatively, it may have been used as a kindling for the kiln, as it is a fast-burning wood that ignites with a bright flame (Rackham 1980, 189).

Given the results from the sampled charcoal kilns, it is not surprising that oak is also dominant in samples from other metal-working features excavated at Kilbree Lower 1 and Claggarnagh East 6. Oak would have

been deliberately selected for a smithing hearth at Kilbree Lower 1. Two pits at this site that contained mainly oak, with small amounts of hazel (*Corylus avellana*), were possibly used to store charcoal, though this may also have resulted from cleaning out nearby smithing hearths. As suggested at Dooleague 3 (above), the hazel and *Maloidea* (hawthorn, mountain ash, apple, or pear) found in metal-working features at Kilbree Lower 1 and Claggnarnagh East 6 were probably collected incidentally with bundles of oak wood or deliberately gathered for use as kindling.

Working the land

Kerri Cleary

In the past, archaeological fieldwork in Ireland has largely focused on medieval settlement sites rather than the landscapes they occupied. In recent decades, however, major linear infrastructure projects, and especially national road schemes, have allowed large tracts of landscape to be examined, permitting us to explore the farmland between the settlement sites. The N5/N59 project is a good example. Our investigation of the project route did not discover any new medieval settlement sites but did capture glimpses of people moving and working across the landscape. These hints of medieval life outside the home include land clearance work in Aghadrinagh and Cloondeash; a field boundary ditch and drying kiln at Lisnageeha; and isolated hearths at Aghalusky and Lisnakirka (also known as Milebush). Most of the evidence dates from between the end of the 10th century and the late 13th century and comes from a cluster of townlands south of Castlebar, where there are numerous ringforts/settlement enclosures scattered

across the landscape, including Aghadrinagh, Lisnageeha, Lisnakirka, Cloonagh and Drumneen (Illus. 4.2).

Land clearance in Aghadrinagh and Cloondeash

On an excavation site at Aghadrinagh 5 (not illus.) there was a cluster of five large stone sockets, with irregular profiles, all filled with a clean mineral soil with no visible charcoal or other anthropogenic inclusions. The stone sockets were overlain by a dark brown deposit of silty clay and stones, with occasional inclusions of charcoal, burnt clay and fire-damaged sandstone. This evidence suggests an area of ground that had been cleared of trees and boulders, to prepare it for tillage. Ash charcoal from the soil layer was dated to AD 994–1157 (Poz-99253), which is very similar to the date obtained from a charcoal kiln at Aghadrinagh 1 (above), located 230 m to the south-east.

At Cloondeash 2, there was a similar cluster of seven large pits or stone sockets, albeit much later in date (Illus. 4.18). Alder charcoal from one of the pits was dated to AD 1480–1640 (Poz-97646). An iron nail (undated) was recovered from the base of another. These too could represent land clearance for farming, though exposed bedrock in one of the pits suggests small-scale quarrying of the underlying limestone may also have taken place, perhaps for a nearby lime kiln (Chapter 5). Three such kilns are recorded within 370 m of the site on the first edition Ordnance Survey map of 1839 (surveyed 1837), for example.

Early medieval sources indicate that ploughing was often accompanied by harrowing to break up clods of earth but, before either of these could be successfully employed, the fields had to be cleared of



Illus. 4.18 Cloondeash 2. Large pits interpreted as stone sockets probably represent an episode of land clearance for tillage (ACSU Ltd).

stones; where there was an abundance of stones, they were often built into walls nearby or piled up as clearance cairns (Kelly 1997, 478; Feehan 2003, 46–8). Burning as a method of clearing land and controlling weeds was probably used in all periods. There are 17th-century records of the sod layer being burnt prior to tilling and sowing to provide extra nutrients for the crop, although this practice was widely condemned by progressive agricultural ‘improvers’ as the post-medieval world gave way to early modern thinking and it was ultimately banned by an Act of the Irish Parliament in 1743 (Feehan 2003, 91; Bell & Watson 2008, 71).

Field ditch and drying kiln at Lisnageeha

At Lisnageeha 2 a drying kiln was built within

an existing field ditch, sometime between the late 12th and late 13th century (Illus. 4.19). The ditch was up to 1.1 m wide and 0.36 m deep, widening at the north-west end where it incorporated the kiln (Illus. 4.20). The ditch was filled with brown loam ploughsoil that included occasional concentrations of silt, charcoal, burnt clay and large stones. A small quantity of bone was also recovered, including four bird bones and two fragments of a cattle metatarsal (foot bone). The field ditch clearly pre-dated the kiln and was probably still open or partly open when the kiln was constructed.

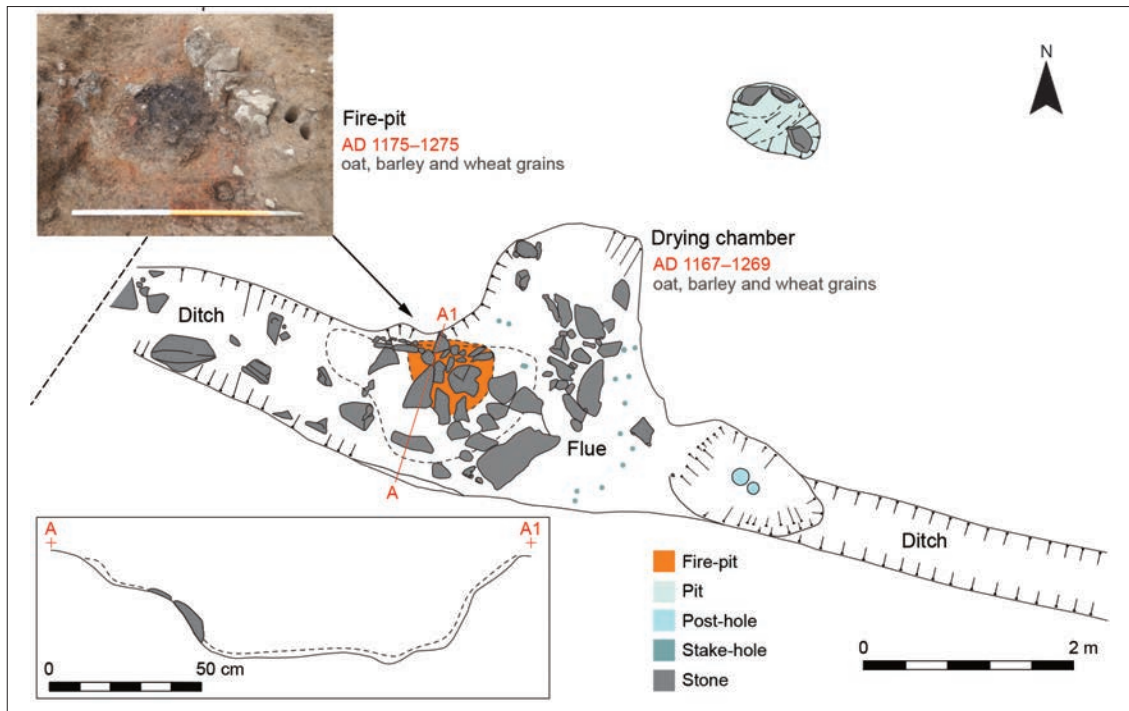
In early medieval sources the land close to a settlement is referred to as the *airlise*, which Kelly (1997, 369) has speculated would typically have comprised enclosures for grazing and cultivation, including a garden. Lisnageeha 2 is within 500 m of at least three known ringforts, all of which may



Illus. 4.19 Lisnageeha 2. Artist's impression of the drying kiln in use (Sara Nylund).



Illus. 4.20 Lisnageeha 2. A drying kiln (top) was cut into a pre-existing field boundary ditch of medieval date (ACSU Ltd).

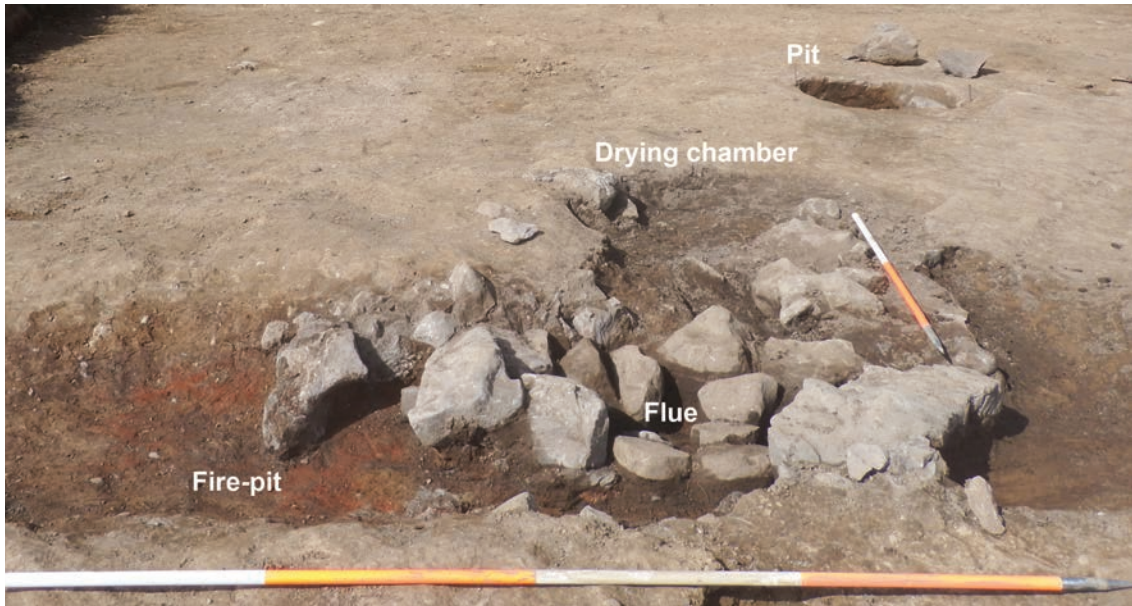


Illus. 4.21 Lisnageeha 2. Plan of the drying kiln. Some of the stones may be collapsed masonry that lined the edges of the kiln but others are remnants of a flue (ACSU Ltd).

have farmed the surrounding land at various times. In his study of land-use in north-west Mayo, O'Connell (1990) argued that, on more fertile lands, there was an intensification of farming in the early medieval period and, from the ninth century onwards, even some marginal land was used for arable farming. Thus, evidence of ditched field boundaries might be expected from at least this period onwards, to demarcate ownership and to protect crops from livestock. It can be difficult, however, to trace these medieval field boundaries in the present-day layout of farmland and across heavily ploughed landscapes. So the ditch at Lisnageeha 2 offers an important glimpse of an early field boundary, which lies roughly parallel with the modern field boundary that survives today.

The drying kiln built into the field ditch at Lisnageeha 2 can be classified as

an L- or comma-shaped kiln. Such kilns were widely used in the past to dry cereal grains, but also legumes and other plants. The surviving remains (Illus. 4.21 and Illus. 4.22) comprised a roughly oval-shaped pit representing the drying chamber and a collapsed, stone-lined flue, which extended to the south-west, in a slight arc, towards the stoke-hole and fire-pit. The drying chamber was positioned upslope from the flue, stoke-hole and fire-pit. This arrangement would have ensured a flow of dry, warm air into the drying chamber and has been recorded at other kiln sites, such as Brooklodge, Co. Cork, and Mullagharlin/Haggardstown, Co. Louth (Monk & Kelleher 2005, 83–4, 95; Clinton 2015; Rickett 2021, 25). An irregular arc of 11 stake-holes around the eastern side of the Lisnageeha 2 kiln may represent a wattled panel forming a windbreak or possibly part



Illus. 4.22 Lisnageeha 2. View from south of the remains of the drying kiln (ACSU Ltd).



Illus. 4.23 Lisnageeha 2. An irregular arc of 11 stake-holes around the eastern side of the drying kiln may represent a wattled panel forming a windbreak or possibly part of the kiln superstructure (ACSU Ltd).

of the kiln superstructure (Illus. 4.23). A roughly L-shaped stone setting in the area of the fire-pit may have been the remains of a fire-box. Three post-holes between the drying chamber and the fire-pit also suggest a superstructure, while two more post-holes, east of the flue and stake-hole arc, may relate to some sort of fixture, perhaps to facilitate loading and unloading the kiln.

A pit with a scorched base, containing some large stones, frequent charcoal and charred cereal grains, was c. 1.6 m north-east of the kiln (Illus. 4.19 and Illus. 4.21). The pit fills resembled kiln waste, while the large stones suggest that some of this may have been dumped after the kiln was dismantled.

Drying kiln fuelwood

Ellen OCarroll

The pattern of different wood-burning choices for different tasks in the medieval period is seen again in charcoal sampled from the late 12th- or 13th-century drying kiln at Lisnageeha 2. Hazel (8.5 g) was the dominant wood, with small amounts of ash (1 g) and *Maloideae*, such as mountain ash, hawthorn, apple and pear (1 g) also identified. The samples were recovered from the fire-pit and the bowl of the drying chamber, as well as from a nearby pit that probably contained dumped material cleaned out of the kiln.

Charcoal recorded from drying kilns is often dominated by one or two wood species (rather than a miscellany of whatever species were easily available), which indicates deliberate selection of preferred fuelwoods. Hazel would have been collected as a fuel because it has a high calorific value and burns well. But hazel rods were also favoured for construction and craftwork (e.g. wattled wall and fence panels, baskets) because they are strong yet flexible. So charred hazel

from kilns may represent recycled wood, sourced from demolished buildings or worn and broken craft objects. Hazel is also likely to have been used in the construction of the kilns themselves (e.g. to support grain heaped over the bowl of the drying chamber, or to support a domed roof of sods or earth covering the chamber). Given the high risk of accidental fires associated with any pyrotechnic activity, some of the charred hazel found in excavated drying kilns may simply have resulted from the superstructures burning down (Evans 1957, 123).

The wood selected as fuelwood at Lisnageeha 2 probably came from nearby scrubland (i.e. the hazel and *Maloideae*), which may have been coppiced (hazel). The small quantity of ash identified indicates areas of more open, managed landscape locally. When the charcoal data from drying kilns is combined with data from charcoal kilns and smithing hearths, a picture emerges of how wood types were preferentially selected, and woodlands exploited and managed, to maintain a constant supply for use in crop-processing and metal-working in this part of Mayo in the medieval period.

Plant remains from the Lisnageeha drying kiln

David Stone

In medieval Ireland cereals were cultivated primarily for their nutritional value and were used to produce food products including breads, porridges and gruels. Cereals were also used for brewing and as animal feed. Secondary products included bedding and thatching straw, for roofs.

The damp Irish climate necessitated drying the harvested grain before further processing. Drying the grain halted



Illus. 4.24 Lisnageeha 2. Charred oats comprised 90% of the plant remains from the drying kiln, with smaller quantities of barley, wheat and wild or weed seeds (David Stone).

germination, prevented decay and made it easier to mill. Grains and other burnt plant parts found in the fire-pit of a kiln may have simply fallen in and become burnt accidentally, or may have been swept up with waste accumulated during the threshing and winnowing stages of crop-processing and subsequently used as tinder. Burnt grain from the drying chamber or kiln bowl is generally interpreted as a remnant of the last use of the kiln. Drying kilns were also regularly cleaned out so, on archaeological sites, kiln waste, including burnt grains, is often found in nearby pits or ditches.

At Lisnageeha 2, charred plant remains were recovered from the fire-pit, stoke-hole and drying chamber of the kiln, and from an adjacent pit. Combining these contexts, 90% of the cereal grain was identified as oat (*Avena* sp.) (2,032 grains; Illus. 4.24), 6% as barley (*Hordeum vulgare*) (139 grains), 3% was indeterminate to species (63 grains) and 1% was wheat (cf. *Triticum turgidum/aestivum/durum*) (16 grains). Oat was one of the most important cereal types in medieval

Ireland and became the dominant crop in the later medieval period; it is well suited to the wet Irish climate and is more tolerant of poor soils in which wheat and barley struggle (McClatchie 2003, 398).

A small number of wild or weed species were also present, including nettle (*Urtica dioica*), wild radish (*Raphanus raphanistrum*), broad-leafed dock (*Rumex obtusifolius*), thistle (*Sonchus* sp.) and buttercup (*Ranunculus acris/repens*). These may have been growing nearby and become accidentally incorporated into the kiln with the cereals. Some of these wild species also have known medicinal properties, however, and could have been used to mitigate health problems. For example, herbalist sources have noted the medicinal properties of species such as dock for treating scurvy and nettle for cleansing blood (Allen & Hatfield 2004, 96).

Additionally, there were four fragments of charred hazelnut shell in the stoke-hole of the kiln and a charred apple core in the fire-pit. They may have been food waste discarded in the kiln during use or may simply have



Illus. 4.25 Aghalusky 1. Trowelling the surface around an isolated hearth (ACSU Ltd).

arrived on site on hazel or *Maloideae* branches used as fuelwood.

Isolated hearths in Lisnakirka and Aghalusky

Kerri Cleary

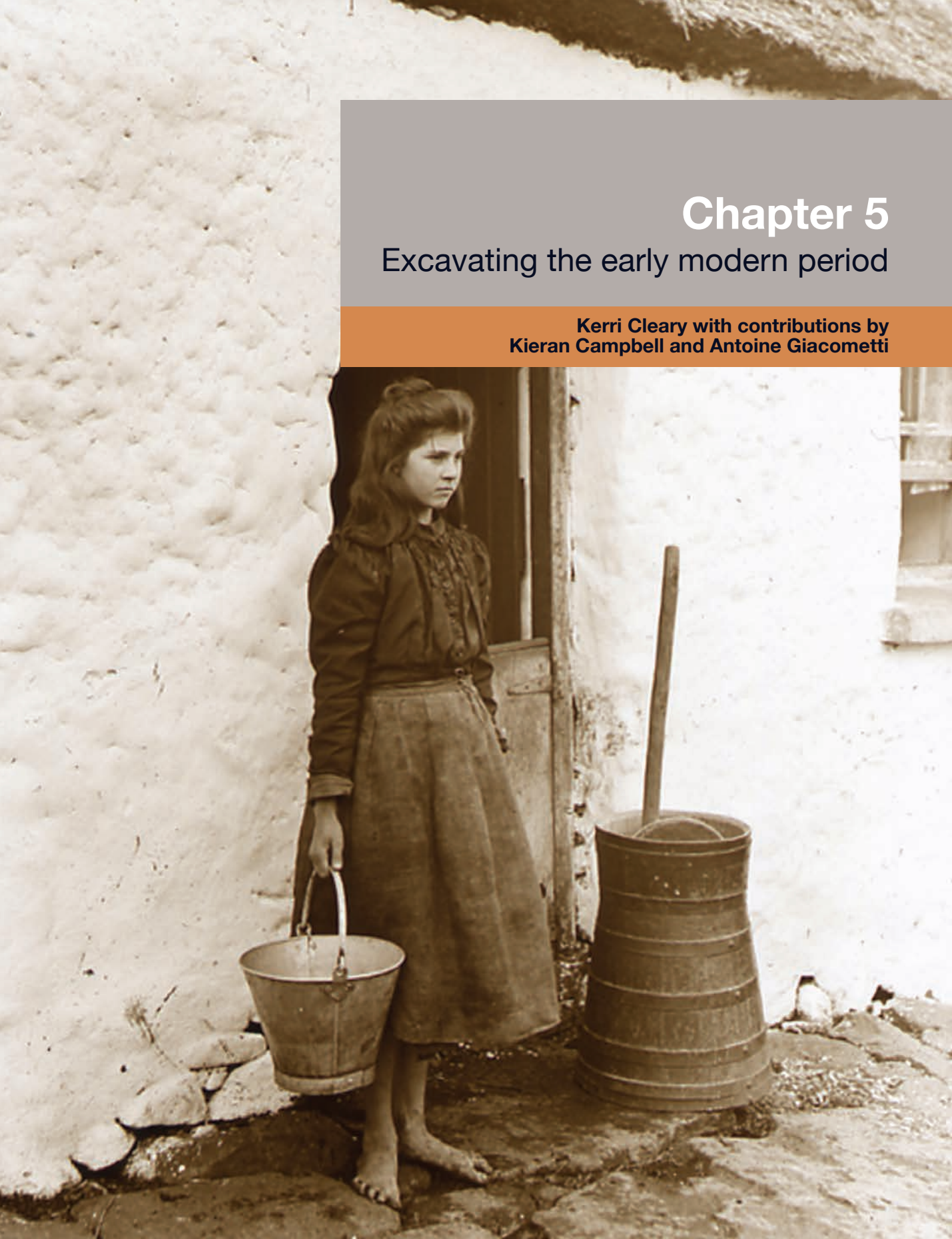
Isolated hearths in unenclosed sites are not uncommon but are difficult to interpret. They can sometimes signal unenclosed dwellings, such as a 10th/11th-century example at Killarainy 5, Co. Galway. This was surrounded by numerous stake-holes in a worn surface interpreted as the ‘well-worn, bare earth floor of a hut or small round-house, with a hearth at its centre’ (Delaney & O’Sullivan 2019, 48–50). There were two examples on the N5/N59 project, similar in date to the Killarainy hearth: they were found at

Lisnakirka 1, south of Castlebar (not illus.), and Aghalusky 1, north-east of Castlebar (Illus. 4.25). Alder charcoal from Lisnakirka 1 was dated to AD 995–1158 (Poz-80372). Hazel charcoal from Aghalusky 1 was dated to AD 1039–1210 (Poz-80374). Neither of these hearths had associated evidence for a dwelling. While similar in appearance to the charcoal kilns described above, they did not contain comparable quantities of charred wood. They are interpreted instead as single-use fires, probably made for cooking and warmth by people working at a distance from their home settlements—perhaps foraging for fuelwood, harvesting crops or herding cattle. The distances need not have been great. The hearth in Aghalusky was 100 m from the nearest ringfort, which may well have been occupied at the time.

Chapter 5

Excavating the early modern period

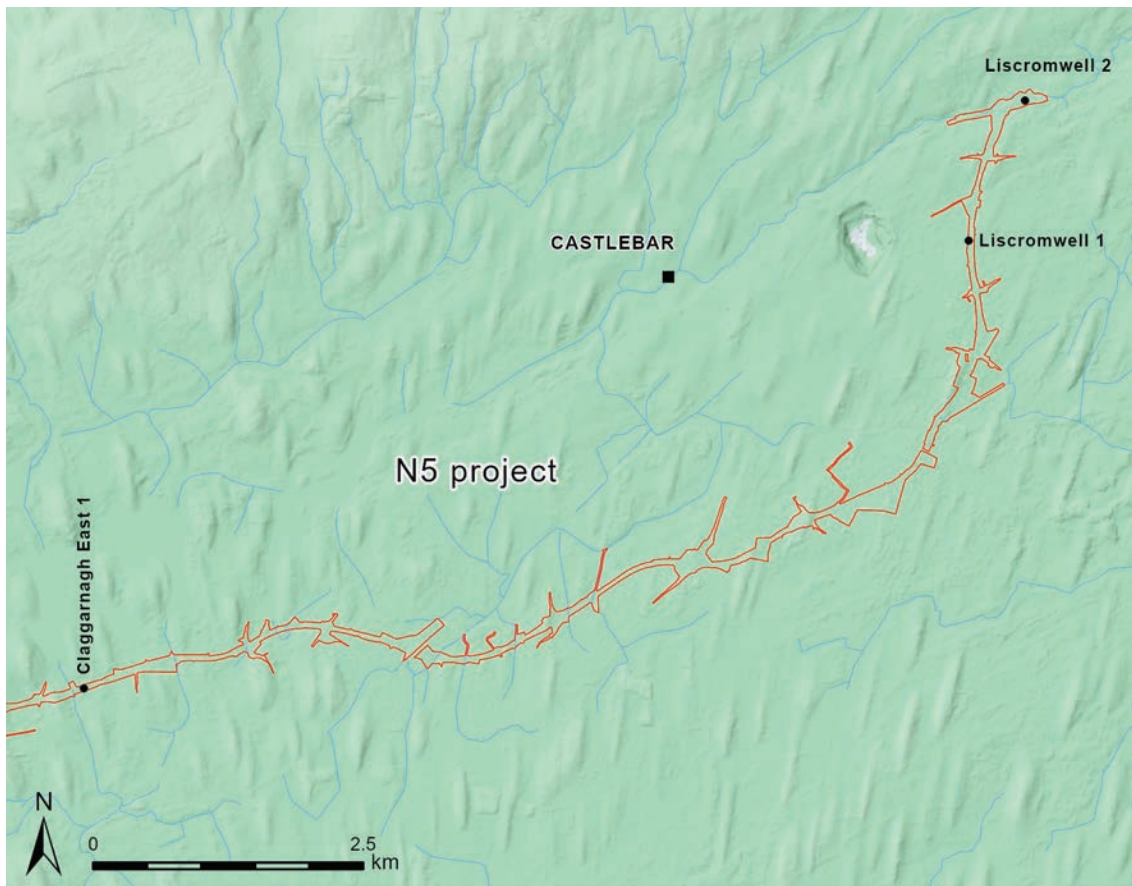
Kerri Cleary with contributions by
Kieran Campbell and Antoine Giacometti



Excavating the early modern period

Archaeological investigation of the early modern period (AD 1700–1900) is a relatively new aspect of the discipline in Ireland. Recent years have seen the publication of overviews of the material

remains of the period (e.g. Horning et al. 2007) as well as studies on particular themes, including industrial heritage (Rynne 2006) and domestic architecture (Orser 2006; O'Reilly 2011).



Illus. 5.1 Excavated sites of the early modern period (AD 1700–1900) on the N5/N59 project (ACSU Ltd based on Tailte Éireann mapping).

On the N5/N59 project there were excavations of early modern remains at three sites, representing a farmhouse, a lime kiln and a water-powered mill (Table 5.1; Illus. 5.1). Architectural surveys were also recorded at a further seven sites, ranging from stone-built bridges (Illus. 5.2) and boundary walls to a section of railway line (Stirland 2015).

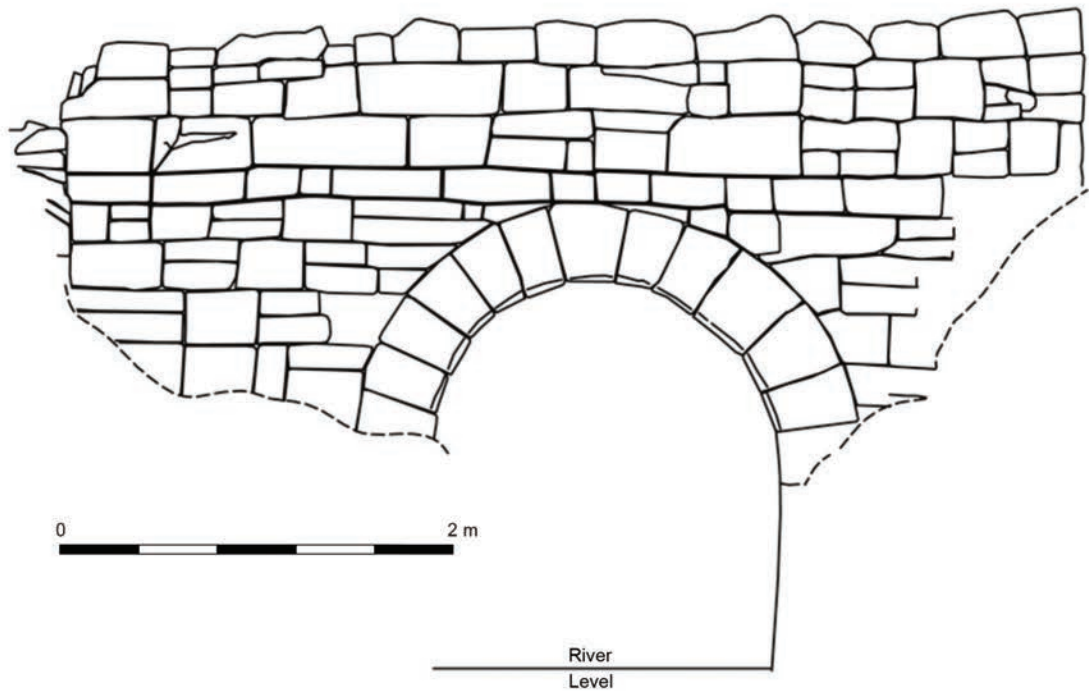
To date, the only other archaeological excavations of vernacular houses in Co. Mayo have taken place on Achill Island, where a deserted village at the foot of Slievemore Mountain was the focus of a seasonal fieldwork campaign from 1991 to 2013. This comprised a survey of the village and excavation of three houses. The village houses were arranged along a street, with a gable end facing the street, and were interpreted as ‘byre-houses’ that accommodated both people and cattle. They were rectangular in plan, many with opposing doorways and some with bed-alcoves and wall recesses (McDonald 2006). Elsewhere, ruins of nine vernacular houses or outbuildings have been surveyed in the vicinity of Charlestown, including a byre dwelling at Cloonlara and a two-roomed house at Cloonfane (Kerrigan &

Gillespie 2010b, 349–57). There have been no previous excavations of early modern mill sites within the county, other than investigations of a tail-race in Westport Demesne (Taylor 2020) and a windmill at Drumshinnagh, which was already in ruins by the 1830s (Guinan 2006). Lime kilns have been excavated in the vicinity of Claremorris, at Mayo Abbey (MacLeod & Madigan 2010) and Rockfield (Nolan 2001), and surveyed at Cranmore, near Charlestown (Kerrigan & Gillespie 2010b, 361–2).

History records the major historical events of the early modern period, from the Irish Rebellion of 1798, to the Great Famine of 1845–52 and the Land War of the later 19th and early 20th centuries. The everyday lives of the generations who witnessed and experienced these events can be understood by looking at the material remains of the period through an archaeological lens. In the future, as more archaeological investigations are undertaken on early modern sites, we will be able to build up a more textured understanding of society and economy and a richer appreciation of everyday life in the period.

Table 5.1 — Early modern (AD 1700–1900) excavation sites on the N5/N59 project

Site name	Features	Objects
Claggarnagh East 1	Farmhouse and associated outbuildings	Pottery, glassware, window glass, clay tobacco pipes, copper-alloy button, iron nails, iron spade-head
Liscromwell 1	Lime kiln	—
Liscromwell 2	Water-powered grain mill with drying kilns and mill-race	Pottery, glassware, glazed tile, red brick



Illus. 5.2 Cloonan Bridge. Architectural survey of north elevation of early 19th-century, single-arch, masonry road bridge, over a narrow stream that marks the townland boundary between Claggarnagh West and Cloonan (ACSU Ltd).

Early modern society in Mayo

In the 18th and early 19th centuries, most people in rural Mayo lived in the clustered settlements known as clachans, built by tenants renting common land from landlords. This type of communal landholding by small farmers, often with close kinship ties, was known as rundale farming (Whelan 1997; Yager 2002; O'Reilly 2018). It employed the infield-outfield system, whereby the nucleated settlement was situated on the best land (infield), primarily used for tillage, with surrounding land of inferior quality (outfield) largely used for grazing livestock but sometimes reclaimed for growing potatoes. Beyond this lay commonage where grazing was organised communally. This system allowed most individuals to have access to some land, no matter how limited in acreage. It could also result in a tenant's holding being fragmented over a wide area and in the unequal distribution of suitable land among co-tenants. The Hon. Frederick Cavendish, proprietor of the Castlebar newspaper the *Connaught Telegraph*, reported in 1844 to the Devon Commission (1845, 423)⁴ that this led to 'perpetual squabbling and fighting'.

While the term 'clachan' is widely used to describe such settlements, it is also acknowledged to be somewhat problematical. It is a Scottish-Gaelic word that was introduced to Ireland during the early 17th-century plantation of Scottish and English colonists in Ulster. The term formerly referred to a small settlement that usually had a church, rather than a cluster of simple dwelling houses, as it came to

mean in Ireland. Other terms that have been applied to nucleated common tenancies are 'farm village' and 'hamlet'. Almquist (1977, 84–8) suggests that the average village rental in Mayo during the 19th century probably involved 15 to 20 partners and 'taking all village people into account—partners, wives, widows, widowers and children—the total number of people living in a common rental varied from 60 to 110 or perhaps many more.'

A population surge in Ireland in the 18th century led to much subdivision of existing tenanted landholdings, as well as expansion into previously unsettled areas, largely west of the River Shannon. Such expansion was aided by the ability of potato crops to thrive in boggy ground in a wet climate. As the century progressed there was also a boom in tillage for cereal crops, due to demand from European markets. This demand initially led to the granting of bounties (government subsidies) to farmers sending corn and flour to Dublin from 1759, but was later replaced with payments to grain merchants for the export of grain, with the passing of Foster's Corn Law in 1784 (Feehan 2003, 98). The end of the 18th century also saw large-scale immigration of Ulster Catholics to Mayo, following sectarian clashes with Presbyterian linen-weavers that led to the infamous 'Battle of The Diamond' in Co. Armagh, in 1795 (Hogan 1979). Population growth and expansion onto previously unfarmed land, alongside an increase in cereal farming for export and the growth of the linen industry, all led to a rise in the demand for fertilisers to maintain the intensively worked infield areas in the rundale (infield-outfield) system

4 Officially this was called the Commission on Occupation of Land (Ireland) but was commonly known as the Devon Commission after its chairman, the Earl of Devon. It was established in 1843 to investigate issues around land leases. The findings were reported in 1845.

(Feehan 2003, 115). The fertilisers included manure, peat, seaweed, sand and lime.

On their smallholdings in Mayo, farmers at this time generally grew oats for the export market, barley for illegal distillers, flax for local linen manufacturing and potatoes mainly for personal consumption (Jordan 1994, 57). At the beginning of the 19th century, McParlan's (1802, 28–9) *Statistical Survey of the County of Mayo* records that in the barony of Burrishoole, where Claggarnagh East is located, 'no less than 150 ton of oats, 50 of barley, and 100 of potatoes, are annually exported from Newport, beside an abundance for home consumption', while in the barony of Carra, barley was 'smuggled for private distilleries'. During this time, spinning flax was a cottage industry across Mayo, with many small farmers relying on the linen industry to earn cash to pay their rents. Farmers also had access to outfield grazing land, and McParlan (*ibid.*, 41) reported that in the mountainous pasture of the barony of Murrisk, most had 'one or two cows, and one horse, besides a few sheep, in proportion to their tenures'.

By the 1830s, efforts were being made to undermine the rundale system of communal farming by landlords who wanted to reorganise their lands into more productive and lucrative large farms. Due to population pressure, this initially failed in many areas. Indeed, by 1841 Mayo was the most intensively subdivided county in Ireland, with 72.6% of all holdings comprising between one and five acres (Almquist 1977, 356). As the population continued to rise in the decades before the Great Famine, smallholders whose farms were getting smaller as their families got bigger became single-crop farmers, with little land now available for cash crops such as oats. The proportion of land devoted to potatoes grew

steadily. The linen cottage industry had also collapsed by this time due to technological changes that led to factory-based spinning and weaving, alongside the emerging dominance of cotton in the English market. Writing in 1837, Lewis (1837, vol. 2, 358) described the decline in frank and concise terms:

In the districts around Westport and Newport the people were formerly in comfortable circumstances, uniting the occupations of farmer, weaver, and fisherman; but for several years the change in their circumstances for the worse has been very great, which has been attributed to the decline in the linen trade, the subdivision of farms, and early and improvident marriages.

The consequence was an increasingly impoverished population. The ensuing Famine saw a wave of evictions and emigration. Numerous oral accounts of house levelling, in the course of evictions, were recorded across the island at this time, many of which recall thatched roofs being burned and stone walls dismantled and scattered. In 1847, for example, when John Walsh of Castlehill, Crossmolina, evicted his tenants on the Mullet peninsula, Belmullet, he unroofed their houses, only to later find many of them sleeping in lean-tos or makeshift tents in the rubble of their former homes (Jordan 1994, 111). Immediately after the Famine, the Earl of Lucan reportedly cleared entire townlands in Co. Mayo of tenants that were in arrears, often converting their tillage land into pasture for cattle and sheep and either keeping the land himself

or leasing it out to large ranchers (*ibid.*, 112–13). The townland of Liscromwell is a good example of this, where 10 families were evicted from 13 plots in May 1849 (see also Aghadrinagh in Chapter 1).

Many people gave up their smallholdings at this time in order to receive famine relief. While some landlords reinstated these tenants as caretakers, so that they might still be eligible for relief without losing their landholdings, other landlords abused the system by demanding that the tenants on relief also surrender their cottages, which they then demolished (Jordan 1994, 116). Across the province of Connacht, the official court and constabulary records suggest that 30,000 families, or 150,000 people, were put out on the road in the Famine years (Smyth 2012, 288–9). We have little knowledge of the thousands more who were either evicted without any legal decree or who simply abandoned their holdings and emigrated.

Following the Famine, there were renewed efforts to abolish rundale farming and its associated system of partnership leases. Further clearances of tenants from the land were justified in a number of ways, including a belief that ‘only individual farms would encourage initiative and self-reliance’ (Whelan 1997, 90). Clearances were also a response to rising livestock prices, which meant that a landlord’s income could be guaranteed by letting the lands to large graziers, preferably from England or Scotland (Jordan 1994, 117). Also, the Encumbered Estates Act, introduced in 1849, made no provisions for tenant farmers, and those who purchased the failed estates were determined to make a return on their investments by focusing on sheep and dry cattle (Nolan 2012, 571). Later again, the Congested Districts Board (1891–1923) was charged with consolidating landholdings.

This sometimes involved demolishing entire clachans, the organised ‘migration’ of families, and reorganisation of land plots within new boundaries, though other hamlets remained substantially intact, albeit with a depleted number of buildings (O’Reilly 2018, 28–9). All of this resulted in a great number of traditional clachans disappearing from the landscape during and following the Great Famine. In 1957, Evans (1957, 11–12) stated that one of the most striking reactions to the Famine was the desire of most people living in the countryside to have an isolated dwelling house: ‘the clachan or hamlet, once the centre of communal life and tradition, is despised, a symbol of squabbling poverty’.

A pre-Famine farmhouse at Claggarnagh East 1

On the N5/N59 project an excavation at Claggarnagh East 1 uncovered the remains of a farmhouse that was built in the late 18th or early 19th century and occupied until the Great Famine (1845–52) or later. What survived below the ground indicated that this was a stone-built house aligned roughly east/west, with its west end to the roadside (Illus. 5.3 and Illus. 5.4). A north/south wall at the west end incorporated a fireplace with an open hearth at floor level. Small sections of other wall foundations also survived, but these were too fragmentary and intermittent to ascertain the original length of the building or the number of rooms. Houses where the fireplace is positioned on or near one of the gable walls were typical in the west of Ireland (Illus. 5.5; Aalen 1997, 149). Some were small, one- or two-room dwellings, while others had an additional small room behind the hearth (Ó Danachair 1946; 1972; Aalen 1996). The kitchen, which was the main room, often included opposing

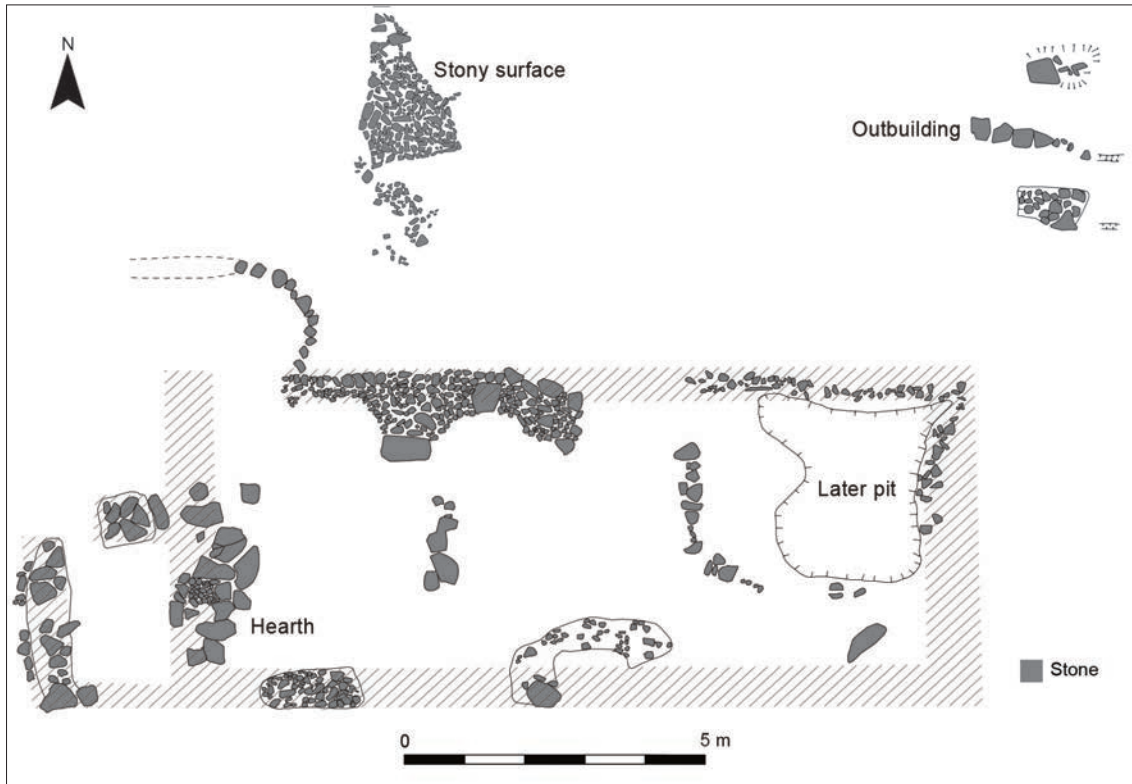


Illus. 5.3 Claggarnagh East 1. General view from west of the excavated building remains (ACSU Ltd).

doors positioned away from the fireplace. This allowed direct entry into the house and helped to manage the flow of air and to disperse smoke from turf fires.

The earliest detailed mapping of Claggarnagh and its environs is found in William Larkin's (1808) *First Division of the Mail Coach Road from Ballinasloe to Westport* (see Chapter 1). This map illustrates a small cluster of buildings in this area labelled 'Clararuagh' but does not specifically show a house on the Claggarnagh East 1 site (Illus. 5.6). William Bald's (1830) *Map of the Maritime County of Mayo*, which was commissioned by the Grand Jury and surveyed between 1809 and 1817, depicts a larger concentration of buildings (i.e. a clachan), labelled 'Clogarnagh'. It is possible then that the Claggarnagh East 1 farmhouse

was built between 1808 and Bald's survey in 1809–17. The next detailed map is the first edition Ordnance Survey six-inch map of 1839 (surveyed in 1837). On this map, the clachan, with its 'corn mill' and millpond, consists of about three dozen buildings. The farmhouse at Claggarnagh East 1 is clearly depicted for the first time. It stood in the corner of a small, oblong plot of land, on the east side of a local road or track that passed through the clachan, extending southwards to join the old main road (corresponding with the former N5). By 1896, when the Ordnance Survey 25-inch map was surveyed, most of the buildings in the clachan had disappeared, including the farmhouse at Claggarnagh East 1, along with the mill and its millpond. This map shows only a handful of buildings, including a smithy and a school, concentrated



Illus. 5.4 Claggarnagh East 1. Plan of the excavated building remnants (ACSU Ltd).

around the main road.

As described above, the consequences of the Great Famine were emigration, evictions and house levelling, including clearances of entire villages. It is likely that the farmhouse at Claggarnagh East 1 was abandoned during this time, either voluntarily or under duress, and that the land was subsequently cleared and levelled for reuse. There is some particular evidence for this from the excavated remains: a large pit was cut through the compacted earthen floor of the eastern part of the house and filled with demolition rubble, presumably to clear and level the site for agricultural use. This is paralleled in a settlement at Ballykilcline, Co. Roscommon, where tenants' houses were pulled down in 1847 and 1848 under the orders of George Knox of Strokestown,

who was the agent for Crown lands in the area (Scallan 1995, 4–5). This followed a long period of rent arrears, after the lands had been all but forgotten by the Crown, and ultimately resulted in a forced mass emigration of the tenants, to New York. The abandoned site was archaeologically investigated by Orser (2006, 57), who found that, following demolition, the largest stones were taken away—undoubtedly for use by the landlord elsewhere—and the land levelled for grass pasture.

Remains of the house

Only some of the foundations of the farmhouse at Claggarnagh East 1 survived but, based on other examples of vernacular houses of this period, it is likely to have



Illus. 5.5 Small cottage with chimney in the gable wall at Foxford, Co. Mayo, photographed in 1911 by John Cooper Ashton (University of Glasgow Archives & Special Collections, Ashton 3/77).

been a single-storey building, oblong in plan and one-room deep. The foundation remnants were limestone rubble and spreads of similar rubble across the site indicate that this was used for the walls too. These stones could have been bonded with clay or lime mortar, but no such materials were observed during the excavation, and indeed, drystone construction was more common in the West of Ireland, sometimes with lime-rendered internal walls (McParlan 1802, 65; Aalen 1997, 154). No slates were found in the demolition rubble or topsoil, which suggests the roof was thatched. The surviving foundations and rubble spreads indicate a house measuring approximately 13 m long by 6 m wide externally, with walls 0.5–0.8 m thick (Illus. 5.7). Internally, some large stones were perhaps vestigial remnants of

a transverse partition wall. If the house was divided in this way, each room would have opened into the next without a passage or central hall. Such houses often had a sleeping loft at one or both ends of the building, although there was no evidence of such in the scant surviving remains on the present site. The western end-wall incorporated a fireplace with an open hearth at floor level (Illus. 5.8). There were traces of a ‘rammed’ or compacted earthen floor throughout the area, and some flagstones around the hearth.

Claggarnagh East 1 was probably a ‘direct entry’ house, which means that the main entrance(s) opened directly into the living space, which was invariably also the kitchen. (This was the commonest arrangement in the west and north of Ireland. ‘Lobby-entry’ houses, with a little internal lobby



Illus. 5.6 The clachan settlement at Claggarnagh East on early maps: (top left) Larkin's *First Division of the Mail Coach Road from Ballinasloe to Westport* 1808 (National Library of Ireland); (top right) Bald's *Map of the Maritime County of Mayo* 1830 (surveyed 1809–17) (Mayo County Council); and (bottom) the Ordnance Survey first edition six-inch map 1839 (surveyed 1837) (Taillte Éireann).

at the main entrance, were more common in the south and east.) An entrance in the north wall of the farmhouse was suggested by a large flagstone that would have been positioned just inside the threshold. The fireplace was usually set in the transverse wall further from the entrance. The main fireplaces in these houses were generally 'high, wide canopied structures occupying the width of one end of the kitchen and deep enough to accommodate a bench' (O'Reilly 2011, 204). All cooking was done on the open fire and the flagstones around the hearth at Claggarnagh East 1 would have formed a flat, clean surface for earthenware or metal

pots and cooking utensils. A large fragment of black-glazed earthenware was recovered from the rubble in this area. It was probably a fragment of a large storage vessel or a crock for processing milk (Campbell, below).

Ancillary buildings

The foundations of an external structure or lean-to abutted the gable wall at the west end of the house (Illus. 5.4). As the lean-to would have benefited from heat generated by the fireplace within the house, in the shared gable wall, it would have been ideal for stalling animals. Alternatively, it may

have been a fuel store, as peat was commonly stored in lean-tos abutting a gable wall, and would also have benefited from transferred heat, keeping it dry over the winter.

There were foundations of a detached outbuilding north-east of the house, at a distance of 3 m from it (Illus. 5.4). This was probably a cow byre. Livestock were kept close to dwellings at this time to facilitate their care, especially when ill or birthing. A byre would have had at least one stall and probably contained a dung channel in the floor. Alternatively, this structure may have

been a stone-built, open pen, used as a pigsty.

Compact stony spreads were present outside the house. One stony surface at the north wall, around the entrance, was probably a remnant of a cobbled path. Another stony surface 2.8 m north of the house, directly opposite the entrance, might have been part of a yard or the floor surface of another outbuilding (Illus. 5.4). A detached outbuilding is depicted on this side of the house in the first edition Ordnance Survey map of 1839 (surveyed 1837) (Illus. 5.6).



Illus. 5.7 Claggarnagh East 1. Foundation remnant of a long wall on the north side of the building (looking west) (ACSU Ltd).



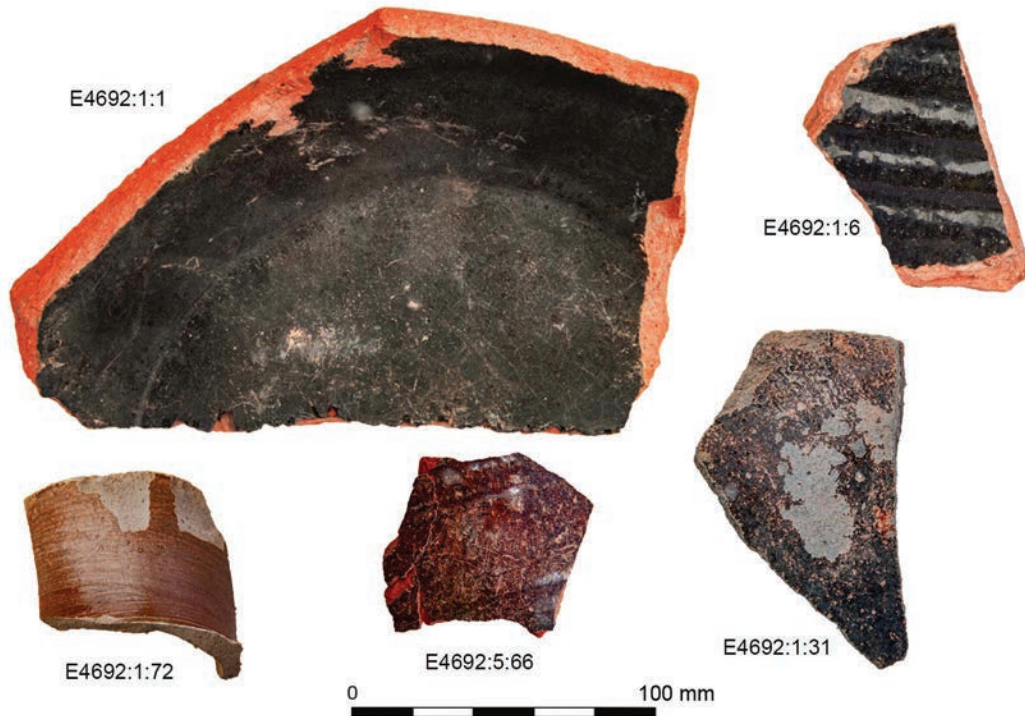
Illus. 5.8 Claggarnagh East 1. Detail of the flagstone floor of a hearth set into the western wall, possibly the gable end-wall of the building (ACSU Ltd).

Objects from daily life

Broken and discarded objects recovered on the excavation site provide insights into the daily life of the people who built and occupied the farmstead at Claggarnagh East. The pottery sherds represent coarse earthenware vessels, fine white tablewares and a stoneware jar, comprising a mixture of locally made and imported wares (Illus. 5.9 and 5.10; Campbell, below). The pottery assemblage is typical of rural farmsteads of this date and mirrors assemblages from similar sites, such as Ballykilcline, Co. Roscommon (Orser 2006), and Lavally, Co. Galway (Delaney et al. 2010). The householders would have proudly displayed their ware on a wooden dresser, which was a focal point of most kitchens at this time (Illus. 5.11). While Irish-made coarse earthenwares would have been common during this period, relatively little is known about this indigenous rural industry. In a study on Irish earthenwares, Orser (2006, 76) mentions an early 19th-century account of Ireland by Edward Wakefield,

an English statistician and authority on agriculture, who referenced the superb qualities of Irish ‘potter’s clay’, with good clay sources existing in counties Kilkenny, Tyrone, Meath, Donegal, Cork, Leitrim and Mayo. There are no known early references to potters in Mayo, although there are examples from the neighbouring counties of Galway and Roscommon. A lot more is known about imported wares from Britain at this time, much of which was refined earthenware (also referred to as ‘ceramics’), in a wide variety of forms that included teacups, teapots, plates, serving platters, mixing bowls and chamber-pots (Brighton & White 2006). Between the 1760s and 1840s, ceramic wares were imported into Ireland in increasing quantities and varieties, much of it from Staffordshire and, because of their relative cheapness and utility, they were found in most Irish homes (Barnard 2021).

Glassware sherds from Claggarnagh East 1 represented at least 15 different vessels (Table 5.2). The assemblage (not illus.) includes sherds of tall cylindrical wine bottles



Illus. 5.9 Claggarnagh East 1. Domestic pottery sherds from the farmstead site represented by coarse earthenware vessels such as imported black-glazed earthenware (1:1 and 1:6), locally made glazed red earthenware (1:31 and 5:66) and an imported salt-glazed stoneware jar (1:72) (Ian Russell).

with well-worn bases, and sherds of lead-crystal wine glasses, all dating to c. 1760–1850 (Giacometti 2019). Fragments from coloured phials represented a pale green, octagonal bottle, and a clear, cylindrical vessel, both of likely 18th- or 19th-century date. These would have held small quantities of valuable liquids such as medicine, oil or perfume. In broad terms this assemblage is typical of the period, although the wine glasses are a rare find and would have been luxury items in a small tenant farmer's household—perhaps a gift from relatives who had emigrated.

Seventeen pieces of flat glass, representing at least six windowpane fragments, were also recovered (Giacometti 2019). These are mainly clear, although four

have blue or green tints. They include one diamond-shaped 'quarry' of a type first seen in Ireland in the windows of late 16th- and 17th-century mansion houses, but which had become common in lower-status houses (e.g. labourers' estate cottages) by the 19th century (Roche 2007, 10). If such a window did exist on the Claggarnagh East farmhouse then the remaining panes and associated window frame may have been salvaged for reuse before the house was levelled.

Seven iron nails and an iron shovel-head were recovered. The remains of the shovel-head were found in the area of the outbuilding, where it may have been stored or was left after the building was abandoned. A copper-alloy single-loop button was recovered from the interior of the house



Illus. 5.10 Claggarnagh East 1. Imported fine white tablewares: pearlware shell edge plates (40:38 and 40:36), London shape cup (1:91), spongware tea or coffee pot (1:198), dipped ware bowl rim with rouletted band (5:88) and dipped ware bowl with banded decoration (40:63) (Ian Russell).



Illus. 5.11 Dresser displaying ware in kitchen of cottage in Co. Mayo, photographed in 1900s by John Cooper Ashton (University of Glasgow Archives & Special Collections, Ashton 3/15).

Table 5.2—Claggarnagh East 1. Early modern glassware (MNV = minimum number of vessels)

Vessel type	Sherds	MNV	Form
Wine glasses	1	1	Clear crystalline glass, drinking bowl fragment
	3	1	Clear glass, possibly lead crystal, drinking bowl fragments
Wine bottles (cylindrical)	67	9	Dark to bright green bottles with rounded heels and both low and high push-ups
Phials (cylindrical)	1	1	Clear glass, thick walled with rounded heel
	2	1	Pale blue glass, thin walled
Phial (octagonal)	2	1	Pale green glass, thick walled with square heel
Bottle (square sided)	2	1	Clear flat glass with green tint
Total	78	15	



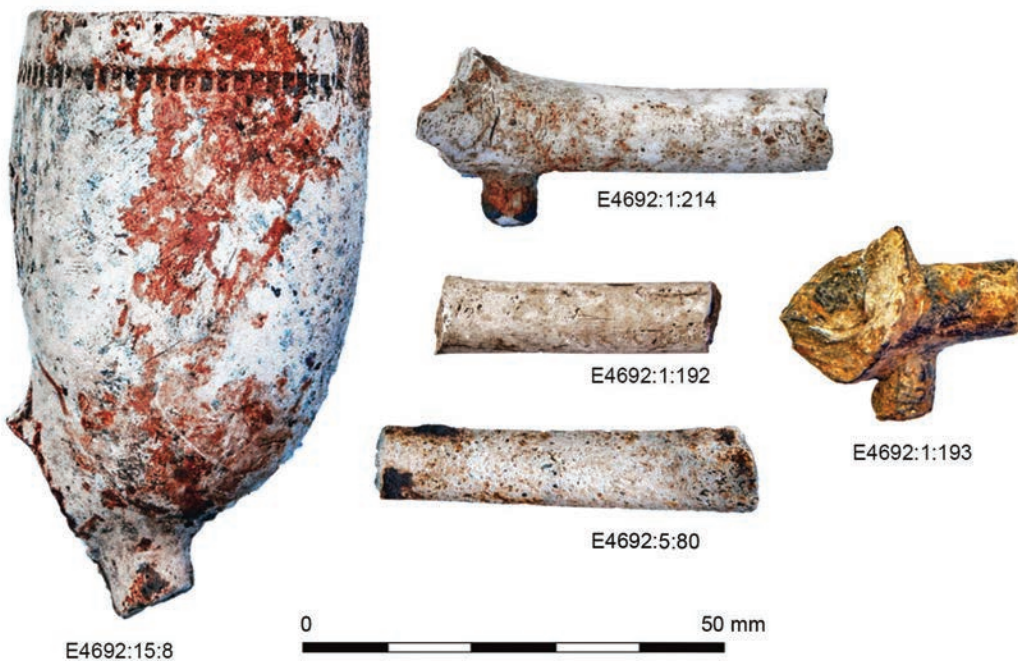
Illus. 5.12 Claggarnagh East 1. Copper-alloy button: front (left) and back (right) (Ian Russell).

and is likely to date to the 19th century (Illus. 5.12). It has a plain, roughly circular face, while the rear surface has a single line concentric to the button edge and a single

loop containing some preserved textile.

Five clay tobacco pipes were represented by two stem fragments and three bowls (Table 5.3; Illus. 5.13). These span the 17th to 19th centuries and include both imported and locally made examples. The imported ones were probably shipped in via Sligo or Westport (Buckley 2018). The earliest pipes had small bowls due to the scarcity and high cost of tobacco and were quite plain, but the bowls became larger as supply

increased and by the mid-17th century highly decorated examples were being produced, heavily influenced by Dutch styles (Atkinson & Oswald 1972; Norton 2013). In the 19th



Illus. 5.13 Claggarnagh East 1. Clay tobacco pipe stem fragments (1:192 and 5:80), bowl and stem fragments with a spurred foot (1:214 and 1:193) and a complete bowl (15:8) from a 'labourer's pipe' made in Galway in the mid or late 19th century (Ian Russell).

Table 5.3—Claggarnagh East 1. Early modern clay tobacco pipes

Date	Fragment type (Illus. 5.13)	Bore diameter	Origin
17th to early 18th century	Stem, undecorated (1:192)	2 mm	—
Late 17th century	Bowl, spurred base, partial stem, undecorated (1:193)	2 mm	England
Late 17th century	Bowl (shattered, not illus.), spurred base, partial stem, undecorated (1:214)	2 mm	England?
19th century	Stem with heavily abraded mouthpiece, undecorated (5:80)	3 mm	—
Mid- to late 19th century	Bowl, spurred base, partial stem, milled and stamped decoration (15:8)	3 mm	Galway

century, many pipe bowls manufactured in Ireland were decorated with political slogans, and the ‘labourer’s pipe’, also known as a ‘cutty’ or ‘duidgan’ (dúigín), became ubiquitous (Buckley 2018). At Claggarnagh East 1, a 19th-century stem fragment and a mid- or late 19th-century pipe bowl were recovered from the demolition rubble and interior of the house. The top of the bowl is decorated with milling (or rouletting). This was a common form of decoration applied with a small knife or similar tool. The inner face of the bowl, just above the stem, bears a stamped design of the number ‘43’ encircled. This is the maker’s mark of Laurence or Samuel O’Gorman of No. 43 Presentation Road, indicating that the pipe was made in Galway city (Norton 2004).

Domestic pottery

Kieran Campbell

An assemblage of 279 pottery sherds was recovered from the ruins of the early 19th-century cottage at Claggarnagh East 1. The sherds are from coarse earthenware vessels for use in the kitchen or dairy, fine white

tablewares, and a stoneware jar (Table 5.4; Illus. 5.9 and Illus. 5.10). The sherds were largely recovered from disturbed contexts and reflect the abandonment and demolition of the cottage, whereby some of the contents of the house were mixed in with collapsed rubble and dispersed across the site when the building was levelled, probably in the period of the Great Famine (1845–52) or its aftermath, when famine and disease were succeeded by emigration.

Coarse earthenware

Two fabric types were identified among the coarse earthenwares: black-glazed earthenware and brown-glazed red earthenware. No complete vessel profiles could be reconstructed from the sherds, though many were quite large, but all would appear to come from a limited range of storage jars and large bowls or pans. Among the glazed red earthenwares there are two rim sherds, both rounded externally, one from a bowl with a diameter of c. 240 mm (Illus. 5.14) and glazed internally, and the second from a small storage jar, glazed both internally and externally.

Table 5.4—Claggarnagh East 1. Early modern ceramics (MNV = minimum number of vessels)

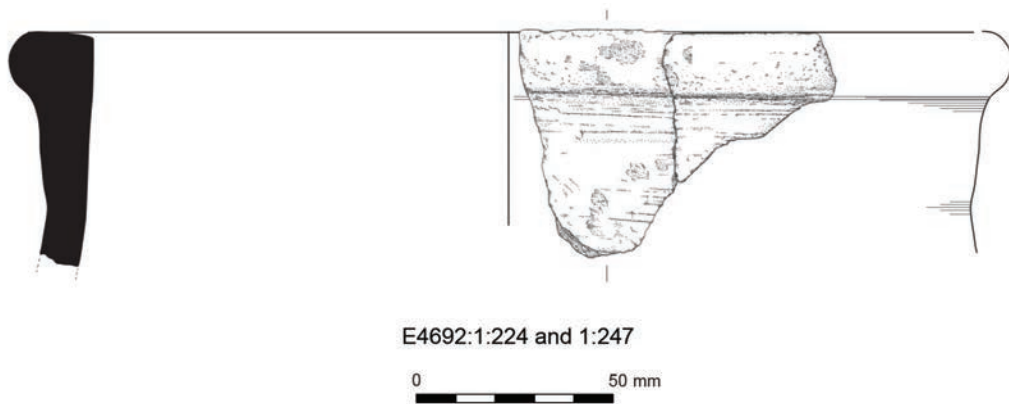
Pottery type	Sherds	Weight (g)	MNV	Form	Origin
Black-glazed earthenware	98	4426	5	4 large bowls/pans; 1 storage vessel	England/Wales
Glazed red earthenware	40	685	5	Bowl, storage vessel, jug?	Ireland
Creamware	11	16	2	Mug, cup	England
Pearlware	88	514	14	Plates, saucer, bowls, jug	England, including Stoke-on-Trent
Dipped ware	20	90	5	Bowls, mug, jug?	England
Spongeware	5	37	2	Bowl, tea/coffee pot	England
Other glazed white ware	15	113	3	Plate, bowl, cups	England
Stoneware	2	30	1	Blacking bottle	England
Total	279	5911	37		

While black-glazed pottery was sometimes produced in Ireland, for example at Tuam in Co. Galway, the Claggarnagh East 1 vessels appear to be imported ware, most likely from a source in north-west England, e.g., south Lancashire or Staffordshire, or from Buckley in Clwyd, north Wales. Black earthenwares were being imported into Galway from Liverpool and Chester from the late 18th century (Meenan 2004, 393–4). The glazed red earthenware is more likely the product of one of the many local potteries operating throughout Ireland until the mid-19th century. Orser (2006, 75–6) counted references to 24 such industries operating in 1837 in Samuel Lewis's *Topographical Dictionary of Ireland*. None of these is situated in Co. Mayo, however, and indeed many other potteries, not mentioned by Lewis, appear

on early Ordnance Survey maps. In Galway, for example, a pottery kiln is shown on the first edition six-inch map of 1840 (surveyed in 1837) operating at Killaloonty, 1 km west of the town of Tuam, with the site of a kiln reportedly discovered there in the 1960s (Carey & Meenan 2004). An 18th-century pottery kiln has also been excavated in the town of Tuam, while at Boyle Abbey, Co. Roscommon, an excavated kiln for producing roof tiles, and possibly pottery, was dated to the late 17th or early 18th century (ibid.; Meenan 2022, 141–2).

Glazed white earthenware

The glazed white earthenware consisted of fine tableware, either plain white or decorated with bright colours in a variety of techniques (Table 5.4; Illus. 5.10). These



Illus. 5.14 Claggarnagh East 1. Reconstructed rim of a glazed red earthenware bowl (Sara Nylund).

wares were factory-made at many centres in Britain from the mid-18th century onwards. Creamware has a start date in the 1730s and was widely manufactured in Staffordshire and other locations in England throughout the second half of the 18th century (Jennings 1981, 227). Pearlware was produced from c. 1780 as a development of creamware and continued to be made into the 19th century, with cobalt added to the glaze to effect a blueish tint. The pearlware recovered from Claggarnagh East 1 includes at least seven shell-edged plates, with a characteristic symmetrical, scalloped design dating to the period 1800–1830. Dipped ware is a late 18th- and 19th-century ware on which different coloured slip was used to make banded, trailed or cut designs (Brighton & White 2006, 121–2). It usually comes in ‘hollow’ vessel forms such as mugs, jugs, bowls, tea and coffee pots, and was the cheapest coloured earthenware available. Spongeware is characterised by glaze in a variety of colours, dabbed or stippled onto the biscuit body with a sponge. (Biscuit refers to the first firing, conducted at a temperature lower than the subsequent glaze firing.) It was common on tea wares in the mid- to late 19th century and was especially popular in

the 1820s and 1830s.

Stoneware

Rim and shoulder sherds from a salt-glazed stoneware jar from Claggarnagh East 1 are of a form commonly known as ‘blacking bottles’. Blacking was a fine black paste, generally imported from England, and used widely in the 19th century for polishing shoes and coating kitchen ranges and stoves.

Overall, the assemblage from Claggarnagh East 1 represents a collection of pottery sherds that one might find in any rural cottage of the period and offers a glimpse of life in pre-Famine Mayo. An iron pot would have been the primary cooking vessel of the time, with coarse earthenware vessel forms, such as milk pans and bowls, used for preparing and storing foodstuffs. Wooden vessels may also have been used but rarely survive. Imported tea and table wares were obviously affordable for rural, tenant, farming families. Earthenwares were readily available at markets and in shops specialising in these wares and it is notable that Slater’s *Commercial Directory* of 1846 lists three ‘China, Glass & Earthenware Dealers’ in both Castlebar (all on Shop Street) and Westport

(two on Market Street and one on Bridge Street).

An agricultural lime kiln at Liscromwell 1

A simple lime kiln at Liscromwell 1, built with local undressed rubble, is typical of the small agricultural kilns that became ubiquitous in the Irish rural landscape in the early modern period. In fact, lime kilns of one sort or another are the most numerous and widely distributed monument of the industrial period in Ireland (Rynne 2006, 130).

Rural lime kilns in early modern Ireland

Quarried limestone (calcium carbonate) was ‘calcined’ by burning in kilns at temperatures of c. 900–1,000°C. The product was burnt lime (calcium oxide) or ‘quick lime’, as it was commonly known. Crushed quick lime had several uses. It was spread on land as a fertiliser, or mixed with water to form hydrated lime or ‘slaked lime’ (calcium hydroxide) which, in turn, could be used as limewash (a coarse white paint or render), mixed with sand to form lime putty (a building mortar), or spread and levelled in buildings to form floor surfaces.

Lime fertiliser was first adopted in Ireland in the mid-17th century and was widely employed in the 18th and 19th centuries. It was used to improve the quality of grass pasture but also supported tillage farming at a time when arable output in Ireland as a whole was especially high relative to pastoral farming (Drumm & Tierney 2014, 167). Lime fertiliser would have been very beneficial around Liscromwell 1 in improving the quality of farmland by breaking up heavy clay soils, neutralising acidic topsoils (i.e. by raising the pH values) and ‘sweetening’ the

grass for livestock.

Most lime kilns in Ireland were draw kilns, where the limestone was burnt in a continuous process. The quarried limestone would have been broken into smaller pieces before being transported to the kiln by horse and cart. Alternating layers of fuel and limestone were loaded from the top. To facilitate loading in this way, kilns were often built into sloping ground or had a ramp raised against the rear (Power et al. 2000, 642). Peat was typically used as a fuel in small agricultural kilns, though coal would also have been used in larger, commercial kilns. The fuel was ignited at the bottom and burning proceeded under constant supervision. A minimum temperature of about 900°C was required to convert the stone into lime. There was a draw-hole or stoke-hole in the base of the kilns, at the front. This drafted air (oxygen) into the kiln to maintain combustion of the fuel and also provided a means of drawing out the burnt lime when it was fully calcined and the fire had died out. In larger kilns, quick lime could be produced in a ‘batch’ process, whereby the kiln burned continuously for several days. Here, the kiln was either fed as a result of communal effort, involving large numbers of local people, with individuals taking turns to draw away a supply for their own use, or the farmer maintained the kiln themselves and sold the lime to other farmers.

Liscromwell 1 lime kiln

The lime kiln at Liscromwell 1 was a roughly circular structure built with random rubble using undressed limestone blocks (Illus. 5.15). Smaller packing stones, here and there, were inserted to secure the larger stones but there was no bonding agent (clay or mortar). The external measurements of the kiln were



Illus. 5.15 Liscromwell 1. This simple lime kiln, built with local limestone rubble, is a typical example of the small kilns that became ubiquitous in rural Ireland in the early modern period (ACSU Ltd).

3.1 m (north/south) by 2.9 m (east/west) at ground level; it was 1.55 m high. The kiln was built into a small gravel ridge that provided a natural access ramp to the open top. A draw-hole in the base of the west-facing elevation measured 0.38 m wide by 0.51 m high. There was a flue or air channel, 0.1 m deep, cut into the base of the charging bowl and covered by flat limestone lintels (Illus. 5.16). As found, there was a layer of lime residue, 1.0 m thick, on the floor of the kiln. Externally, a compact stony surface formed a narrow pathway to the draw-hole. There was a narrow, overgrown boren or laneway located behind the kiln, on the east side of the gravel ridge.

An account of a lime kiln in the townland of Forthill, near Ballyhaunis in Co. Mayo, was recorded in the 1970s by a local student, Christina Nolan (1978, 83). Patrick Nolan, who resided near the kiln, recalled it being built into the sloping part of a field in 1912, but said it had been out of use since 1930.

Nolan noted that ‘the stones were held together by soil and it was not until the first burning, when the lime itself plastered the stones together, that the walls were secure’ (ibid.). He indicated that the whole lime-burning process took about 40 hours, with another 40 hours for the lime to cool down, after which it was extracted through the draw-hole (known locally as the ‘poreen’) by means of a long-handled shovel.

A folklore record gathered in the 1930s by the Schools’ Collection (National Folklore Collection 2024b) includes a reference to the use of lime kilns in Crossmolina, Co. Mayo, describing the process as follows.

Long ago as well as nowadays people in Crossmolina burned their own lime. A lime kiln was made. A bank was made in a field, a deep hole was dug, this hole would be like a chimney.



Illus. 5.16 Liscromwell 1. An air duct or flue in the base of the charging bowl of the lime kiln was covered in flat limestone slabs (ACSU Ltd).

At the base of this hole a space was left for a fire. (The hole was from six to seven feet deep.) The kiln is filled with lime stones and turf [peat] (every second layer). The turf is lighted and the stones burn for three days. Turf is added for three days. The kiln is covered with wet bags to cool the lime. If the lime is not sold immediately it is left in the kiln. It is not lucky to visit the lime kiln at night.

Lime kilns are depicted on early Ordnance Survey maps as a small circle enclosing an attached black dot, which represents the draw-hole. Distribution analysis of the map evidence suggests that many farmsteads had their own small kiln, or a group of farmers

may have shared a communal kiln (Gillespie et al. 2017). While the Liscromwell 1 lime kiln is not depicted on any of the Ordnance Survey maps, in the same townland to the far north-east four lime kilns are illustrated on the first edition Ordnance Survey map of 1839 (surveyed 1837). These are in an area with several houses, roads and land divisions, suggesting each may have belonged to an individual farmstead or landholding.

Liscromwell 2 grain mill

Vertical waterwheels were in widespread use in Ireland in the 18th and 19th centuries, when water power was the backbone of Irish industry (Rynne 2006, 30). As at Liscromwell 2, many of these were used to power small grain mills built to serve a local farming community (Cleary: text box). Mill-houses



Illus. 5.17 Liscromwell 2. Artist's reconstruction (isometric view) of the grain mill as a simple, two-storey building with a thatched roof, internal drying kilns, and 'undershot' mill-wheel (Sara Nylund).

at this time were generally simple, two-storey buildings, typically roofed with thatch until the mid-19th century (Illus. 5.17). The ground floor housed the main mill-gearing and was also used for weighing and bagging flour and meal. The first floor, known as the 'stone floor', housed the millstones in a wooden tun. As the millstones rotated, an overhead wooden hopper was agitated mechanically to feed grain into the eye, or opening, of the upper millstone (Rynne 2006, 195). Many mills of this period had more than one set of millstones. Above the first floor there may have been a storage loft.

Due to the damp climate in Ireland, grain was kiln-dried before it was milled. This was

particularly important for oats as removing the husks became more difficult if they were not rendered sufficiently brittle by drying (Rynne 2006, 198). At Liscromwell 2 there were surviving remains of two kilns. Heat was supplied by a central furnace and would have been inducted upwards via a stone or brick vault to a drying floor, overhead, where the grain was spread. The drying floor did not survive at Liscromwell 2 but would typically have consisted of perforated metal plates or ceramic kiln tiles (ibid.).

Mills in the Castlebar area

In the *Statistical Survey of the County of Mayo*,

Grinding grain at home

Kerri Cleary



Illus. 5.18 Drumaleheen 1/2. Upper stone of a rotary quern; top face (left) and bottom face (right) (Ian Russell).

Alongside small grain mills built for the local community, many households had their own hand-operated mills, known as querns. These comprised two stones, whereby the upper stone was moved against a stationary lower stone to grind grain and other food stuffs. Querns of one sort or another have been used in Ireland for nearly 4,000 years, since the development of farming in the Neolithic period. Following the advent of water mills in the sixth century AD, hand-operated querns remained in domestic use, co-existing with mills until the early 20th century. Over that time they have evolved from using a hand-held upper stone (rubber) in a largely back-and-forth motion, to using a rotating upper stone, operated by means of one or two projecting handles. On the N5/N59 project, the upper stone of a rotary quern (Illus. 5.18) was found at Drumaleheen 1/2, in the fill of a relict field boundary ditch (Chapter 3). This sandstone quern stone has a large central hole with two smaller holes near the perimeter, for a pair of wooden handles. It measures approximately 500 mm in diameter by 70 mm thick and weighs 27 kg. The grain would have been poured into the central hole and the handles, set in the smaller outer holes, used to rotate the stone. The ground grain, in the form of coarse flour or meal, was dispersed at the perimeter and collected on a mat spread beneath the quern. This style of quern was in widespread use across Ireland for a long period, from medieval to early modern times.

McParlan (1802, 112) recorded ‘three bleach-mills about Castlebar, one good flour-mill, beside a great number of common oat and tuck-mills’. Tuck-mills were used in making woollen textiles; bleach-mills were used in making linen, from flax (Rynne 2006, 218–22). A short article in the *Castlebar Parish Magazine* by local historian Paddy Jennings (1988) referenced seven mills operating in the area between the 19th and early 20th centuries—one on a local stream at Ballyvary; another at Moyhenna on the Manulla River; three on the Clydagh River; and two on the Castlebar River, at Ballynew and Clogher near Turlough. These mills were used for ‘grinding and crushing oats, wheat and barley for domestic and animal consumption, and also for scutching flax, which was grown extensively in the area’ (ibid., 34). Bald’s *Map of the Maritime County of Mayo*, surveyed in 1809–17, and the Ordnance Survey first edition map, surveyed in 1837, record at least five mills operating on the Castlebar River in the early 19th century. They include the mill recorded here at Liscromwell 2; two mills listed by Jennings (ibid.) at Ballynew (‘Flour Mill’) and Clogher (‘Tuck & Corn Mill’); and two other mills at Springfield (‘Old Bleach Mills’) and Leckneen (‘Bleach & Corn Mill’). In describing the mill at Cloonnagleragh on the Clydagh River, Jennings (ibid., 34) records some detail about the operation of its kilns:

The mills contained three kilns for drying the grain. The largest kiln, which was used for drying grain for grinding, was covered by 18-inch perforated square tiles, while the kilns used for crushing purposes were floored by strong perforated sheets of metal. The work of drying,

grinding and crushing was both exacting and laborious. The grain had to be constantly turned on the kilns to prevent it burning. This was done by the use of shovels and sometimes with bare hands, in which case the operator had to go in over the kiln and endure the heat.

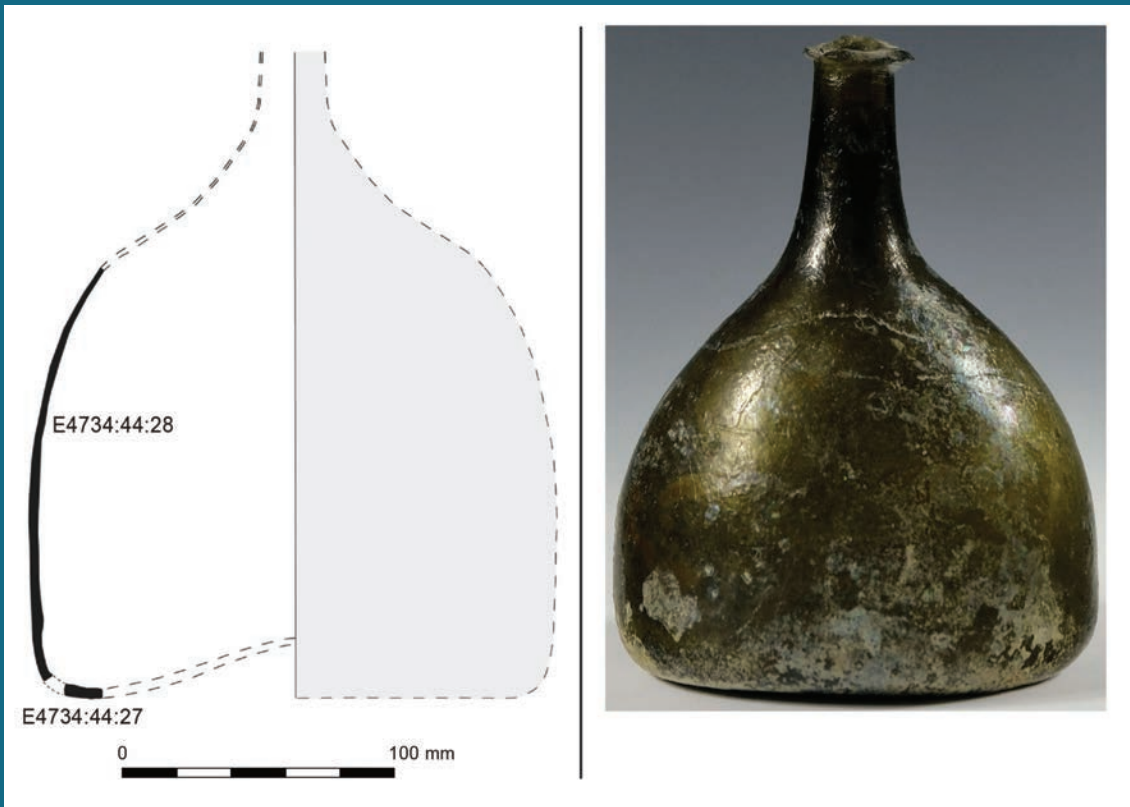
Jennings (1988) also states that, during the flax season, the mill would have operated both day and night, with scutching done during the day and grinding and crushing at night. Overall, the work was tough and created a dusty environment, resulting in the widespread use of beverages such as poteen, porter and suhaun (oatmeal seeped in water), to wash down food such as ‘Steel Tom’, which was made from baked oaten meal and flour (ibid., 35). A notable find at Liscromwell 2 was 10 sherds from an 18th- or 19th-century glass bottle (Giacometti: text box), perhaps used by a millworker to quench their thirst and sustain their work.

The earliest available cartographic evidence for the mill at Liscromwell 2 is on Bald’s *Map of the Maritime County of Mayo* (1830; surveyed in 1809–17). The townland is identified as ‘Liscromel’ and both the mill building and mill-race are depicted (Illus. 5.20). On the first edition Ordnance Survey six-inch map (1839; surveyed in 1837) the mill-race is shown, straddled by a building, but the legends now read ‘Old Mill-race’ and ‘Mill in ruins’. There are similar legends on the 25-inch Ordnance Survey map (1897, surveyed in 1895), but now the mill is depicted in outline as a ruin on the north side of the mill-race. Some of the field boundaries to the south-west are also absent, presumably removed by this time. There is a record in the House Books of the Valuation

An 18th-century globular glass bottle from Liscromwell 2

Antoine Giacometti

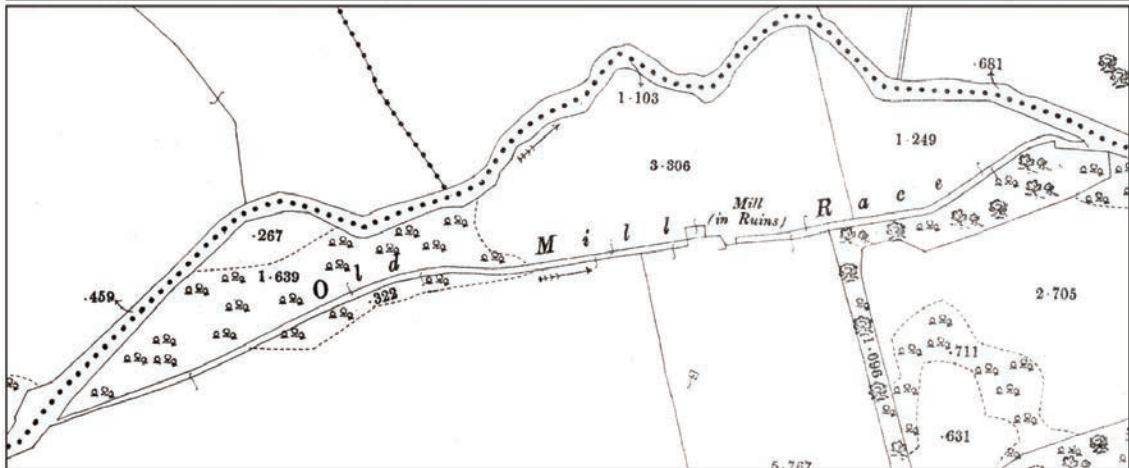
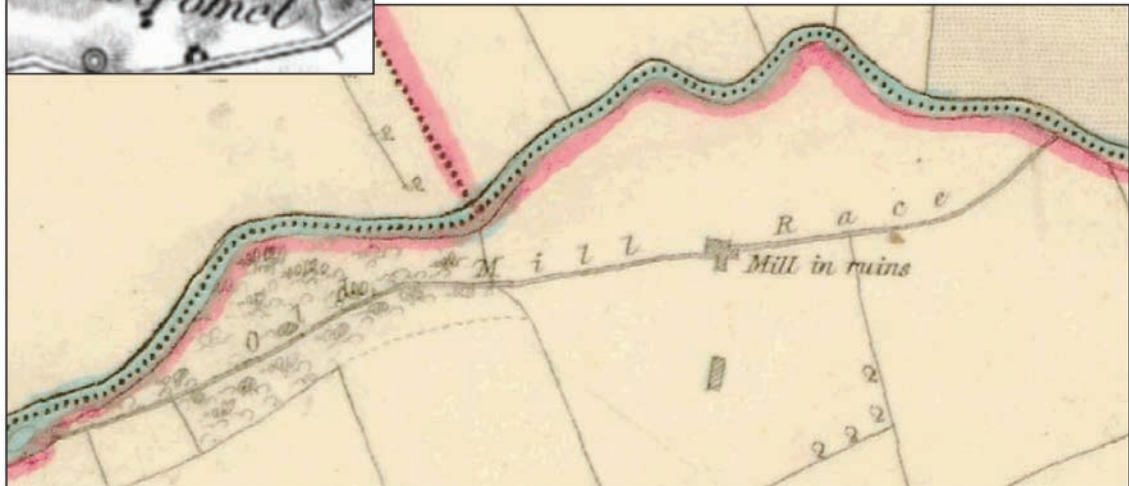
Ten glass sherds from an unusual, globular, green bottle were recovered from demolition rubble on the mill site at Liscromwell 2 (Illus. 5.19). The bottle may have been used by a thirsty millworker to relieve thirst and fatigue arising from his difficult and dusty work. The sherds are pale green with frequent air bubbles. The bottle had a rounded heel and the base sherds show heavy wear. It has a larger-than-average capacity for the period and was globular, not cylindrical, which was the more common bottle form at this time. This profile suggests that it was possibly a large-capacity bottle, such as a 'carboy' or 'demijohn'. These were generally covered in wicker and were commonly manufactured from the mid-18th century well into the 19th century (Jones 2010, 101–3). There are no close parallels in the Irish archaeological record, but this example may have been similar to early 18th-century English 'bladder bottles' or American-style globular 'chestnut' flasks, dating from c. 1780–1830. The absence of neck, finish, shoulder or diagnostic basal sherds means that comparisons are necessarily limited. However, within the context of Liscromwell, this bottle probably dates to the 18th century.



Illus. 5.19 Liscromwell 2. Green glass sherds from the rubble overlying the mill site represent a large, globular bottle (left), perhaps for a beverage to refresh thirsty millworkers. Variants of this type were common throughout the 18th and 19th centuries, like this English bladder bottle example (right), dating to c. 1710 (drawing Oisín O'Brien; photo Marris Antiques).



Illus. 5.20 The earliest map evidence for the mill at Liscromwell 2 is on Bald's *Map of the Maritime County of Mayo* (top left), surveyed in 1809–17 (Mayo County Council). By the first edition Ordnance Survey six-inch map (middle), surveyed in 1837, the mill is in ruins, and it is similarly depicted on the 25-inch Ordnance Survey map (bottom), surveyed in 1895 (Taillte Éireann).



Office for the parish of Aglish, dated 1841, for a mill at Ballynew, immediately west of Liscromwell 2 (Valuation House Office Book 1841). This describes an undershot waterwheel that powered three pairs of millstones, one for shelling and the other two likely for grinding. The lack of any reference to the Liscromwell mill in the Valuation Office books suggests that it had long ceased to function by the 1840s and was deemed by

the surveyors to have no rateable valuation. Indeed, in 1938 the Schools' Collection (National Folklore Collection 2024c) recorded that the mill at Liscromwell was 'very old with its walls broken down' and that 'the man that worked it is dead for years past', also that it originally 'had a farm beside that mill'. During excavation, the condition of the surviving remains suggested that the machinery was dismantled after the mill had

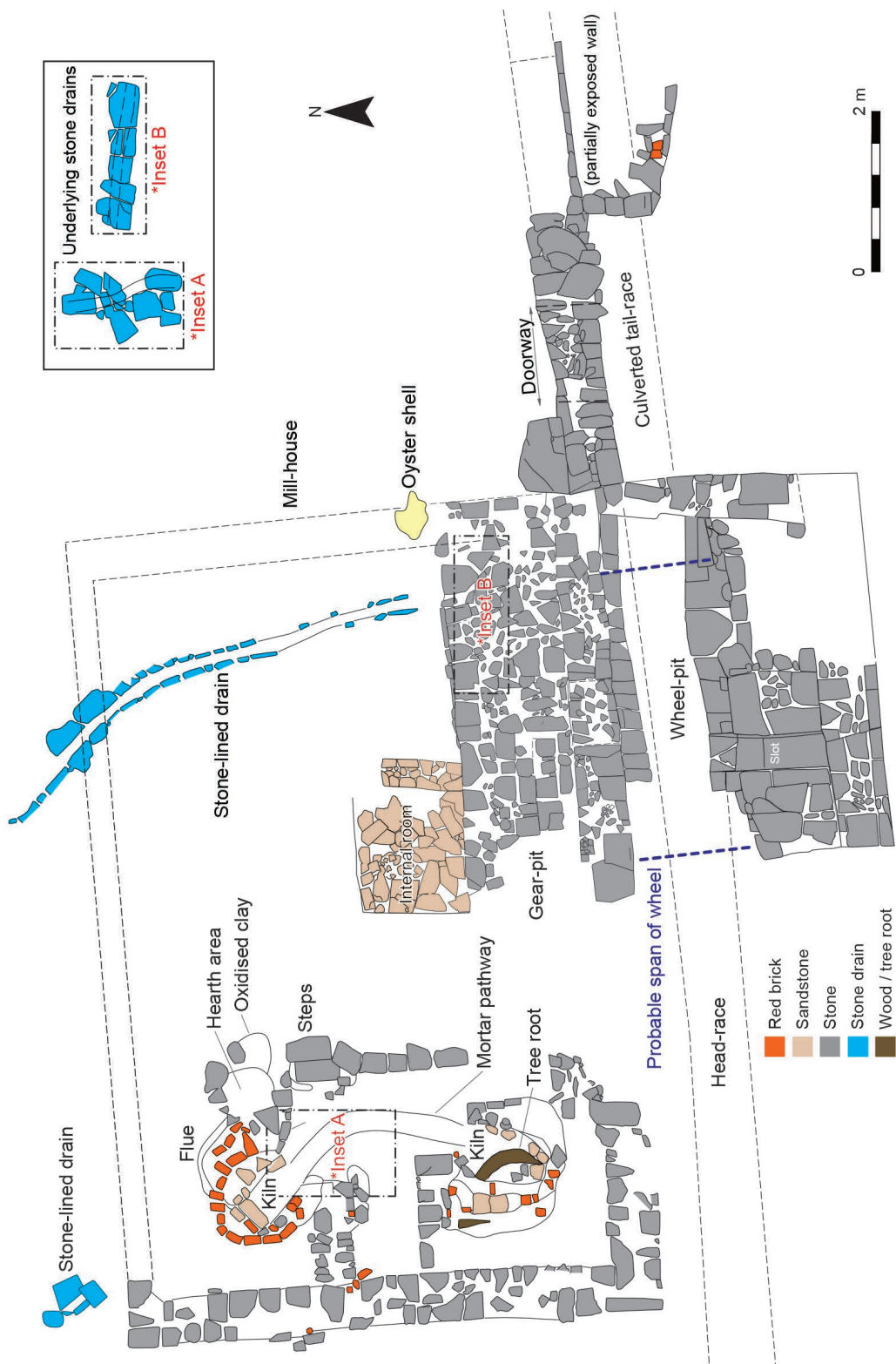
gone out of use, the building demolished and the mill-race infilled. No millstones were found.

Mill-race, kilns and mill-house at Liscromwell 2

The mill-race at Liscromwell 2 had been filled with stone, rubble and soil after the mill went out of use. Excavation exposed a small but largely intact section along the south side of the mill-house. Ordnance Survey maps indicated that the mill-race once conducted the water in a west to east direction, from the Castlebar River to the mill and back to the river again. The head-race, or upper part of the channel, would have directed water into the wheel-pit and onto the paddle boards or 'floats' of an undershot waterwheel (Illus. 5.21). The tail-race, or lower part of the channel, carried water away from the mill, and back to the Castlebar River, downstream from the mill. It was partly culverted at the mill building but was probably an open channel otherwise (Illus. 5.22). Overall, the combined head- and tail-races formed a mill-race c. 900 m long and, where exposed in the wheel-pit, 0.77 m wide by 0.97–1.60 m deep. The sides of the mill-race were revetted with dressed limestone blocks bonded with limestone mortar. A splayed stone in the wheel-pit directed the flow downwards to create a concentrated water jet against the paddle boards of the wheel. The south side of the wheel-pit had a beam slot within the thickness of the side wall. This was 1.4 m deep within the wall and sloped down slightly toward its outer (mill-race) end, where there was a metal fitting at the base. This slot probably held a beam that could secure the waterwheel when it was not in use. Until the second half of the 18th century, all Irish waterwheels were made entirely of wood.

The transition to all-metal wheels was a slow process as they were considered too costly by Irish mill owners (Rynne 2006, 36). The wheel at Liscromwell is likely to have been made entirely of wood and was probably 16–18 ft (4.9–5.5 m) in diameter, as no Mayo mill recorded in 1840 had a wheel in excess of 20 ft (Colin Rynne, pers. comm.). While nothing of the wheel survived, wear marks were evident on the masonry of the south-facing wall of the mill-race.

Some remains of the mill building were uncovered on the northern side of the mill-race and included the gear-pit and two drying kilns in the western end of the building (Illus. 5.21 and Illus. 5.23). The south-facing wall, above the wheel-pit, contained an opening for the axle of the waterwheel. Sometime in the past, the lower part of this opening was blocked up by coarser stonework. A small area of sandstone paving, measuring 1.50 m (east/west) by 1.34 m, survived within the mill building in what was the ground floor. Limestone steps led down into the room with the kiln furnaces. It is likely that both kilns shared a chimney, centrally positioned in the western gable of the mill building. The kilns themselves were constructed of red brick, limestone and occasionally sandstone blocks, and the entrances to both were flanked by poorly preserved limestone walls. A slightly curving, partly mortared pathway extended between the entrances of both kilns and overlay a stone-lined drain. Other areas of the mill building also had sub-floor, stone-lined drains, while outside to the west there was a roughly cobbled surface suggesting a yard. Although 25 fragments of glazed tile were recovered during the excavation at Liscromwell 2, none has any perforations or other distinguishing features to suggest they were kiln tiles.



Illus. 5.21 Liscromwell 2. Plan of the excavated remains of the mill-house and kiln chamber (ACSU Ltd).



Illus. 5.22 Liscromwell 2. Recording the wheel-pit and culverted section of the tail-race that carried water away from the mill and back to the Castlebar River (ACSU Ltd).



Illus. 5.23 Liscromwell 2. View from west of remnants of two grain-drying kilns in the ground floor of the mill-house (ACSU Ltd).

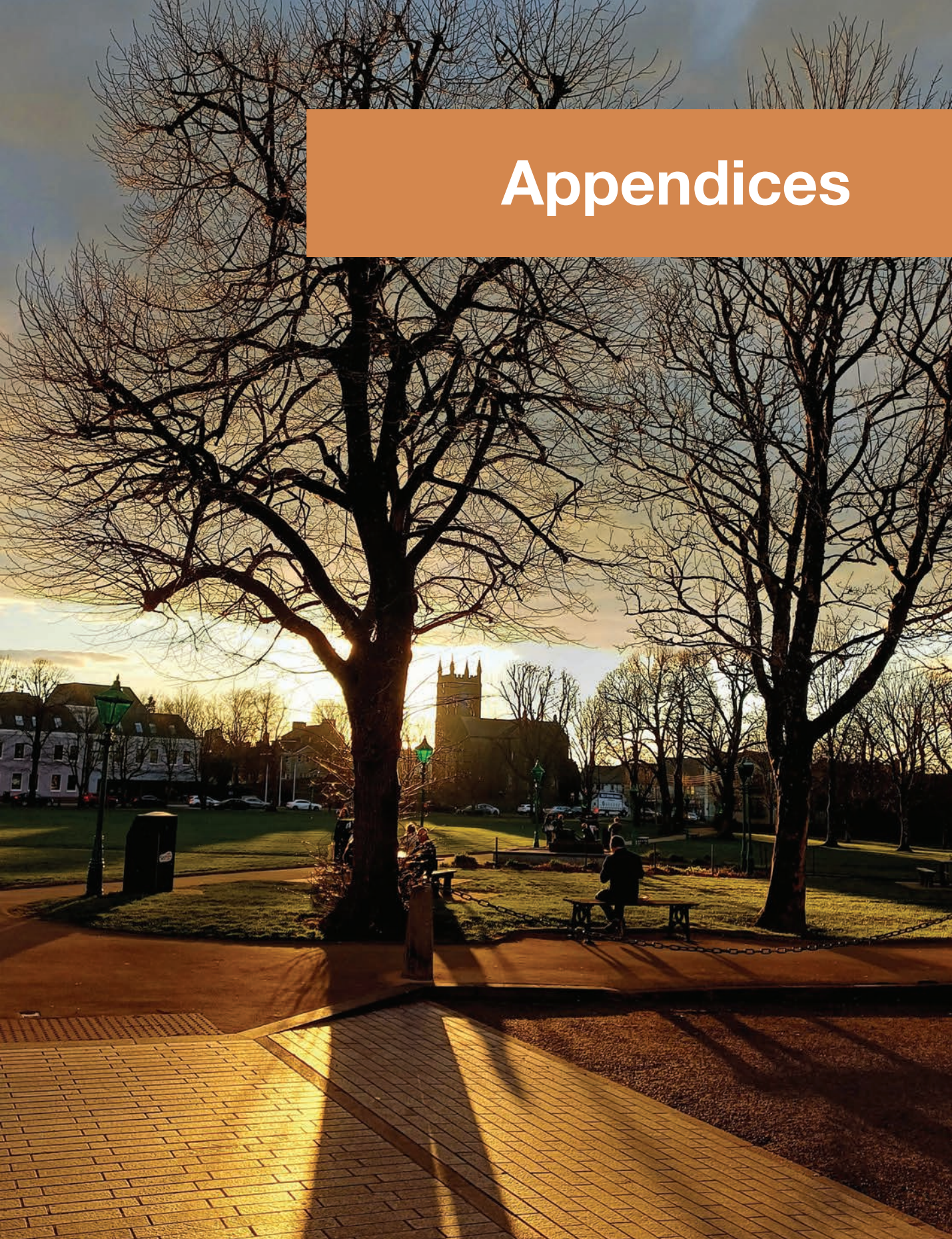
Products of the mill at Liscromwell 2

While the two drying kilns at Liscromwell 2 attest that grain was processed at the site prior to milling, the main cereal crop is unknown. Based on Jennings' (1988) account of mills in the area, however, it is likely that many different cereal types could have been milled here. McParlan's (1802, 29) *Statistical Survey of the County of Mayo* records that in the barony of Carra, where Liscromwell 1 is located, oats was the principal crop, and great quantities of this were exported. He recorded that wheat and barley were also grown here, with barley being brought into Trawley and Gallen to be smuggled into private distilleries.

Pockets of oyster shells, including a concentration measuring 0.6 m (east/west) by 0.4 m (Illus. 5.21), were found during the excavation. Far from being an expensive delicacy, oysters in the early 19th century were plentiful and commonly eaten as a cheap source of protein. Those found at Liscromwell 2 may have fed hungry

millworkers, with the shells subsequently dumped to one side. Alternatively, the oyster shells may have been brought there for a different use. Early modern mills were sometimes used to crush marine shells as a source of lime for agricultural fertiliser (Christianson 2005). The mill at Liscromwell 2 is over 20 km from the coast, which would have been a long distance to cart marine shells for processing, but the journey may have been considered worthwhile, as rapid population growth in the early 19th century meant that obtaining manures was an ongoing challenge for farmers. Accordingly, they used a variety of sources, favouring 'dung, seaweed, turf mould, sea sand and ashes', with other manures used on a more limited scale such as 'bones, rape meal, malt dust, liquid manures, oyster and other shells, furriers clippings and horn shavings' (Walsh et al. 1957, 105). It is not unlikely then that fertiliser, derived from a variety of raw materials, was among the products of the mill at Liscromwell 2 before it fell out of use sometime in the early 19th century.

Appendices



Appendix 1 Radiocarbon dates

These are the radiocarbon dates from excavated archaeological sites on the N5 Westport to Turlough road project and Barleyhill to Kilmeena section of the N59 Westport to Mulranny road project, in Co. Mayo. The dates are listed in alphabetical order by site name, then laboratory (lab.) code (Beta = Beta Analytic, Florida, USA; ICA = International Chemical Analysis, Maryland, USA; and Poz = Poznań Radiocarbon Laboratory, Poland). Radiocarbon ages are quoted in conventional years BP (before present = AD 1950). The $\delta^{13}\text{C}\text{‰}$ value is a measurement of the Carbon 13 isotope and

can help to identify an anomalous result. Calibrated date ranges are in calendrical years expressed at one-sigma and two-sigma levels of confidence (1σ = 68% probability; 2σ = 95% probability). All of the dates were obtained using the accelerator mass spectrometry (AMS) method and calibrated using OxCal v4.4.4 (Bronk Ramsey 2009), IntCal 20 (© Bronk Ramsey 2021) and atmospheric data from Reimer et al. (2020). All dates quoted in the main text of this book are calibrated (calendrical) dates at two-sigma confidence level.

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}\text{‰}$	Calibrated dates
Aghadrinagh 1—Charcoal kilns				
Poz-80370	Oak brushwood charcoal (2.0 g) from charcoal-rich deposit F188 at 2 m north of charcoal kiln (pit) F01	945 ± 30	-28.1	AD 1040–1154 (1 σ) AD 1027–1166 (2 σ)
Aghadrinagh 2—Burnt mound, trough with stone, slot-trench, stake-holes				
Poz-97538	Ash charcoal (0.02 g) from primary fill F30 of trough F05	3245 ± 35	-27.2	1536–1451 BC (1 σ) 1611–1435 BC (2 σ)
Aghadrinagh 3—Burnt mound, trough, pit, water channel				
Poz-99249	Hazel charcoal (0.1 g) from burnt mound deposit F18	3010 ± 30	-23.6	1371–1212 BC (1 σ) 1386–1127 BC (2 σ)
Poz-99250	Ash charcoal (1.0 g) from tertiary fill F21 of trough F20	2985 ± 30	-28.4	1265–1129 BC (1 σ) 1376–1116 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Aghadrinagh 4—Burnt mound deposit, disturbed				
Poz-99251	Hazel charcoal (1.0 g) from north-east quadrant of burnt mound F03	2865 ± 30	-26.5	1110–990 BC (1 σ) 1125–926 BC (2 σ)
Aghadrinagh 5—Land clearance				
Poz-99252	Oak charcoal (0.01 g) from upper fill F13 of stone socket F07	>47000	-24.3	—
Poz-99253	Ash charcoal (0.01 g) from burnt sediment deposit F01	985 ± 30	-29.2	AD 1022–1149 (1 σ) AD 994–1157 (2 σ)
Aghadrinagh 6/7—Burnt mound, trough, water channel				
Poz-99254	Hazel/alder charcoal (0.2 g) from south-east quadrant of burnt mound F01	3215 ± 30	-26.0	1505–1447 BC (1 σ) 1531–1424 BC (2 σ)
Poz-99350	Ash wood (1.0 g) from peat F12 underneath burnt mound F01	4760 ± 35	-22.1	3630–3523 BC (1 σ) 3637–3381 BC (2 σ)
Aghalusky 1—Hearth				
Poz-80374	Hazel charcoal (0.2 g) from hearth F03	915 ± 30	-27.1	AD 1046–1175 (1 σ) AD 1039–1210 (2 σ)
Attireesh 1—Burnt mound, troughs with wood, stone and moss, hearth, pits, post/stake-holes				
Poz-97694	Hazel stake F39 from side lining F30 of trough F38	3390 ± 35	-28.0	1736–1626 BC (1 σ) 1867–1544 BC (2 σ)
Poz-99255	Hazel charcoal (0.2 g) from south-west quadrant of burnt mound F03	3595 ± 30	-25.7	2013–1900 BC (1 σ) 2033–1831 BC (2 σ)
Poz-99256	Hazel charcoal (0.2 g) from hearth F06	3540 ± 30	-28.2	1931–1779 BC (1 σ) 1959–1751 BC (2 σ)
Attireesh 2—Burnt mound deposit, disturbed				
Poz-99257	Hazel charcoal (0.1 g) from north-west quadrant of burnt mound F03	2910 ± 30	-27.7	1190–1021 BC (1 σ) 1211–1012 BC (2 σ)
Poz-99380	Alder charcoal (0.01 g) from fill F09 of water channel F10	2955 ± 35	-27.8	1255–1114 BC (1 σ) 1272–1021 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Carrowbeg 1—Burnt mound deposit, disturbed				
Poz-80358	Hazel charcoal (0.2 g) from burnt mound F72	3855 ± 35	-28.0	2449–2210 BC (1 σ) 2459–2204 BC (2 σ)
Carrownaclea 1—Burnt mound deposit, disturbed				
Poz-99259	Alder charcoal (0.94 g) from south-west quadrant of burnt mound F03	2750 ± 30	-27.6	920–834 BC (1 σ) 981–817 BC (2 σ)
Carrownaclea 2—Burnt mound deposit, disturbed				
Poz-99284	Alder/hazel charcoal (0.46 g) from south quadrant of burnt mound F03	3580 ± 30	-26.3	2008–1888 BC (1 σ) 2028–1782 BC (2 σ)
Claggarnagh East 2/3—Burnt mound deposit, disturbed				
Poz-99260	Hazel charcoal (1.0 g) from south-west quadrant of burnt mound F03	3510 ± 30	-29.9	1887–1773 BC (1 σ) 1922–1746 BC (2 σ)
Claggarnagh East 4/5—Burnt mound, trough with wood, hearth, pits, well, stake-holes				
Poz-99261	Ash charcoal (0.2 g) from burnt mound F03	3535 ± 30	-26.4	1931–1776 BC (1 σ) 1960–1747 BC (2 σ)
Poz-99262	Alder charcoal (0.3 g) from upper fill F11 of trough F10 (Phase 2)	2775 ± 30	-27.5	979–842 BC (1 σ) 1003–834 BC (2 σ)
Poz-99288	Alder plank (T8) from basal lining of trough F10 (Phase 1)	2940 ± 30	-24.4	1215–1060 BC (1 σ) 1258–1020 BC (2 σ)
Claggarnagh East 6—Smithing hearths				
Poz-97539	Alder charcoal (0.1 g) from fill F13 of smithing hearth F10	3685 ± 35	-26.3	2136–2028 BC (1 σ) 2196–1957 BC (2 σ)
Poz-99263	Oak charcoal (1.0 g) from smithing hearth debris F09	530 ± 30	-24.8	AD 1399–1430 (1 σ) AD 1325–1440 (2 σ)
Claggarnagh West 1—Burnt mound, trough with stone				
Poz-97540	Alder charcoal (0.1 g) from upper fill F05 of trough F04	3870 ± 35	-26.7	2454–2291 BC (1 σ) 2463–2208 BC (2 σ)
Poz-97541	Hazel charcoal (0.1 g) from burnt mound F03	3840 ± 35	-29.0	2399–2205 BC (1 σ) 2456–2200 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Claggarnagh West 1—Burnt mound, trough with stone (continued)				
Poz-97695	Oak wood (T2) from fill F08 of stake/root-hole F10	1650 ± 30	-29.1	AD 376–531 (1 σ) AD 262–537 (2 σ)
Claggarnagh West 2—Burnt mound, troughs with wood, stone and moss, well				
Poz-97542	Alder charcoal (0.1 g) from fill F15 of trough F16	3205 ± 35	-29.2	1502–1444 BC (1 σ) 1531–1416 BC (2 σ)
Poz-97696	Alder roundwood (T33) from basal lining of trough F16	3205 ± 35	-29.2	1502–1444 BC (1 σ) 1531–1416 BC (2 σ)
Poz-107024	Alder charcoal (1.0 g) from fill F20 below wood F11 of trough F21	3140 ± 30	-23.8	1448–1324 BC (1 σ) 1498–1306 BC (2 σ)
Claggarnagh West 3—Burnt mound, troughs, one with wood, water channel				
Poz-97439	Ash roundwood (T4) from basal lining F08 of trough F06	2900 ± 35	-33.5	1155–1014 BC (1 σ) 1215–987 BC (2 σ)
Poz-99264	Hazel charcoal (0.2 g) from fill F10 of trough F09	3710 ± 35	-25.9	2192–2036 BC (1 σ) 2204–1979 BC (2 σ)
Claggarnagh West 4—Burnt mound, trough with wood, stone and moss, pits, water channel				
Poz-97440	Ash wood from wooden post/stopper F26	6770 ± 40	-30.5	5711–5636 BC (1 σ) 5731–5622 BC (2 σ)
Poz-97543	Ash charcoal (0.1 g) from moss F24 lining base of trough F17	3580 ± 35	-27.8	2011–1887 BC (1 σ) 2031–1778 BC (2 σ)
Claggarnagh West 5—Burnt mound, trough with wood and moss, posts				
Poz-97545	Oak charcoal (0.05 g) from peat F24 between boulder and smaller rocks	3845 ± 35	-28.8	2402–2206 BC (1 σ) 2456–2202 BC (2 σ)
Poz-97697	Alder plank (T2) from basal lining of trough F06	3020 ± 35	-25.0	1376–1217 BC (1 σ) 1397–1128 BC (2 σ)
Poz-99265	Hazel charcoal (1.0 g) from burnt mound F03	2910 ± 30	-26.6	1190–1021 BC (1 σ) 1211–1012 BC (2 σ)
Claggarnagh West 7—Burnt mound deposit, disturbed				
Beta-518392	Hazel charcoal (0.3 g) from burnt mound F03	3580 ± 30	-25.3	2008–1888 BC (1 σ) 2028–1782 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Cloondeash 1—Burnt mound, trough with wood, spring, water channel				
Poz-97546	Hazel charcoal (0.2 g) from north-west quadrant of burnt mound F03	3245 ± 35	-28.6	1536–1451 BC (1 σ) 1611–1435 BC (2 σ)
Cloondeash 2—Pits (quarrying?)				
Poz-97646	Alder charcoal (0.05 g) from upper fill F30 of pit F04	330 ± 30	-27.0	AD 1502–1635 (1 σ) AD 1480–1640 (2 σ)
Cloondeash 3—Burnt mound, trough				
Poz-97547	Hazel charcoal (0.2 g) from north-east quadrant of burnt mound F03	3265 ± 35	-29.6	1609–1465 BC (1 σ) 1617–1449 BC (2 σ)
Cloondeash 4—Burnt mound deposits, pits, gullies (possible land clearance)				
Poz-97591	Hazel charcoal (0.1 g) from burnt mound deposit F03	3235 ± 35	-25.0	1532–1450 BC (1 σ) 1608–1425 BC (2 σ)
Poz-97682	Ash charcoal (0.8 g) from fill F06 of pit F07	2910 ± 35	-23.3	1192–1020 BC (1 σ) 1220–1003 BC (2 σ)
Poz-97683	Ash charcoal (0.1 g) from fill F41 of pit F40	2470 ± 35	-22.2	754–520 BC (1 σ) 767–421 BC (2 σ)
Conrea 1—Burnt mound deposit, disturbed				
Poz-99266	Hazel charcoal (0.1 g) from burnt mound deposit F03	3430 ± 30	-30.0	1867–1645 BC (1 σ) 1875–1626 BC (2 σ)
Deerpark East 1—Burnt mound, troughs with wood, stone and moss, hearth?				
Poz-97684	Birch charcoal (0.5 g) from south quadrant of burnt mound F03	3725 ± 35	-25.4	2198–2040 BC (1 σ) 2276–1985 BC (2 σ)
Poz-97698	Maloideae roundwood (T9) from basal lining of upper trough F05	3230 ± 35	-29.8	1518–1447 BC (1 σ) 1607–1421 BC (2 σ)
Poz-97699	Hazel stake (T56) from outer wattle F17E of lower trough F17B	3550 ± 35	-25.7	1947–1780 BC (1 σ) 2019–1767 BC (2 σ)
Deerpark East 3—Burnt mound deposits, post-hole				
Poz-97489	Willow charcoal (0.2 g) from lower burnt mound deposit F06	3675 ± 35	-29.4	2135–1981 BC (1 σ) 2193–1950 BC (2 σ)
Poz-97685	Birch charcoal (0.2 g) from fill F10 of post-hole F08 underneath upper, disturbed burnt mound F03 and marl F04	3565 ± 35	-24.1	2008–1827 BC (1 σ) 2025–1773 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Deerpark East 4—Burnt mound, trough with wood, stake/post-holes, stone surface, hearth?				
Poz-97490	Ash charcoal (0.1 g) from burnt mound F03	3625 ± 35	-27.7	2033–1935 BC (1 σ) 2131–1890 BC (2 σ)
Poz-97644	Alder wood F41a from below peat layer F40	9080 ± 50	-26.4	8323–8242 BC (1 σ) 8455–8225 BC (2 σ)
Poz-97701	Alder roundwood F22j from base of lining on south side of trough F18	3435 ± 35	-25.7	1871–1644 BC (1 σ) 1878–1626 BC (2 σ)
Poz-99286	Alder/hazel charcoal (1.0 g) from peat layer F40	3745 ± 35	-23.7	2203–2048 BC (1 σ) 2283–2034 BC (2 σ)
Poz-105604	Alder roundwood F38c from basal lining of trough F18	3345 ± 30	-28.5	1675–1543 BC (1 σ) 1736–1533 BC (2 σ)
Derrylea 1—Burnt mound, trough, stake-holes, hearth?				
Poz-97640	Oak charcoal (0.2 g) from fill F17 of land clearance hollow F16 partly under burnt mound F03	3330 ± 35	-28.4	1628–1535 BC (1 σ) 1731–1515 BC (2 σ)
Poz-97647	Hazel charcoal (0.2 g) from burnt mound F03	3730 ± 35	-28.8	2199–2041 BC (1 σ) 2280–1985 BC (2 σ)
Doogary 1—Burnt mound deposit, disturbed, hearth?				
Poz-99285	Holly charcoal (0.02 g) from burnt mound deposit F22 in land clearance hollow F21	3975 ± 35	-28.0	2568–2463 BC (1 σ) 2577–2348 BC (2 σ)
Dooleague 3—Charcoal kiln				
Poz-97686	Oak charcoal (0.5 g) from primary fill F06 of charcoal kiln (pit) F03	1050 ± 30	-21.1	AD 987–1026 (1 σ) AD 895–1035 (2 σ)
Drumaleheen 1/2—Bronze Age barrow; stake-holes, post-holes				
Poz-80368	Alder charcoal (0.1 g) from fill F10 of post-hole F09 (during test-excavations)	3335 ± 35	-25.5	1665–1536 BC (1 σ) 1735–1516 BC (2 σ)
Poz-99274	Hazel charcoal (0.01 g) from primary fill F118 of barrow ditch F102	3330 ± 30	-23.9	1624–1540 BC (1 σ) 1687–1517 BC (2 σ)
Drumaleheen 3—Iron Age ring-ditch; medieval pit				
Poz-80367	Ash charcoal (0.2 g) from fill F10 of pit F09 cut into ring-ditch F03	320 ± 30	-25.3	AD 1515–1637 (1 σ) AD 1484–1644 (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Drumaleheen 3—Iron Age ring-ditch; medieval pit (continued)				
Poz-99275	Alder charcoal (0.3 g) from primary fill F07 of ring-ditch F03	2060 $\pm$ 30	-26.2	144 BC–AD 5 (1 σ) 162 BC–AD 17 (2 σ)
Drumaleheen 4—Bronze Age occupation soil; Iron Age pit				
Poz-80375	Hazel charcoal (0.4 g) from occupation soil F04	2895 $\pm$ 35	-26.9	1125–1012 BC (1 σ) 1212–983 BC (2 σ)
Poz-99276	Alder charcoal (0.2 g) from fill F07 of pit F03	2055 $\pm$ 30	-24.5	103 BC–AD 8 (1 σ) 160 BC–AD 22 (2 σ)
Drumaleheen 5—Hearth				
Poz-80376	Hazel brushwood charcoal (2.0 g) from hearth F03	2830 $\pm$ 30	-26.6	1015–928 BC (1 σ) 1107–904 BC (2 σ)
Drumaleheen 7—Pit				
Poz-80377	Hazel charcoal (0.2 g) from deposit F217 (probably representing disturbed fill F05 from pit F03)	2890 $\pm$ 35	-26.0	1122–1012 BC (1 σ) 1209–936 BC (2 σ)
Drummindoo 2—Pit, burnt sediment				
Poz-97687	Holly charcoal (1.0 g) from fill F05 of pit F04	3000 $\pm$ 30	-25.3	1286–1132 BC (1 σ) 1381–1124 BC (2 σ)
Drummindoo 3—Burnt mound, trough with wood				
Poz-97642	Hazel charcoal (1.0 g) from burnt mound F03	3550 $\pm$ 30	-29.0	1943–1782 BC (1 σ) 2014–1771 BC (2 σ)
Drummindoo 4—Burnt mound, troughs with wood and moss, hearth?				
Poz-97688	Hazel charcoal (1.0 g) from north-east quadrant of burnt mound F03	3750 $\pm$ 35	-24.4	2270–2051 BC (1 σ) 2286–2036 BC (2 σ)
Poz-97702	Alder roundwood from north-east side of upper trough F09	3560 $\pm$ 35	-28.5	1956–1782 BC (1 σ) 2021–1773 BC (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Drummindoo 5—Smithing hearth, charcoal kiln, pits, stake-holes				
Poz-97689	Oak charcoal (0.2 g) from primary fill F11 of charcoal kiln (pit) F50	1015 ± 30	-23.3	AD 993–1036 (1 σ) AD 987–1153 (2 σ)
Drumneen 1—Burnt mound deposit, disturbed				
Poz-97691	Hazel charcoal (0.05 g) from burnt mound deposit F03	3170 ± 35	-27.3	1497–1417 BC (1 σ) 1507–1323 BC (2 σ)
Drumneen 2—Neolithic occupation features; Bronze Age burial, four-post structure				
Poz-99278	Hazel charcoal (0.8 g) from fill F60 of cremation burial pit F15	3470 ± 35	-23.2	1877–1701 BC (1 σ) 1890–1688 BC (2 σ)
Poz-99279	Hazel charcoal (0.3 g) from fill F65 of post-hole F41 in four-post structure	2795 ± 35	-24.8	998–906 BC (1 σ) 1045–834 BC (2 σ)
Poz-99280	Hazel charcoal (0.1 g) from fill F83 of post-hole F27	4770 ± 35	-26.2	3631–3527 BC (1 σ) 3640–3382 BC (2 σ)
Poz-99381	Ash charcoal (0.01 g) from primary fill F76 of post-hole F42 in four-post structure	2775 ± 35	-24.4	980–841 BC (1 σ) 1007–832 BC (2 σ)
Poz-122786	Cremated human bone (2.0 g long bone fragment) from fill F60 of cremation burial pit F15	3490 ± 30	-23.7	1880–1751 BC (1 σ) 1892–1699 BC (2 σ)
Kilbree Lower 1—Sunken smithing settings, water troughs, pits, drain				
Poz-80369	Oak brushwood charcoal (0.1 g) from upper fill F35 of sunken smithing setting F34	620 ± 30	-25.9	AD 1302–1395 (1 σ) AD 1296–1400 (2 σ)
Poz-99281	Oak charcoal (2.0 g) from fill F21 of pit F20	600 ± 30	-28.7	AD 1314–1398 (1 σ) AD 1301–1408 (2 σ)
Poz-99282	Oak charcoal (9.0 g) from primary fill F22 of sunken smithing setting F34	775 ± 30	-23.3	AD 1229–1276 (1 σ) AD 1221–1281 (2 σ)
Poz-99290	Hazel charcoal (2.0 g) from fill F39 of pit F38	760 ± 30	-22.1	AD 1231–1281 (1 σ) AD 1222–1285 (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Kilbree Lower 2—Burnt mound, trough				
Poz-99291	Birch charcoal (0.1 g) from burnt mound F03	2910 $\pm$ 30	-19.8	1190–1021 BC (1 σ) 1211–1012 BC (2 σ)
Knockbrack 1—Burnt mound, trough with wood and stone				
Poz-97703	Hazel stake (T15) from wood lining F06 of trough F07	3830 $\pm$ 35	-26.2	2342–2204 BC (1 σ) 2455–2147 BC (2 σ)
Poz-99292	Ash charcoal (0.5 g) from south-west quadrant of burnt mound F03	3910 $\pm$ 35	-23.2	2466–2345 BC (1 σ) 2552–2238 BC (2 σ)
Knockbrack 2—Burnt mound, trough with wood, stone and moss, woodpile?				
Beta-518393	Alder charcoal (0.1 g) from base of south-west side of burnt mound F01	3540 $\pm$ 30	-26.8	1931–1779 BC (1 σ) 1959–1751 BC (2 σ)
Beta-518394	Hazel charcoal (0.8 g) from fill F05 at base of trough F04	3590 $\pm$ 30	-28.1	2011–1896 BC (1 σ) 2031–1829 BC (2 σ)
Knockbrack 3—Burnt mound, trough with wood and stone				
Beta-518395	Alder charcoal (1.0 g) from base of north side of burnt mound F03	4050 $\pm$ 30	-27.8	2623–2494 BC (1 σ) 2837–2472 BC (2 σ)
Beta-518396	Hazel charcoal (0.5 g) from fill F04 at base of trough F05	4070 $\pm$ 30	-27.5	2831–2499 BC (1 σ) 2850–2488 BC (2 σ)
Knockbrack 4—Burnt mound, trough with wood and moss				
Beta-518397	Alder charcoal (1.0 g) from lower layer F05 in north-east quadrant of burnt mound	3890 $\pm$ 30	-27.0	2457–2342 BC (1 σ) 2468–2239 BC (2 σ)
Beta-518398	Hazel charcoal (0.1 g) from fill F21 near base of trough F19	3170 $\pm$ 30	-29.5	1496–1417 BC (1 σ) 1505–1397 BC (2 σ)
Beta-518399	Alder stake (T17) in wattle screen F23	3210 $\pm$ 30	-28.8	1503–1447 BC (1 σ) 1519–1422 BC (2 σ)
Lisnageeha (or Antigua) 2—Field boundary ditch, drying kiln, pit				
Poz-99293	Hazel charcoal (1.0 g) from fill F18 of kiln drying chamber F17	830 $\pm$ 30	-28.0	AD 1181–1263 (1 σ) AD 1167–1269 (2 σ)

Lab. code	Sample description	Yrs BP	$\delta^{13}\text{C}_{\text{‰}}$	Calibrated dates
Lisnageeha (or Antigua) 2—Field boundary ditch, drying kiln, pit (continued)				
Poz-99294	Ash charcoal (0.07 g) from upper deposit F19 of kiln fire-pit	815 ± 30	-24.2	AD 1220–1262 (1 σ) AD 1175–1275 (2 σ)
Lisnakirka (or Milebush) 1—Hearth				
Poz-80372	Alder charcoal (0.1 g) from fill F03 of hearth/fire-pit F04	980 ± 30	-25.0	AD 1024–1149 (1 σ) AD 995–1158 (2 σ)
Sheean 1—Burnt mound deposit, trough				
Poz-97643	Holly charcoal (0.1 g) from north-east quadrant of burnt mound F03	3220 ± 30	-23.7	1507–1448 BC (1 σ) 1533–1427 BC (2 σ)
Poz-99295	Alder charcoal (0.2 g) from fill F04 of trough F05	3365 ± 35	-25.5	1736–1566 BC (1 σ) 1743–1537 BC (2 σ)
Sheean 3—Burnt mound, troughs with wood and stone, pit, stone surface				
Poz-97645	Alder roundwood (T4) from basal lining F18 of trough F09	3475 ± 30	-27.4	1876–1745 BC (1 σ) 1886–1694 BC (2 σ)
Poz-99283	Hazel charcoal (0.1 g) from burnt mound F03	3680 ± 35	-24.9	2136–1984 BC (1 σ) 2195–1952 BC (2 σ)
Poz-99382	Ash charcoal (0.05 g) from fill F50 of pit F51	3610 ± 35	-27.1	2026–1924 BC (1 σ) 2127–1883 BC (2 σ)
Westport Demesne 1—Charcoal kiln				
ICA-16C/0950	Oak brushwood charcoal (1.0 g) from fill F04 of charcoal kiln (pit) F03	850 ± 30	—	AD 1166–1226 (1 σ) AD 1054–1267 (2 σ)
Westport Demesne 2—Charcoal kiln				
Poz-97692	Oak charcoal (1.2 g) from fill F05 of charcoal kiln (pit) F06	1095 ± 30	-27.5	AD 896–993 (1 σ) AD 890–1017 (2 σ)
Westport Demesne 3—Charcoal kilns				
Poz-97693	Young oak charcoal (0.3 g) from fill F07 of charcoal kiln (pit) F08	1435 ± 30	-28.2	AD 605–645 (1 σ) AD 580–655 (2 σ)

Appendix 2 Burnt mound excavation summaries

The characteristics of the burnt mound sites excavated on the N5 Westport to Turlough road project and the Barleyhill to Kilmeena section of the N59 Westport to Mulranny road project are described in detail in Chapter 2, with reference to examples. This Appendix 2 presents summary data for all of the excavated burnt mound sites on the project

route. The radiocarbon dates quoted here are calibrated calendrical dates at a two-sigma degree of confidence ($2\sigma = 95\%$ probability), with the details presented in Appendix 1. The full, technical reports for all these burnt mound sites are accessible through the Digital Repository of Ireland, the details of which are provided in Appendix 4.

Site name	Aghadrinagh 2 (E4680)
Description	Rectangular trough that may have been lined with clay/marl and stone (upright flat stone in short, south-west side). Adjacent cluster of 18 stake-holes, short section of slot-trench and associated charcoal-flecked deposit. Sealed by disturbed burnt mound deposit
Landscape setting	On drier ground at edge of wet grassland, on the west side of a palaeochannel representing a former river or stream, on same side as Aghadrinagh 6/7 but opposite side to Aghadrinagh 3 and Aghadrinagh 4
Artefacts	Two bipolar flake fragments (undiagnostic), flint and quartz; broken clay tobacco pipe (post-1840); sherd of black-glazed earthenware (late 18th–19th century)
Charcoal/wood	Charcoal (alder, hazel, ash)
Period	Middle Bronze Age
Radiocarbon date	1611–1435 BC (Poz-97538)
Site name	Aghadrinagh 3 (E4681)
Description	Rectangular trough that may have been lined with clay/marl. Associated water overflow/outlet-channel and adjacent long, subrectangular pit. Sealed by disturbed burnt mound material representing at least two discrete deposits
Landscape setting	East side of palaeochannel, on same side as Aghadrinagh 4 but opposite side to Aghadrinagh 2 and 6/7

Site name	Aghadrinagh 3 (E4681) (continued)
Artefacts	Clay tobacco pipe stem fragment (18th century); three sherds of glazed white earthenware (18th/19th century); glass bottle fragment and flat glass (window) fragment (19th/20th century)
Charcoal/wood	Charcoal (ash, hazel, alder)
Animal bone	Fragment of burnt bone (0.22g) unidentifiable to species or element
Period	Middle Bronze Age
Radiocarbon date	1386–1127 BC (Poz-99249) 1376–1116 BC (Poz-99250)
Site name	Aghadrinagh 4 (E4682)
Description	Disturbed burnt mound deposit
Landscape setting	East side of palaeochannel, on same side as Aghadrinagh 3 but opposite side to Aghadrinagh 2 and 6/7
Artefacts	Clay tobacco pipe stem fragment (18th century); sherd of glazed red earthenware and sherd of glazed white earthenware (18th/19th century)
Charcoal/wood	Charcoal (alder, hazel, ash, birch)
Period	Late Bronze Age
Radiocarbon date	1125–926 BC (Poz-99251)
Site name	Aghadrinagh 6/7 (E4684)
Description	Circular trough with irregular-shaped extension on east side, probably a water inlet channel. Sealed by a disturbed burnt mound deposit
Landscape setting	West side of palaeochannel, on same side as Aghadrinagh 2 but opposite side to Aghadrinagh 3 and 4
Artefacts	Flint bipolar core (undiagnostic)
Charcoal/wood	Charcoal (hazel, alder, willow, holly, ash, pomaceous (apple/hawthorn-type) fruitwood)
Period	Middle Bronze Age
Radiocarbon date	1531–1424 BC (Poz-99254)

Site name	Attireesh 1 (E4687)
Description	Four troughs. Rectangular trough with two stake-holes in north-west end and a third just outside eastern corner. Hearth at north-east side. Oval trough with roundwood-lined base (hazel and alder). Truncated rectangular trough with stone lining in base and short south-east side, roundwood-lined long sides (ash) and stake (hazel) in east corner. Moss lining also on base. Post-hole and two pits/post-holes to north-west. Rectangular trough with wood-lined base (alder) and stake (hazel) in south-west corner. Adjacent stockpile of stones and displaced hazel and willow roundwoods. Sealed by a horseshoe-shaped burnt mound deposit
Landscape setting	East-facing slope, between dry ground and area of wet grassland and peat bog, with stream to south-east, 25 m south-west of Attireesh 2
Charcoal/wood	Charcoal (hazel, alder, ash, holly, birch); wood (hazel, alder, ash, apple/hawthorn-type fruitwood, willow)
Period	Early Bronze Age
Radiocarbon date	2033–1831 BC (Poz-99255) 1959–1751 BC (Poz-99256) 1867–1544 BC (Poz-97694)
Site name	Attireesh 2 (E4688)
Description	Disturbed burnt mound deposit
Landscape setting	On south-facing slope in waterlogged field with higher, drier ground to west and stream to south, 25 m north-east of Attireesh 1
Charcoal/wood	Charcoal (alder, ash, holly, oak, apple/hawthorn-type fruitwood, willow)
Period	Middle Bronze Age
Radiocarbon date	1272–1021 BC (Poz-99380) 1211–1012 BC (Poz-99257)
Site name	Carrowbeg 1 (E4621)
Description	Disturbed burnt mound deposit in natural hollow, subcircular in plan
Landscape setting	Wet grassland at base of drumlin ridge, 95 m north-west of Drummindoo 1
Charcoal/wood	Charcoal (hazel)
Period	Chalcolithic
Radiocarbon date	2459–2204 BC (Poz-80358)

Site name	Carrownaclea 1 (E4690)
Description	Tree/scrub land clearance hollow, sealed by disturbed burnt mound deposit
Landscape setting	On north-east edge of small stream, 200 m south-west of Carrownaclea 2 and 110–180 m east of Drummindoo 3 and 4
Charcoal/wood	Charcoal (oak, alder, ash, hazel, birch, elm)
Period	Late Bronze Age
Radiocarbon date	981–817 BC (Poz-99259)
Site name	Carrownaclea 2 (E4691)
Description	Disturbed burnt mound deposit
Landscape setting	Base of low drumlins to north, with canalised stream to west and field boundary ditch to east, 200 m north-east of Carrownaclea 1, 310 m and 380 m north-east of Drummindoo 3 and 4
Charcoal/wood	Charcoal (alder, alder/hazel, pine)
Period	Early Bronze Age
Radiocarbon date	2028–1782 BC (Poz-99284)
Site name	Claggarnagh East 2/3 (E4693)
Description	Largely preserved (65%) <i>in situ</i> outside the footprint of road project, on north side. Disturbed burnt mound deposit
Landscape setting	On east side of stream, 290 m to north-east of Claggarnagh East 4/5 and 550 m to north-east of Claggarnagh West 6
Charcoal/wood	Charcoal (hazel, ash, willow)
Period	Early Bronze Age
Radiocarbon date	1922–1746 BC (Poz-99260)

Site name	Claggarnagh East 4/5 (E4694)
Description	Rectangular trough that had been relined. First phase had plank-lined base (alder, oak, ash) and possible corner stake-holes. One of the alder planks had possible saw marks. Second phase had plank-lined base (alder, ash) and corner stake-holes. Five stake-holes adjacent to the trough; two at north-east corner and three on west side set in triangular arrangement. Possible hearth at north-west side. Pit with associated post/stake-holes, representing a well, over 3 m north of the trough. Stone-lined pit over 6 m to north-east of well, probably a roasting pit. To south-east, two stake-holes, one with remains of a stake (oak). Sealed by disturbed burnt mound deposit
Landscape setting	Base of west-facing slope with a former watercourse depicted on six-inch Ordnance Survey map of 1839 (surveyed 1837), 290 m south-west of Claggarnagh East 2/3 and 250 m north-east of Claggarnagh West 6
Artefacts	Three chert platform flakes (undiagnostic), one modified as a scraper; two glass bottle fragments (19th/20th century)
Charcoal/wood	Charcoal (hazel, alder, oak, ash, birch, holly, willow); wood (alder, oak, ash)
Period	Middle and Late Bronze Age
Radiocarbon date	1960–1747 BC (Poz-99261) 1258–1020 BC (Poz-99288) 1003–834 BC (Poz-99262)
Site name	Claggarnagh West 1 (E4696)
Description	Circular trough with partly stone-lined base. Sealed by disturbed burnt mound deposit
Landscape setting	Near foot of drumlin ridge in a waterlogged field, with canalised stream to west, 48 m north-east of Claggarnagh West 2, 50 m south-east of Claggarnagh West 3 and 70 m SSE of Claggarnagh West 4
Charcoal/wood	Charcoal (hazel, alder)
Period	Chalcolithic
Radiocarbon date	2463–2208 BC (Poz-97540) 2456–2200 BC (Poz-97541)
Site name	Claggarnagh West 2 (E4697)
Description	Two troughs. Rectangular trough with stone-lined short sides, stakes (hazel, ash) on long sides and roundwood-lined base (alder). Truncated rectangular trough with roundwood-lined base (alder) and, adjoining the south-east side, a pit with stone-lined base and natural spring, probably a well; trough cut by a second pit and displaced wood scattered around it. Moss lining also on base of both troughs. Sealed by burnt mound deposit. Possible large stone extraction pits to north-east and south-east, one with natural spring in base

Site name	Claggarnagh West 2 (E4697) (continued)
Landscape setting	Base of north- and west-facing slope in waterlogged field, on west side of canalised stream, 30 m south of Claggarnagh West 3, 48 m south-west of Claggarnagh West 1 and 75 m south of Claggarnagh West 4
Charcoal/wood	Charcoal (hazel, ash, oak, apple/hawthorn-type fruitwood, alder); wood (alder, hazel, ash, pine, willow)
Plant remains	Hazel nuts (3), hazelnut shell fragments (4)
Animal bone	Sheep/goat left metacarpal fragment (possible cut marks)
Period	Middle Bronze Age
Radiocarbon date	1531–1416 BC (Poz-97542) 1531–1416 BC (Poz-97696) 1498–1306 BC (Poz-107024)
Site name	Claggarnagh West 3 (E4698)
Description	Two troughs connected by a water channel. Oval trough with roundwood-lined base (ash). Circular trough with stone-lined hollow adjoining north side, likely a water-holding area for overspill; water then flowed into a channel that extended downslope to north, into the oval trough. Largely sealed by kidney-shaped burnt mound deposit
Landscape setting	Base of north- and west-facing slope in waterlogged field, directly east of canalised stream, 30 m north of Claggarnagh West 2, 40 m south of Claggarnagh West 4, 50 m north-west of Claggarnagh West 1 and 160 m south-west of Claggarnagh West 5
Charcoal/wood	Charcoal (hazel, ash, alder); wood (ash)
Period	Early and Middle Bronze Age
Radiocarbon date	2204–1979 BC (Poz-99264) 1215–987 BC (Poz-97439)
Site name	Claggarnagh West 4 (E4699)
Description	Circular trough with moss- and stone-lined base and wattle-lined sides suggested by eight stakes (hazel, ash). Water channel diverted water from a natural spring downslope into the trough and two water-holding pits, with excess water discharged into an area of peat. Third pit/possible tree-throw hole north-west of the trough. Sealed by burnt mound deposit, subcircular in plan
Landscape setting	Base of north- and west-facing slope in waterlogged field, directly east of canalised stream, 40 m north of Claggarnagh West 3, 75 m north of Claggarnagh West 2, 70 m north-west of Claggarnagh West 1 and 130 m south-west of Claggarnagh West 5
Artefacts	Nine chert platform flakes (undiagnostic), one with edge retouch

Site name	Claggarnagh West 4 (E4699) (continued)
Charcoal/wood	Charcoal (hazel, ash, alder, oak); wood (hazel, ash, alder, pine)
Period	Early Bronze Age
Radiocarbon date	2031–1778 BC (Poz-97543)
Site name	Claggarnagh West 5 (E4700)
Description	Rectangular trough with moss- and plank-lined base (alder) and wattle/ wood-lined sides suggested by 15 stakes (hazel). Two alder planks had possible saw marks. Three posts (ash) outside short south-east end of trough in triangular arrangement. Sealed by disturbed burnt mound deposit. Pit/possible tree-throw hole to west
Landscape setting	Base of north-facing slope in waterlogged field on slightly higher ground, 130 m north-east of Claggarnagh West 4
Charcoal/wood	Charcoal (ash, oak, alder, hazel, yew, holly); wood (alder, hazel, ash)
Plant remains	Hazel nut (1)
Animal bone	Fragment of burnt bone (0.67 g), unidentifiable to species or element
Period	Middle Bronze Age
Radiocarbon date	2456–2202 BC (Poz-97545) 1397–1128 BC (Poz-97697) 1211–1012 BC (Poz-99265)
Site name	Claggarnagh West 6 (E4701)
Description	Heavily disturbed burnt mound deposit. Pit, possibly for stone extraction and stockpiling stones
Landscape setting	On gentle south-facing slope overlooking waterlogged area, on the opposite, east side of steep drumlin ridge to Claggarnagh West 1–5 and 7
Period	Undated
Site name	Claggarnagh West 7 (E5015)
Description	Heavily disturbed burnt mound deposit
Landscape setting	Wet grassland at base of west-facing slope of same drumlin ridge as Claggarnagh West 1–5
Charcoal/Wood	Charcoal (hazel)

Site name	Claggarnagh West 7 (E5015) (continued)
Period	Early Bronze Age
Radiocarbon date	2028–1782 BC (Beta-518392)
Site name	Cloondeash 1 (E4702)
Description	Oval trough with wood lining suggested by a piece of degraded wood just above the base. Water inlet channel on west side, on higher ground, facilitated flow of water from a natural spring into the trough. Sealed by disturbed burnt mound deposit
Landscape setting	On gentle west-facing slope overlooking waterlogged area, 375 m and 405 m to north-east of Cloondeash 3 and 4
Charcoal/wood	Charcoal (ash, alder, hazel, elm, apple/hawthorn-type fruitwood, willow)
Period	Middle Bronze Age
Radiocarbon date	1611–1435 BC (Poz-97546)
Site name	Cloondeash 3 (E4704)
Description	Shallow, oval trough with large flat stone abutting north-east side. Partly sealed by disturbed burnt mound deposit
Landscape setting	On gentle north-facing slope in wet, marginal ground, with canalised stream to west, 25 m north-east of Cloondeash 4 and 375 m south-west of Cloondeash 1
Charcoal/wood	Charcoal (ash, hazel, alder)
Period	Middle Bronze Age
Radiocarbon date	1617–1449 BC (Poz-97547)
Site name	Cloondeash 4 (E4705)
Description	Seven pits/possible pits in two clusters and seven shallow linear gullies (possible land clearance). Sealed by disturbed burnt mound deposit
Landscape setting	On gentle west-facing slope descending to canalised stream, 25 m south-west of Cloondeash 3
Charcoal/wood	Charcoal (ash, hazel, alder, birch, oak)
Period	Middle–Late Bronze Age

Site name	Cloondeash 4 (E4705) (continued)
Radiocarbon date	1608–1425 BC (Poz-97591) 1220–1003 BC (Poz-97682) 767–421 BC (Poz-97683)
Site name	Conrea 1 (16E0432)
Description	Redeposited burnt mound material, perhaps disturbed during dredging and canalisation of nearby stream
Landscape setting	In low-lying, flat terrain on the edge of peat basin with canalised stream to north, 200 m south-east of a cluster of four burnt mounds outside the present road project (Drumard 1–4; Gilligan & Hession 2014a; Hourihan & Hession 2014a–c)
Charcoal/wood	Charcoal (hazel, alder, ash, willow)
Period	Early Bronze Age
Radiocarbon date	1875–1626 BC (Poz-99266)
Site name	Deerpark East 1 (E4706)
Description	Two troughs. Oval trough with stone-lined base and double wattle-lined sides (hazel, ash, alder, holly, birch, oak), with space between packed with moss. Wattle screen (birch) on north-west side. Replaced by rectangular trough with roundwood and plank-lined base and sides (hazel, apple/hawthorn-type fruitwood, willow, alder), also a disturbed stake (alder) and a possible stone-lined, short south-west side (stone displaced). Moss lining also on base. Possible raised hearth on south-east side, comprising semi-circular arrangement of small stones and deposit of ash. Sealed by burnt mound deposit, subcircular in plan
Landscape setting	In a peat basin, 195 m north-east of Deerpark East 3 and 260 m north-east of Deerpark East 4
Charcoal/wood	Charcoal (oak, birch, ash, hazel, alder); wood (hazel, alder, ash, birch, oak, holly, apple/hawthorn-type fruitwood, willow)
Plant remains	Hazel nuts (24), hazelnut shell fragments (10)
Period	Early and Middle Bronze Age
Radiocarbon date	2276–1985 BC (Poz-97684) 2019–1767 BC (Poz-97699) 1607–1421 BC (Poz-97698)

Site name	Deerpark East 3 (E4708)
Description	Post-hole, sealed by a burnt mound deposit, suboval in plan; then covered by layers of peat and marl, indicating periods of flooding and peat development, and by additional disturbed burnt mound material, kidney-shaped in plan
Landscape setting	On drier ground at edge of wet grassland on west side of a stream, 60 m south-east of Deerpark East 4, 195 m south-west of Deerpark East 1
Artefacts	Retouched flint platform flake and broken chert arrowhead (undiagnostic); fragment of windowpane glass (18th–20th-century); complete glass torpedo bottle (19th century); ten sherds of glazed white earthenware, pearlware and black-glazed earthenware (18th–19th-century)
Charcoal/wood	Charcoal (hazel, alder, willow, ash, oak, birch)
Period	Early Bronze Age
Radiocarbon date	2193–1950 BC (Poz-97489) 2025–1773 BC (Poz-97685)
Site name	Deerpark East 4 (E4709)
Description	Rectangular trough with roundwood-lined base and sides (alder). Two large stones at north corner. Metalled surface directly to west, with three stake-holes and a post-hole. Possible hearth at short north-west side of trough. Peat in former lake basin with unworked wood (yew, alder, oak, birch and willow), probably from trees that grew around the water's edge. Sealed by kidney-shaped burnt mound deposit
Landscape setting	On east-facing slope overlooking stream/former lake, with deep peat; 60 m north-west of Deerpark East 3, 260 m south-west of Deerpark East 1
Artefacts	1 chert bipolar core, 3 chert bipolar flakes (one edge retouched), 5 platform flakes—4 chert (1 retouched as convex end scraper) and 1 quartz; 3 discoidal bone beads (Neolithic); 28 sherds of black-glazed earthenware, glazed white earthenware, porcelain and stoneware (18th–19th-century); 13 glass fragments from bottles, phials, drinking glass and windowpane (18th–20th-century); non-local, unworked crystal of purple vein quartz (amethyst)
Charcoal/wood	Charcoal (alder, hazel, oak, ash, birch, apple/hawthorn-type fruitwood); wood (alder, oak, willow, birch, yew)
Animal bone	Five cattle bone elements (left metacarpal, right metatarsal, left tibia, two loose teeth) and one bone fragment unidentifiable to species or element
Period	Early Bronze Age
Radiocarbon date	2283–2034 BC (Poz-99286) 2131–1890 BC (Poz-97490) 1878–1626 BC (Poz-97701) 1736–1533 BC (Poz-105604)

Site name	Derrylea 1 (16E0608)
Description	Rectangular trough, stepped at short, south-west end, forming a ledge with four stake-holes arranged in pairs. Three stake-holes along short, north-east side of the trough. Further east, two large flat stones, paving or stepping stones. Possible hearth 2.4 m north of the trough, comprised of ash and charcoal in a shallow, subcircular hollow. Four land clearance hollows. Sealed by burnt mound deposit, subcircular in plan
Landscape setting	On gentle south-facing slope of a low drumlin ridge, with stream to east
Charcoal/wood	Charcoal (alder, oak, ash, hazel, holly, apple/hawthorn-type fruitwood)
Period	Early Bronze Age
Radiocarbon date	2280–1985 BC (Poz-97647) 1731–1515 BC (Poz-97640)
Site name	Doogary 1 (E4711)
Description	Possible hearth comprising thin deposit of charcoal staining. Twelve land clearance hollows. Disturbed burnt mound deposit
Landscape setting	Flat area of wet grassland
Charcoal/wood	Charcoal (alder, ash, oak)
Period	Chalcolithic
Radiocarbon date	2577–2348 BC (Poz-99285)
Site name	Drumaleheen 6 (E4721)
Description	Disturbed burnt mound deposit in natural hollows
Landscape setting	Base of a drumlin ridge, on east-facing slope at edge of wet grassland
Period	Undated
Site name	Drummindoo 1 (E4723)
Description	Circular trough, sealed by disturbed burnt mound deposit
Landscape setting	Base of a drumlin ridge, on south-facing slope in area of wet grassland, 95 m south-east of Carrowbeg 1
Period	Undated

Site name	Drummindoo 3 (E4725)
Description	Circular trough with wattle-lined sides suggested by 12 poorly preserved stakes; partly sealed by burnt mound deposit, horseshoe-shaped in plan
Landscape setting	Base of slope on south side of stream, 52 m south-west of Drummindoo 4 and 173 m west of Carrownaclea 1
Charcoal/wood	Charcoal (ash, hazel, birch, alder, oak)
Period	Early Bronze Age
Radiocarbon date	2014–1771 BC (Poz-97642)
Site name	Drummindoo 4 (E4726)
Description	Two superimposed, rectangular troughs and a circular trough. Lower trough (north/south) with wood-lined base of planks/roundwoods (alder, hazel). Upper trough (NW/SE) with wood-lined sides of planks/roundwoods (alder), held in place with stakes, and moss packed around sides with outer wall of wattle on north-east side. Circular trough on slightly higher ground, with roundwood-lined sides (alder) held in place by stakes (hazel) and moss in base. Possible hearth represented by band of charcoal (0.05 m thick) on south side of site. Sealed by kidney-shaped burnt mound deposit
Landscape setting	Base of slope on south side of stream in area of peat, 52 m north-east of Drummindoo 3 and 133 m west of Carrownaclea 1
Charcoal/wood	Charcoal (alder, hazel, willow, oak, birch, apple/hawthorn-type fruitwood); wood (alder, hazel)
Period	Early Bronze Age
Radiocarbon date	2286–2036 BC (Poz-97688) 2021–1773 BC (Poz-97702)
Site name	Drumneen 1 (E4728)
Description	Disturbed burnt mound deposit
Landscape setting	Base of slope in waterlogged field, 650 m north-east of Kilbree Lower 2
Charcoal/wood	Charcoal (hazel)
Period	Middle Bronze Age
Radiocarbon date	1507–1323 BC (Poz-97691)

Site name	Kilbree Lower 2 (E4731)
Description	Rectangular trough, partly sealed by burnt mound deposit, suboval in plan
Landscape setting	Area of wet grassland, 650 m south-west of Drumneen 1
Charcoal/wood	Charcoal (birch)
Period	Middle–Late Bronze Age
Radiocarbon date	1211–1012 BC (Poz-99291)
Site name	Knockbrack 1 (E4732)
Description	Truncated rectangular trough with roundwood-lined base/sides (hazel, oak, alder, apple/hawthorn-type fruitwood) and three stakes (hazel) in short north end. Two large flat stones may have lined the base or once stood upright at the short south end. Sealed by burnt mound deposit, subcircular in plan
Landscape setting	Base of a steep drumlin ridge in flat area of reclaimed bog at the edge of a peat basin, with a stream to west, 415 m east of Knockbrack 2, 525 m east of Knockbrack 3 and 555 m east of Knockbrack 4
Charcoal/wood	Charcoal (hazel, ash); wood (alder, hazel, oak, apple/hawthorn-type fruitwood)
Plant remains	Waterlogged seeds of bramble (1), stinging nettle (1), dock (1) and common chickweed (1)
Period	Chalcolithic
Radiocarbon date	2552–2238 BC (Poz-99292) 2455–2147 BC (Poz-97703)
Site name	Knockbrack 2 (E5016)
Description	Rectangular trough with stone-lined base, plank-lined long sides (oak, alder), stone-lined short north-east end, wood-lined short south-west end (curved oak plank), and stakes (ash, alder) in north and south corners and north-east end, with a possible post-hole in west corner. Base/sides packed with moss. Possible woodpile (alder, oak) 1 m south-west of trough. Sealed by burnt mound deposit, subcircular in plan
Landscape setting	In peat at south edge of a drumlin ridge, between wetland and drier land, 105 m east of Knockbrack 3, 130 m east of Knockbrack 4, 415 m west of Knockbrack 1
Charcoal/wood	Charcoal (alder, hazel, blackthorn/cherry, willow, ash); wood (alder, oak, ash, hazel)

Site name	Knockbrack 2 (E5016) (continued)
Plant remains	Waterlogged hazelnut (1)
Period	Early Bronze Age
Radiocarbon date	2031–1829 BC (Beta-518394) 1959–1751 BC (Beta-518393)
Site name	Knockbrack 3 (E5017)
Description	Rectangular trough with large stone close to the base in the short, north-west end, as well as three roundwoods (alder). Sealed by burnt mound deposit, subcircular in plan
Landscape setting	In peat at south-west edge of a drumlin ridge, with a stream to south and west, 25 m east of Knockbrack 4, 105 m west of Knockbrack 2, 535 m west of Knockbrack 1
Charcoal/wood	Charcoal (alder, hazel, oak); wood (alder)
Period	Late Neolithic
Radiocarbon date	2850–2488 BC (Beta-518396) 2837–2472 BC (Beta-518395)
Site name	Knockbrack 4 (E5018)
Description	Truncated rectangular trough defined by a hollowed-out tree trunk (oak) and upright curved planks (oak, alder), with lip or out-turned rim (alder) along long western side. Two stakes (oak, alder) in short north end. Moss under the tree trunk and around sides. Section of wattling (hazel, alder, ash, holly) along east side for 1.12 m, also tightly packed with moss. Sealed by disturbed burnt mound material representing at least two discrete deposits
Artefacts	Fragment from carved alder vessel/scoop
Charcoal/wood	Charcoal (alder, hazel, willow, birch, oak, apple/hawthorn-type fruitwood); wood (hazel, alder, oak, pine, ash, holly)
Plant remains	Waterlogged hazelnut shell fragments (2)
Period	Middle Bronze Age
Radiocarbon date	2468–2239 BC (Beta-518397) 1519–1422 BC (Beta-518399) 1505–1397 BC (Beta-518398)

Site name	Lisnageeha (or Antigua) 3 (E4737)
Description	Rectangular trough with some stone lining. Partly sealed by disturbed burnt mound deposit
Landscape setting	At base of a low, west-facing slope, by a palaeochannel representing a former stream
Period	Undated
Site name	Sheean 1 (E4740)
Description	Rectangular trough with large boulder in south-east side. Partly sealed by disturbed burnt mound deposit
Landscape setting	In wet grassland east of stream, 165 m north-east of Sheean 3
Charcoal/wood	Charcoal (hazel, ash, alder, oak, apple/hawthorn-type fruitwood, holly)
Period	Middle Bronze Age
Radiocarbon date	1743–1537 BC (Poz-99295) 1533–1427 BC (Poz-97643)
Site name	Sheean 3 (E4742)
Description	Four troughs. Rectangular trough with four stake-holes along sides (three in north side, one in south-west corner) and large stones haphazardly positioned along east and south edges. Rectangular trough with plank-lined base (alder). Circular trough with wood lining suggested by a bundle of 13 roundwoods (ash, alder) in the north side, and 19 stakes (hazel)/stake-holes, largely around sides. Circular trough with stone-lined base. Stone stockpile or metallised surface. Sealed by burnt mound material representing at least four discrete deposits, irregular in plan but slightly horseshoe-shaped on south-west and north-west sides
Landscape setting	At interface of dry and wet grassland on north-east-facing slope, with canalised stream to east, 165 m south-west of Sheean 1
Charcoal/wood	Charcoal (alder, hazel, ash, apple/hawthorn-type fruitwood); wood (alder, hazel, ash)
Period	Early Bronze Age
Radiocarbon date	2195–1952 BC (Poz-99283) 2127–1883 BC (Poz-99382) 1886–1694 BC (Poz-97645)

Appendix 3 Bayesian modelling of burnt mound dates from Mayo

Ben Spillane

Bayesian methodologies have become increasingly prevalent in archaeological research. Their value is highlighted by the fact that the reporting of modern radiocarbon dates relies heavily on calibration curves (e.g. IntCal20), which are grounded in Bayesian inference (Hamilton & Krus 2018, 189–92; Heaton et al. 2020; Reimer et al. 2020; Anderson et al. 2021, 16). Accordingly, the author was commissioned to apply a Bayesian methodology to the radiocarbon dates derived from burnt mounds excavated on the N5 Westport to Turlough road project, along with two sites from the adjoining Barleyhill to Kilmeena section of the N59 Westport to Mulranny road project, with a focus on tracking the use of burnt mound sites over time. While the results of that analysis are presented in Chapter 2, a more detailed overview of the Bayesian process used is presented here, particularly in relation to radiocarbon sample evaluation and how it informed model structure. In addition, three case study models were produced for a cluster of excavated burnt mounds in the adjacent modern-day townlands of Deerpark East, Attireesh and Gortaroe, located north of Westport town (Chapter 1, Cleary & Gillespie: text box). This combines the N5/N59 sites with those from the Westport Main Drainage Scheme (Gillespie 2007). These dates were collated by Kerri Cleary, incorporating information provided by Richard F Gillespie, Bernard Guinan and Sue Zajac.

Principles of Bayesian modelling

Bayesian chronological models follow the basic principle laid out by Bayes' rule, which is:

$$\text{posterior beliefs} = \text{standardised likelihoods} \times \text{prior beliefs.}$$

Using Bayes' rule allows us to obtain a new understanding of the problem (the posterior belief), which incorporates both the standardised likelihoods and the prior beliefs (the radiocarbon dates and our existing archaeological knowledge). Through the online software provided by OxCal version 4.4.4, which applies a form of Markov Chain Monte Carlo sampling, it is possible to combine this information to produce realistic estimates of the dates of archaeological interest (posterior estimates). In the case of this analysis, the dates of archaeological interest are the start and end of stone-heating, water-boiling activity in the N5/N59 sites. These posterior beliefs are not final but rather interpretative estimates that will change as new data is added by future researchers (Bayes 1763; Bayliss et al. 2007, 4–5; Hamilton & Krus 2018, 189–92). Descriptions of the algorithms used in OxCal and the mathematical processes carried out by the software are available in Bronk Ramsey (1995; 1998; 2001; 2009) or from the online manual.

Modelling approach, structure and sensitivity analysis

Modelling the chronological development of individual burnt mounds was not possible because no site had a sufficient number of radiocarbon dates (at least five dates are required, preferably seven or more). A site such as Deerpark East 1, with a primary trough superimposed by a secondary trough, would present an ideal opportunity for a site-based model that could help us better understand phases of use, abandonment and reuse of burnt mounds over time. However, only three dates are available from Deerpark East 1 and these produce chronological estimates that are very broad and not particularly informative. Therefore, the method adopted was to model the activity associated with burnt mounds (represented by the radiocarbon dates) to track broad chronological trends across the entire route of the road project.

In Chapter 2, two landscape models were developed based on two distinct categories of dates, which were differentiated on the basis of their respective relationships between dated events (the death of the radiocarbon-dated organic material) and target events (the specific episode of human activity in the past that we are interested in). The relationships between a radiocarbon-dated sample, the context from which it was derived, and the archaeological event of interest, are not always consistent (they can often be very separate). For example, an isolated animal bone or shed antler recovered from the backfill of a ditch may not necessarily represent the date when the ditch was dug, but rather a piece of material that was incorporated into the ditch fills long afterwards (Bayliss 2015, 689). Therefore, it is important when modelling dates to

consider this relationship for each sample. The ideal date is one derived from short-lived sample material that is directly linked to a specific archaeological event. (For discussion on the contextual quality of radiocarbon dates for Bayesian models see Bayliss et al. 2007; Bayliss 2015; Buck & Meson 2015.)

Model 1 includes radiocarbon dates derived from trough linings, which can generally be taken as representing the construction of those troughs (but see discussion below). These dates were derived from short-lived wood species forming part of the organic remains lining the troughs. Because the samples were relatively short lived, and directly associated with material used to construct troughs that were preserved *in situ* (i.e. undisturbed in the original context), the relationships between the dated events and the target events (in this case the construction of the troughs) are very close (Bayliss 2015, 689). Model 1, therefore, can provide a secure measurement of the start and end of wood-lined trough use in the landscape of the road project, although the degree to which this can be used to track the beginning and end of the hot-stone water-boiling process overall is less secure.

Model 2 includes dates related to the use of burnt mound complexes. These were dates for charcoal samples derived from burnt mound material: the deposits of heat-shattered stone, charcoal and burnt sediment that were by-products of the stone-heating process. The contexts of such dates include burnt mounds overlying troughs and other features, and the fills of troughs, which are usually composed of burnt mound material that had been backfilled or naturally slumped into the troughs. Dates from other features related to burnt mound complexes (pits, fires or hearths), but with an uncertain stratigraphic relationship to the

trough, were also included in this model, as they also reflect the use of these sites over time. The stratigraphic security of samples derived from burnt mound deposits is more variable than trough linings. That said, a clear relationship that can be inferred is that these charcoal dates do represent hot-stone activity. It can be assumed, therefore, that these dates reflect random use events at the burnt mound sites over time.

Both models were defined in OxCal using the 'bounded phase' structure, which is appropriate because there is no relative ordering of the radiocarbon dates based on stratigraphic sequences, as they are derived from a variety of contexts across the project route (Hamilton & Krus 2018, 197). This model structure applies a uniform 'prior' to the radiocarbon dates and assumes that the activity the dates represent began, occurred over a period of unknown duration, and then ended. It also assumes that the available dates were randomly selected from a uniform distribution of possible material, meaning that this collection of dates is representative of broad chronological trends (Buck et al. 1992). The model structure consists of the radiocarbon dates (R_Dates), which are constrained within an unordered 'phase' and defined by a start and end 'boundary', all placed within a 'sequence'. This establishes the ordered relationship in the model, that hot-stone water-boiling activity began, that datable material (charcoal, wooden trough linings) was deposited at the various sites, and then activity ended (Hamilton & Krus 2018, 196). During modelling, the radiocarbon uncertainties and calibration process produce dates that scatter around the points of archaeological interest (which in this case are the start and end of hot-stone water-boiling activity), and the uniform prior applied to the dates helps to counteract their

statistical scatter.

For Model 2, the dates included are taken to represent the use of the burnt mound sites over time. To test whether the intensity of hot-stone technology was consistent, or variable over different periods, the 'sum' parameter was applied. This parameter provides a summed probability for the modelled posterior probabilities. It is used to test the assumption that the dates were from a single, more or less continuous phase of activity, and that the samples were randomly selected from a uniform distribution of possible material (Hamilton & Kenney 2015, 80). If this summed probability forms a uniform prior distribution (i.e. the modelled date probabilities are uniformly distributed), then it can imply that the activity represented by these dates was carried out consistently for the period of time under consideration. If there are pulses and dips in the distribution, where the bulk of dating is derived from certain periods, it can be suggested that the associated activity was more intensive at the points that the modelled probabilities cluster and less intensive at the points where they do not.

The use of summed probability distributions can be subject to problems, specifically in differentiating between patterns that are significant and patterns that are influenced by artefacts of the 14C calibration curve. It is possible for sharp drops and rises in a summed probability distribution to be associated with plateaus or 'wiggles' in the calibration curve and unrelated to the underlying distribution of events. For example, a series of wiggles in the portion of the calibration curve between 1700 BC and 1480 BC could represent the Minoan Santorini/Thera eruption, which caused fluctuations in the Carbon-14 content in the atmosphere over time (Pearson et al.

2018; Reimer et al. 2020, 735). Radiocarbon dates that intersect with these wiggles can yield a wider series of equally possible calendar age ranges. On the other hand, those that do not intersect with the wiggles of the curve will have more condensed, precise probabilities. This can have the effect of exaggerating the clustering of modelled probabilities to portions of the curve subject to the wiggles, and minimising the other sections, even though in reality the activity could have been relatively consistent.

To ensure as much as possible that the summed probability distribution produced in Model 2 is robust and not overly subject to the aforementioned artefacts of the calibration curve, simulation sensitivity analysis was carried out (Griffiths 2014). This involves creating a bounded phase model, also using the sum parameter with a series of simulated radiocarbon measurements that mimicked the real dates. In total, 20 runs of these simulations were undertaken, with each run randomly calibrating the simulated dates to any point on the calibration curve facilitated by the associated standard error (Bronk Ramsey 1995, 428). If the simulated summed probabilities form uniform distributions, unlike that produced by the real model, then it strengthens the argument that the patterns observed in the real model are not overly affected by the calibration curve and can be considered robust. On the other hand, if the simulated distributions form similar spikes and dips to the real model, this may mean that artefacts of the calibration curve are affecting the distribution of dates (see below for the results of this sensitivity analysis).

Sample quality and security

Waterlogged wood from trough linings

The dates in Model 1 (Table A3.1) are from waterlogged wood from trough linings. As the samples derived from material forming the lining, these dates have a direct relationship to a specific event of archaeological interest (Becker et al. 2011, 20–1).

These samples could hypothetically date the construction of the troughs and therefore the foundation of the associated burnt mounds. We know, however, that some troughs were either replaced or reworked (including relined) during successive periods of use, sometimes hundreds of years after the site was initially established (Hawkes, Chapter 2). This can be invisible in the archaeological record, with evidence for the reuse or long-term use of a burnt mound only identifiable where a new trough replaces the original one, such as at Deerpark East 1. In other cases, while no direct evidence of a trough replacement is evident, charcoal from the trough fill(s) or the burnt mound, despite stratigraphically overlying the trough, can be found to be much earlier than the lining date. At Knockbrack 4, the trough lining and basal fill dated to the Middle Bronze Age, while charcoal from the overlying mound dated several hundred years earlier to the Chalcolithic period. This could be a result of post-depositional movement of the charcoal or disturbance to the burnt mound.

Therefore, while it is uncertain whether dates from trough linings always represent the initial foundation of associated burnt mounds, they do have a secure association with specific events in the history of the sites, specifically when communities built new troughs or relined an existing one for the purpose of boiling water.

Table A3.1—Radiocarbon dates included in Model 1, from excavated burnt mound sites on the N5 Westport to Turlough road project

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability) ⁵
Attireesh 1	Poz-97694	Trough (F38), side lining (F30). Timber 15: hazel/ash brushwood (35 g)	3390 ± 35	1870–1540 cal BC
Claggarnagh East 4/5	Poz-99288	Trough (F10), Phase 1 basal lining (F21). Timber 8: alder wood	2940 ± 30	1260–1050 cal BC
Claggarnagh West 2	Poz-97696	Trough (F16), basal lining (F17). Timber 33: alder wood	3205 ± 35	1540–1410 cal BC
Claggarnagh West 3	Poz-97439	Trough (F06), basal lining (F08). Timber 4: ash wood (44 g)	2900 ± 35	1220–1010 cal BC
Claggarnagh West 5	Poz-97697	Trough (F06), basal lining (F15). Timber 2: alder wood	3020 ± 35	1400–1120 cal BC
Deerpark East 1	Poz-97699	Lower trough (F17B), outer wattle side lining (F17E). Timber 56: hazel wood	3550 ± 35	2020–1760 cal BC
Deerpark East 1	Poz-97698	Upper trough (F05), basal lining. Timber 9: Maloideae wood	3230 ± 35	1610–1420 cal BC
Deerpark East 4	Poz-97701	Trough (F18), side lining (F22). Wood (F22J): alder wood	3435 ± 35	1880–1620 cal BC
Deerpark East 4	Poz-105604	Trough (F18), basal lining (F38). Wood (F38c): alder wood	3345 ± 30	1740–1530 cal BC
Drummindoo 4	Poz-97702	Upper trough (F09), side lining. Alder wood	3560 ± 35	2030–1770 cal BC
Knockbrack 1	Poz-97703	Trough (F07), basal lining (F06). Timber 15: hazel wood (10 g)	3830 ± 35	2400–2050 cal BC
Knockbrack 4	Beta-518399	Trough (F19), wattle screen side lining (F23). Timber 17: alder wood	3210 ± 30	1520–1420 cal BC
Sheean 3	Poz-97645	Trough (F09), basal lining (F18). Timber 4: alder wood	3475 ± 30	1890–1690 cal BC

⁵ Posterior density estimates and modelled radiocarbon date probabilities are rounded to the earliest and latest decades, for the sake of simplicity, and because the data underpinning the calibration curve is from decadal tree-ring samples (Hamilton & Krus 2018, 195).

Charcoal from burnt mounds

The dates in Model 2 (Table A3.2) are from charcoal samples recovered from burnt mounds and related features. Broadly speaking, these charcoal samples reflect episodes of hot-stone water-heating carried out at burnt mound sites. The samples can be divided into three categories: those derived from burnt mounds, those derived from trough fills and those derived from non-trough features (three pits, a post-hole and a fire/hearth).

The stratigraphic security of these samples and their relationships to specific depositional events is more variable than in the first group. Natural variables such as root action, freeze-thaw effects, animal burrowing, and the pressure of overlying sediments can cause fragmentation and movement of charcoal (Allué et al. 2009, 64; Théry-Parisot et al. 2010, 148). The movement of charcoal fragments can also result from water-flow, especially in burnt mounds located at the margins of wetland areas. In addition, how burnt mounds are formed creates an environment where charcoal fragments move around and get mixed up. There is rarely a clear stratigraphic sequence of how burnt mound material was built up. Activities like cleaning out and reusing the trough, subsequent reworking of the mound—including the effects of modern drainage works and tillage—and the loose stony composition of the mound itself, can all result in post-depositional movement of the burnt mound deposits (Hawkes 2011, 80–2; 2018, 26; Chapter 2). This makes it difficult to establish a relationship between the charcoal samples and specific events in the formation of the burnt mound. This issue also permeates other categories of

dates, derived from the fills of troughs and other features, which usually comprise redeposited burnt mound material. A definite relationship that can be inferred is that the charcoal is a by-product of the hot-stone processes carried out at these sites. We can assume, therefore, that these dates represent random activity events at the burnt mound sites excavated along the road project route. By modelling these dates and identifying the temporal points at which they cluster, we can build a reasonably robust picture of the varying levels of activity associated with these burnt mounds over time (Armit et al. 2013, 434; Smith 2016, 214).

Dealing with uncertain samples in Model 2

In the case of Model 2, 51 of the dates were treated as reliable samples, since they were derived from wood species that were reasonably short-lived and were sampled from contexts related to the use of the burnt mounds. This includes Poz-97640 and Poz-97545, which were derived from oak charcoal. Oak has a typical lifespan of 250–500 years, so these samples could potentially have been subject to the ‘old wood effect’ (i.e. the dated charcoal could represent wood that was already many years old when it was used as fuelwood on a burnt mound site) (Allen & Huebert 2014, 257; ¹⁴Chrono Centre [undated]). However, analysis of these oak charcoal fragments by wood specialist Ellen OCarroll found that they were pieces with only three to 10 annual growth rings, indicating that they represented younger portions of the tree, and were not subject to the old wood effect. Therefore, these samples were treated as providing reliable dates in the model.

For reasons outlined above, however, three radiocarbon dates derived from hot-stone contexts had a tenuous relationship to the burnt mound activity and were treated differently (Table A3.2). These dates were included in the model as terminus post quem (TPQ) samples, using the ‘After()’ function in OxCal, which informs the modelling algorithm that a date is older than the context from which it was derived, and prompts it to calculate a probability that the associated archaeological event occurred sometime after the radiocarbon date (Dee & Bronk Ramsay 2014, 84). These dates

include Poz-99350 and Poz-99286, which derived from peat layers below burnt mound deposits. Poz-99350 was derived from a sample of natural wood in a layer of peat that pre-dated the burnt mound; Poz-99286 was derived from charcoal that either represented a pre-existing phase of activity, or sediment that sank into the peat from overlying layers. The other date treated as a TPQ was Poz-99380, which derived from charcoal from a burnt mound deposit that was subject to modern disturbance, removing it from its original context.

Table A3.2—Radiocarbon dates included in Model 2, from excavated burnt mound sites on the N5 Westport to Turlough road project and Barley Hill to Kilmeena section of the N59

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough				
Aghadrinagh 2	Poz-97538	Trough (F05), basal fill (F30): ash charcoal (0.02 g)	3245 ± 35	1620–1430 cal BC
Aghadrinagh 3	Poz-99249	Burnt mound (F18): hazel charcoal (0.1 g)	3010 ± 30	1390–1120 cal BC
Aghadrinagh 3	Poz-99250	Trough (F20), secondary fill (F21): ash charcoal (1.0 g)	2985 ± 30	1380–1110 cal BC
Aghadrinagh 4	Poz-99251	Burnt mound (F03): hazel charcoal (1.0 g)	2865 ± 30	1130–920 cal BC
Aghadrinagh 6/7	Poz-99254	Burnt mound (F01): hazel/alder charcoal (0.2 g)	3215 ± 30	1520–1430 cal BC
Aghadrinagh 6/7	Poz-99350	Peat (F12) accumulated above the natural marl (F11): ash wood (1.0 g)	4760 ± 35	3640–3380 cal BC
		Event occurred after TPQ:	3540 BC (68%)	3400 BC (95%)
Attireesh 1	Poz-99255	Burnt mound (F03): hazel charcoal (0.2 g)	3595 ± 30	2040–1830 cal BC
Attireesh 1	Poz-99256	Possible fire (F06): hazel charcoal (0.2 g)	3540 ± 30	1800–1760 cal BC
Attireesh 2	Poz-99257	Burnt mound (F03): hazel charcoal (0.1 g)	2910 ± 30	1220–1010 cal BC

Table A3.2—Radiocarbon dates included in Model 2 (continued)

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough				
Attireesh 2	Poz-99380	Modern machine cut through burnt mound (F10), single fill (F09): alder charcoal (0.01 g)	2955 ± 35	1280–1020 cal BC
		Event occurred after TPQ:	1136 BC (68%)	1057 BC (95%)
Carrowbeg 1	Poz-80358	Burnt mound (F72): hazel charcoal (0.2 g)	3855 ± 35	2460–2200 cal BC
Carrownaclea 1	Poz-99259	Burnt mound (F03): alder charcoal (0.94 g)	2750 ± 30	990–810 cal BC
Carrownaclea 2	Poz-99284	Burnt mound (F03): hazel/alder charcoal (0.46 g)	3580 ± 30	2030–1780 cal BC
Claggarnagh East 2/3	Poz-99260	Burnt mound (F03): hazel charcoal (1.0 g)	3510 ± 30	1930–1740 cal BC
Claggarnagh East 4/5	Poz-99261	Burnt mound (F04): ash charcoal (0.2 g)	3535 ± 35	1970–1740 cal BC
Claggarnagh East 4/5	Poz-99262	Trough (F10), upper fill (F11): alder charcoal (0.3 g)	2775 ± 30	1010–830 cal BC
Claggarnagh West 1	Poz-97540	Trough (F04), upper fill (F05): alder charcoal (0.1 g)	3870 ± 35	2470–2200 cal BC
Claggarnagh West 1	Poz-97541	Burnt mound (F03): hazel charcoal (0.1 g)	3840 ± 35	2460–2200 cal BC
Claggarnagh West 2	Poz-97542	Trough (F16), upper fill (F15): alder charcoal (0.1 g)	3205 ± 35	1530–1410 cal BC
Claggarnagh West 2	Poz-107024	Trough (F21), basal fill (F20) beneath basal wood lining (F11): alder charcoal (1.0 g)	3140 ± 30	1500–1300 cal BC
Claggarnagh West 3	Poz-99264	Trough (F09), single fill (F10): hazel charcoal (0.2 g)	3710 ± 35	2210–1970 cal BC
Claggarnagh West 4	Poz-97543	Trough (F17), moss basal lining (F24), beneath/between basal stone lining (F23): ash charcoal (0.1 g)	3580 ± 35	2040–1770 cal BC
Claggarnagh West 5	Poz-99265	Burnt mound (F03): hazel charcoal (1.0 g)	2910 ± 30	1210–1010 cal BC
Claggarnagh West 5	Poz-97545	Peat (F24) between boulder and smaller rocks in burnt mound: oak charcoal (0.05 g)	3845 ± 35	2460–2200 cal BC

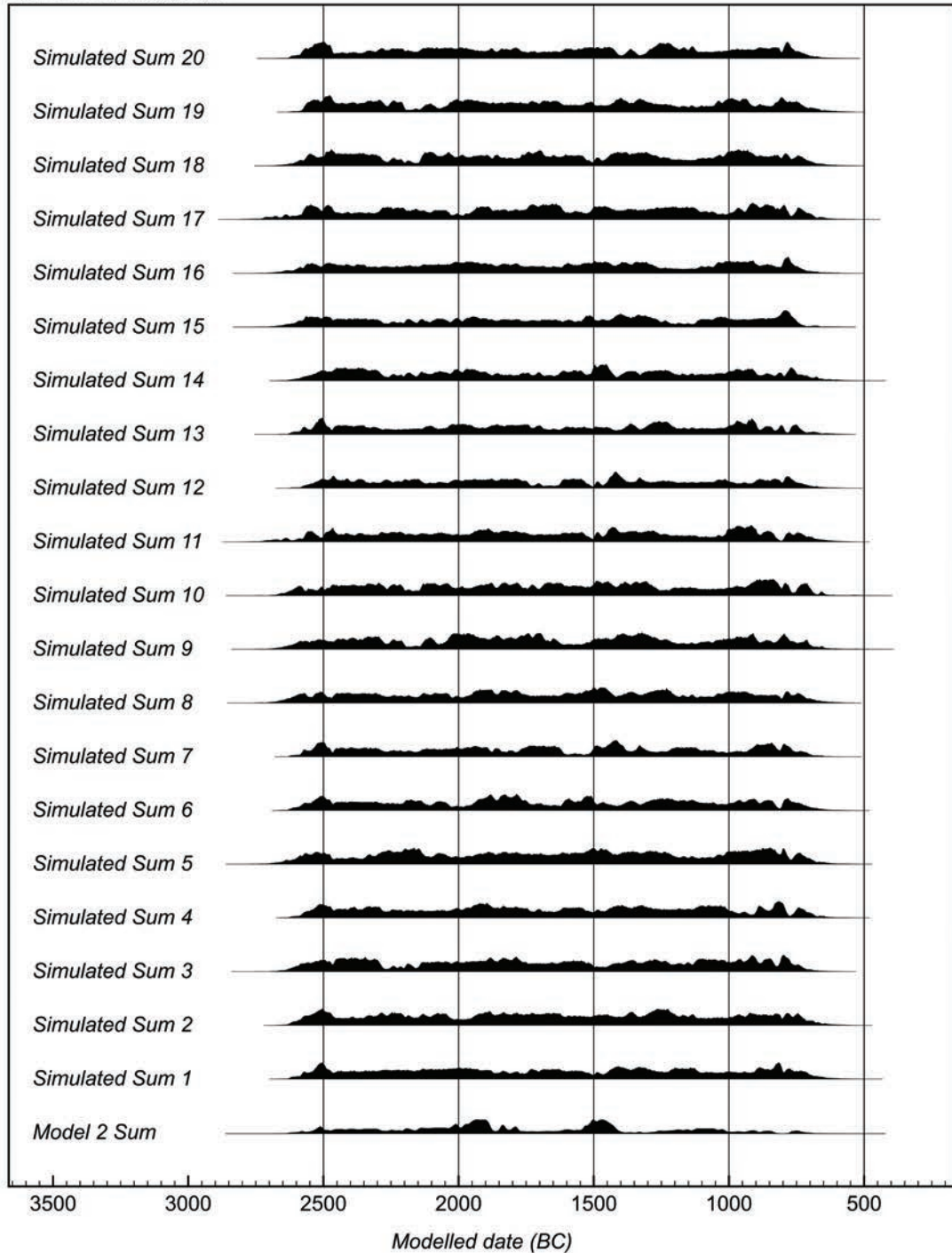
Table A3.2—Radiocarbon dates included in Model 2 (continued)

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough				
Claggarnagh West 7	Beta-518392	Burnt mound (F03): hazel charcoal (0.3 g)	3580 ± 30	2030–1780 cal BC
Cloondeash 1	Poz-97546	Burnt mound (F03): hazel charcoal (0.2 g)	3245 ± 35	1620–1430 cal BC
Cloondeash 3	Poz-97547	Burnt mound (F03): hazel charcoal (0.2 g)	3265 ± 35	1620–1450 cal BC
Cloondeash 4	Poz-97591	Burnt mound (F03): hazel charcoal (0.1 g)	3235 ± 35	1610–1420 cal BC
Cloondeash 4	Poz-97682	Pit (F07), single fill (F06): ash charcoal (0.8 g)	2910 ± 35	1220–1000 cal BC
Cloondeash 4	Poz-97683	Pit (F40), single fill (F41): ash charcoal (0.1 g)	2470 ± 35	790–650 cal BC
Deerpark East 1	Poz-97684	Burnt mound (F03): birch charcoal (0.5 g)	3725 ± 35	2280–1980 cal BC
Deerpark East 3	Poz-97489	Lower burnt mound deposit (F06), part of main burnt mound (F03): willow charcoal (0.2 g)	3675 ± 35	2200–1950 cal BC
Deerpark East 3	Poz-97685	Post-hole (F08), single fill (F10), sealed by marl (F04) under burnt mound (F03): birch charcoal (0.2 g)	3565 ± 35	2030–1770 cal BC
Deerpark East 4	Poz-97490	Burnt mound (F03): ash charcoal (0.1 g)	3625 ± 35	2140–1890 cal BC
Deerpark East 4	Poz-99286	Peat (F40), under burnt mound (F03): alder/hazel charcoal (1.0 g) Event occurred after TPQ:	3745 ± 35 2110 BC (68%)	2290–2030 cal BC 2040 BC (95%)
Doogary 1	Poz-99285	Burnt mound (F22) in hollow (F21): holly charcoal (0.02 g)	3975 ± 35	2580–2340 cal BC
Drummindoo 3	Poz-97642	Burnt mound (F03): hazel charcoal (1.0 g)	3550 ± 30	2020–1770 cal BC
Drummindoo 4	Poz-97688	Burnt mound (F03): hazel charcoal (1.0 g)	3750 ± 35	2290–2030 cal BC
Drumneen 1	Poz-97691	Burnt mound (F03): hazel charcoal (0.05 g)	3170 ± 35	1510–1320 cal BC

Table A3.2—Radiocarbon dates included in Model 2 (continued)

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough				
Kilbree Lower 2	Poz-99291	Burnt mound (F03): birch charcoal (0.1 g)	2910 ± 30	1210–1010 cal BC
Knockbrack 1	Poz-99292	Burnt mound (F03): ash charcoal (0.05 g)	3910 ± 30	2480–2230 cal BC
Knockbrack 2	Beta-518393	Burnt mound (F03), base: alder charcoal (0.1 g)	3540 ± 30	1960–1750 cal BC
Knockbrack 2	Beta-518394	Trough (F04), primary fill (F05): hazel charcoal (0.8g)	3590 ± 30	2040–1830 cal BC
Knockbrack 3	Beta-518395	Burnt mound (F03), base: alder charcoal (1.0 g)	4050 ± 30	2620–2470 cal BC
Knockbrack 3	Beta-518396	Trough (F05), single fill (F04): hazel charcoal (0.5 g)	4070 ± 30	2630–2470 cal BC
Knockbrack 4	Beta-518397	Burnt mound (F05), lower layer: alder charcoal (1.0 g)	3890 ± 30	2470–2240 cal BC
Knockbrack 4	Beta-518398	Trough (F19), primary fill (F21): hazel charcoal (0.1 g)	3170 ± 30	1510–1390 cal BC
Sheean 1	Poz-97643	Burnt mound (F03): holly charcoal (0.1 g)	3220 ± 30	1540–1420 cal BC
Sheean 1	Poz-99295	Trough (F05), single fill (F04): alder charcoal (0.2 g)	3365 ± 35	1750–1530 cal BC
Sheean 3	Poz-99283	Burnt mound (F03): hazel charcoal (0.1 g)	3680 ± 35	2200–1950 cal BC
Sheean 3	Poz-99382	Pit (F51), single fill (F50): ash charcoal (0.05 g)	3610 ± 35	2130–1880 cal BC
N59 Barleyhill to Kilmeena				
Conrea 1	Poz-99266	Burnt mound (F03): hazel charcoal (0.1 g)	3430 ± 30	1880–1620 cal BC
Derrylea 1	Poz-97647	Burnt mound (F03): hazel charcoal (0.2 g)	3730 ± 35	2280–2030 cal BC
Derrylea 1	Poz-97640	Land clearance (F16), single fill (F17): oak charcoal (0.2 g)	3330 ± 35	1740–1510 cal BC

OxCal v4.4.4 Bronk Ramsey (2021); r:5

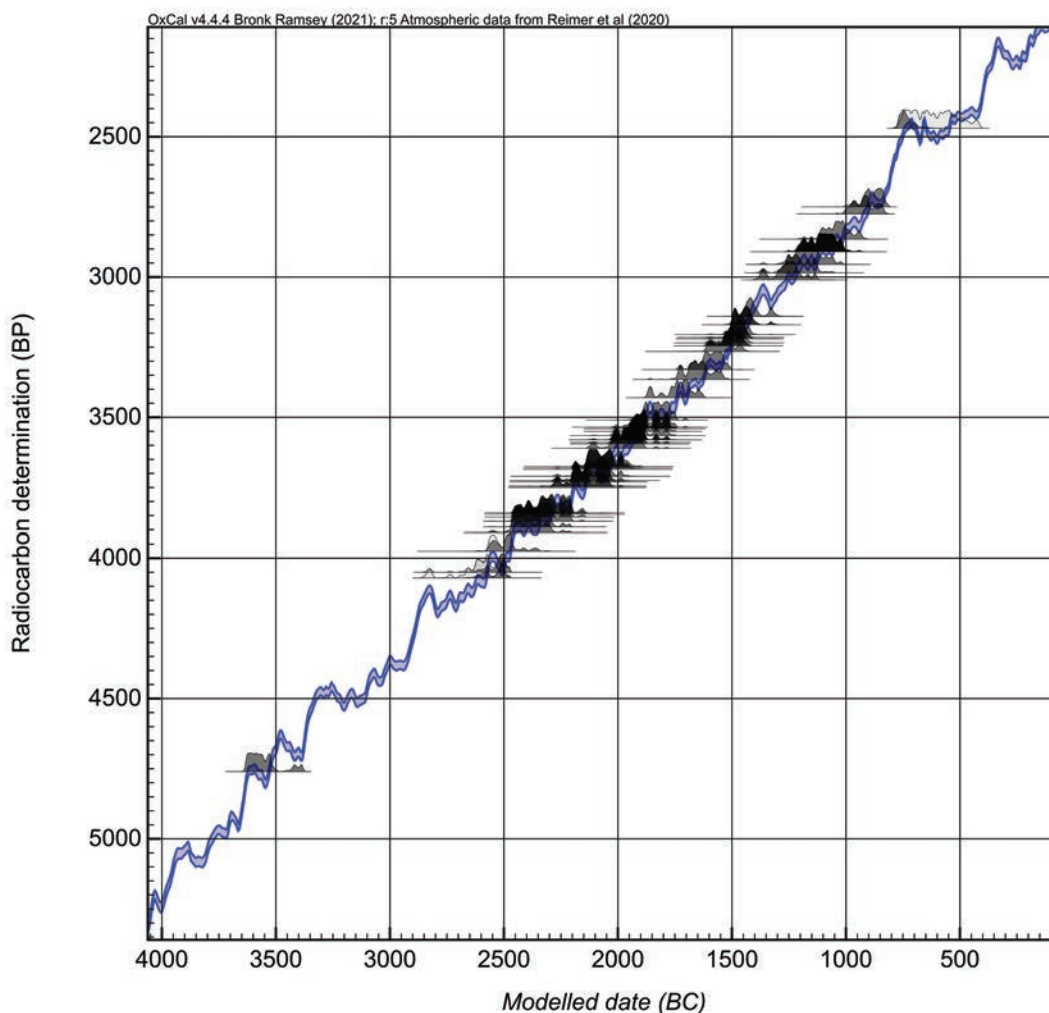


Illus. A3.1 The summed probability distribution of the radiocarbon dates from Model 2 plotted against those from 20 runs of the simulated model (Ben Spillane).

Results of summed probability simulations

The results (Illus. A3.1) show that some pulses from the real model were replicated in some of the simulations. This may have been caused by some of the dates hitting minor wiggles in the calibration curve, such as between 2250 BC and 1800 BC (Illus. A3.2). That said, most of the simulated sum probabilities formed relatively uniform prior

distributions. They do not replicate the gaps in dated probabilities seen in the real model, particularly the significant drop off in activity between 1400 BC and 1300/1250 BC. We can conclude, therefore, that the periods of high or low intensity associated with burnt mound use, derived from the Model 2 summed probability distribution, have a basis in reality and represent robust chronological patterns.



Illus. A3.2 The radiocarbon dates from Model 2 plotted on the calibration curve (Ben Spillane).

Case study: townlands north of Westport town

Thirty burnt mound sites were excavated in four townlands north of Westport town (Chapter 1, Cleary & Gillespie: text box). Of these, 20 excavated on the N5 Westport to Turlough road project and the Westport Main Drainage Scheme had associated radiocarbon dates. These comprised six sites in the townland of Attireesh, five in the townland of Gortaroe and nine in the townland of Deerpark East (see Illus. 1.21). The sites were in two main clusters, located about 300 m apart, one at Deerpark East and the other at Attireesh and Gortaroe. To investigate the chronological development of the burnt mound tradition on a local scale, the 30 radiocarbon dates from these sites were modelled. Three models were constructed from these dates: one each from the two clusters, and an overall model representing all the burnt mounds in the case study. These models aimed to address three main questions:

1. When did burnt mound activity begin and end in the case study area, as well as at the individual clusters?
2. Did the two clusters of burnt mound activity at Attireesh/Gortaroe and Deerpark East begin and end contemporaneously?
3. Was the activity associated with these sites in the case study area carried out consistently, or did it vary over time? And relatedly, does the intensity of activity over time reflect the pattern of burnt mound sites throughout the road project?

Attireesh and Gortaroe: Model 3

The model of burnt mound activity at Attireesh and Gortaroe includes 14 dates from 11 burnt mound sites (Table A3.3). The dates derived from waterlogged wood from two trough linings and short-lived charcoal samples from seven trough fills, four burnt mound deposits and one fire deposit. The model (Illus. A3.3) shows good overall agreement, with an Amodel value of 103%. Burnt mound activity began at Attireesh and Gortaroe in the period 3120–2560 *cal BC* (95.4% probability), probably in 2860–2600 *cal BC* (68.3% probability), and ended in the period 1130–610 *cal BC* (95.4% probability), probably in 1080–880 *cal BC* (68.3% probability). The model estimated that the span of dated activity associated with this cluster of burnt mounds was 1,460–1,810 *years* (95.4% probability), and probably 1,500–1,650 *years* (68.3% probability).

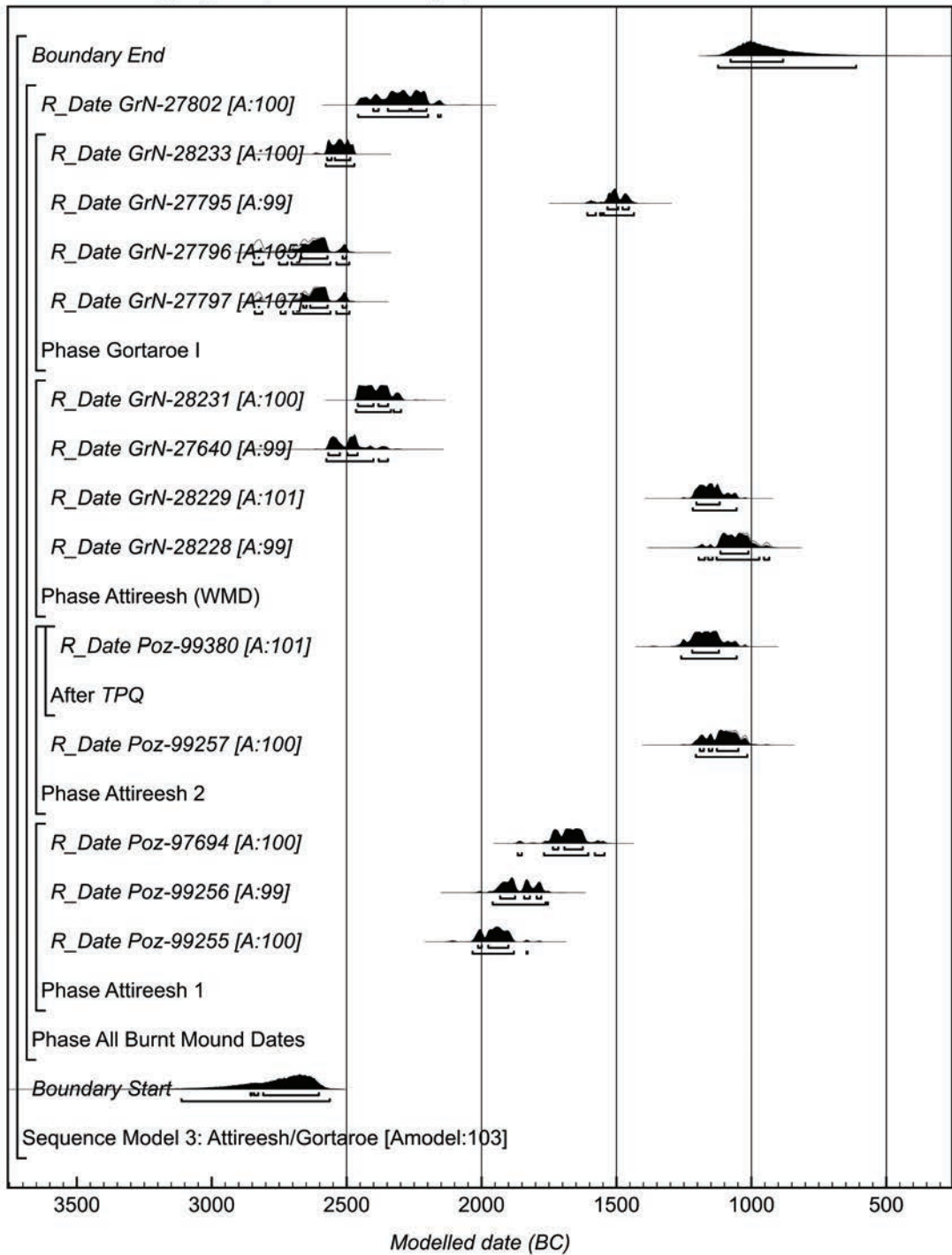
Deerpark East: Model 4

The model of burnt mound activity at Deerpark East includes 16 dates from nine burnt mound sites (Table A3.4). The dates derive from waterlogged wood from four trough linings and charcoal samples from two trough fills, six burnt mounds, two post/stake-hole fills and two peat deposits beneath burnt mounds. Five dates were included in the model as TPQs: Poz-99286 and GrN-27949 because they were derived from peat deposits underneath the burnt mounds; GrN-27947 and GrN-28358 because they were derived from mixed-entity bulk charcoal samples; and GrN-27945 because it was derived from oak charcoal with characteristics that indicated a likely old wood effect.

Table A3.3—Radiocarbon dates included in Model 3, from the Attireesh and Gortaroe sites excavated on the N5 Westport to Turlough road project and the Westport Main Drainage Scheme

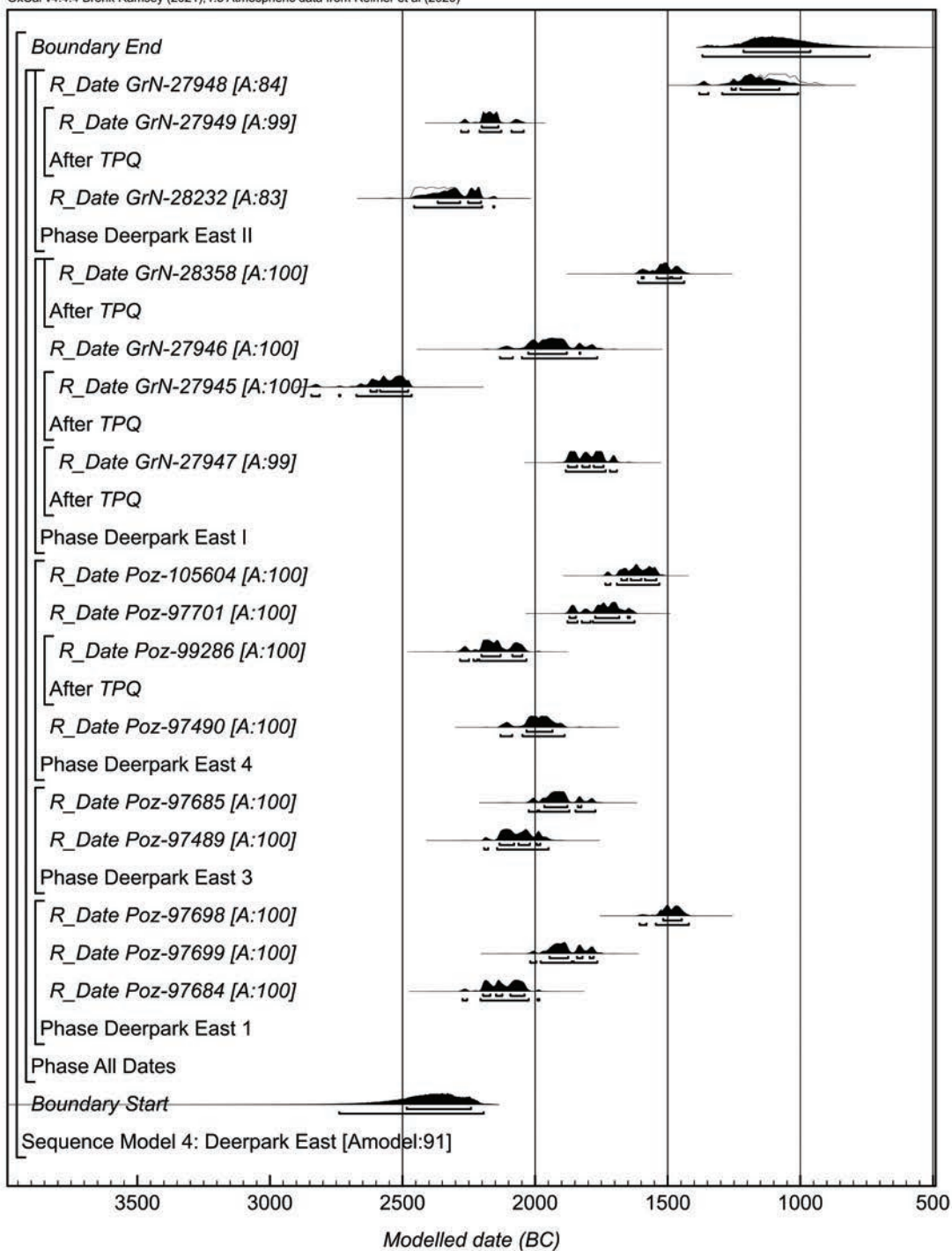
Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough road project				
Attireesh 1	Poz-97694	Trough (F38), side lining (F30). Timber 15: hazel/ash brushwood (35 g)	3390 ± 35	1870–1540 cal BC
Attireesh 1	Poz-99255	Burnt mound (F03): hazel charcoal (0.2 g)	3595 ± 30	2040–1830 cal BC
Attireesh 1	Poz-99256	Possible fire (F06): hazel charcoal (0.2 g)	3540 ± 30	1860–1760 cal BC
Attireesh 2	Poz-99257	Burnt mound (F03): hazel charcoal (0.1 g)	2910 ± 30	1210–1010 cal BC
Attireesh 2	Poz-99380	Modern machine cut through burnt mound (F10), single fill (F09): alder charcoal (0.01 g)	2955 ± 35	1270–1050 cal BC
		Event occurred after TPQ:	1139 BC (68%)	1062 BC (95%)
Westport Main Drainage Scheme				
Attireesh: Area 1	GrN-28228	Trough (C5), single fill (C8): hazel charcoal	2870 ± 30	1200–930 cal BC
Attireesh: Area 2	GrN-28229	Trough (C9), single fill (C10): holly charcoal	2940 ± 20	1220–1050 cal BC
Attireesh: Area 3	GrN-27640	Trough (C27), single fill: hazel charcoal	3970 ± 35	2580–2340 cal BC
Attireesh: Area 4	GrN-28231	Trough (C34), single fill (C32): hazel charcoal	3900 ± 20	2470–2290 cal BC
Gortaroe I: Area 1	GrN-27797	Trough (C22), single fill: hazel charcoal	4080 ± 30	2840–2490 cal BC
Gortaroe I: Area 2	GrN-27796	Trough (C23), single fill: hazel charcoal	4090 ± 35	2850–2480 cal BC
Gortaroe I: Area 3	GrN-27795	Burnt mound (C5): alder charcoal	3245 ± 30	1610–1430 cal BC
Gortaroe I: Area 4	GrN-28233	Trough (C4), basal lining: willow wood	4020 ± 20	2580–2470 cal BC
Gortaroe II	GrN-27802	Trough (C116), single fill (C111): hazel charcoal	3840 ± 40	2460–2150 cal BC

OxCal v4.4.4 Bronk Ramsey (2021); r5 Atmospheric data from Reimer et al (2020)



Illus. A3.3 Chronological Model 3, representing burnt mound activity in the townlands of Attireesh and Gortaroe (Ben Spillane).

OxCal v4.4.4 Bronk Ramsey (2021); r:5 Atmospheric data from Reimer et al (2020)



Illus. A3.4 Chronological Model 4, representing burnt mound activity in the townland of Deerpark East (Ben Spillane).

Appendix 3 - Bayesian modelling of burnt mound dates from Mayo

Table A3.4—Radiocarbon dates included in Model 4, from excavated burnt mound sites in Deerpark East on the N5 Westport to Turlough road project and Westport Main Drainage Scheme

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
N5 Westport to Turlough road project				
Deerpark East 1	Poz-97699	Lower trough (F17B), outer wattle side lining (F17E). Timber 56: hazel wood	3550 ± 35	2020–1760 cal BC
Deerpark East 1	Poz-97698	Upper trough (F05), basal lining. Timber 9: Maloideae wood	3230 ± 35	1610–1420 cal BC
Deerpark East 1	Poz-97684	Burnt mound (F03): birch charcoal (0.5 g)	3725 ± 35	2280–1980 cal BC
Deerpark East 3	Poz-97489	Lower burnt mound deposit (F06), part of main burnt mound (F03): willow charcoal (0.2 g)	3675 ± 35	2200–1950 cal BC
Deerpark East 3	Poz-97685	Post-hole (F08), single fill (F10), sealed by marl (F04) under burnt mound (F03): birch charcoal (0.2 g)	3565 ± 35	2030–1770 cal BC
Deerpark East 4	Poz-97701	Trough (F18), side lining (F22), wood (F22J): alder wood	3435 ± 35	1880–1620 cal BC
Deerpark East 4	Poz-105604	Trough (F18), basal lining (F38), wood (F38c): alder wood	3345 ± 30	1740–1530 cal BC
Deerpark East 4	Poz-97490	Burnt mound (F03): ash charcoal (0.1 g)	3625 ± 35	2140–1890 cal BC
Deerpark East 4	Poz-99286	Peat (F40), under burnt mound (F03): alder/hazel charcoal (1.0 g)	3745 ± 35	2290–2030 cal BC
		Event occurred after TPQ:	2114 BC (68%)	2044 BC (95%)
Westport Main Drainage Scheme				
Deerpark East I: Area 1	GrN-27947	Stake-hole (C38), single fill, in base of wood-lined trough: alder/hazel/oak/ birch/holly/ivy charcoal	3470 ± 30	1890–1690 cal BC
		Event occurred after TPQ:	1760 BC (68%)	1700 BC (95%)
Deerpark East I: Area 2	GrN-27945	Burnt mound (C9): oak charcoal	4040 ± 40	2850–2460 cal BC
		Event occurred after TPQ:	2520 BC (68%)	2470 BC (95%)

Table A3.4—Radiocarbon dates included in Model 4 (continued)

Site	Lab. code	Context and sample material	Radiocarbon age (yrs BP)	Modelled date (95% probability)
Westport Main Drainage Scheme (continued)				
Deerpark East I: Area 4	GrN-27946	Trough (C36), lens of charcoal in fill: hazel charcoal	3585 ± 55	2140–1760 cal BC
Deerpark East I: Area 6	GrN-28358	Burnt mound: hazel/alder/holly/ash charcoal	3250 ± 40	1620–1430 cal BC
		Event occurred after TPQ:	1500 BC (68%)	1440 BC (95%)
Deerpark East II: Area 1	GrN-28232	Trough (C5), single fill: willow charcoal	3880 ± 40	2460–2150 cal BC
Deerpark East II: Area 1	GrN-27949	Peat (C11), under burnt mound (C2): hazel charcoal	3755 ± 20	2280–2040 cal BC
		Event occurred after TPQ:	2150 BC (68%)	2060 BC (95%)
Deerpark East II: Area 3	GrN-27948	Burnt mound (C3), from area of trough (C6): alder charcoal	2910 ± 50	1390–1000 cal BC

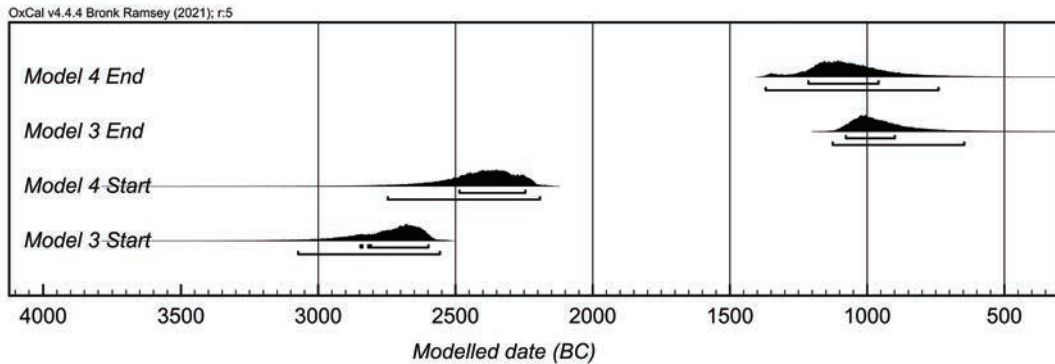
The model (Illus. A3.4) shows good overall agreement, with an Amodel value of 104.5%. Activity began at Deerpark East in the period 2740–2190 cal BC (95.4% probability), probably in 2490–2240 cal BC (68.3% probability) and ended in the period 1370–740 cal BC (95.4% probability), probably in 1220–960 cal BC (68.3% probability). The model estimated that the dated activity associated with this cluster lasted 840–1,380 years (95.4% probability), and probably 1,020–1,260 years (68.3% probability).

Attireesh/Gortaroe and Deerpark East: order of events

An order matrix of the dating produced by the models for the two burnt mound clusters in the study area (Table A3.5) indicates a 95%

probability that the start of activity at the Attireesh/Gortaroe cluster occurred before the start of activity at Deerpark East. There is also a 71% probability that the end of burnt mound activity at the Deerpark East cluster occurred before the end of activity at the Attireesh/Gortaroe cluster. Therefore, the relative order of events indicates that burnt mound activity at Attireesh and Gortaroe began earlier and lasted longer than at Deerpark East (Illus. A3.5).

It is not possible to say why the activity at Deerpark East was not as long-lived as that at Attireesh/Gortaroe. It could be that communities simply preferred the Attireesh/Gortaroe area due to habit or tradition. Alternatively, Attireesh/Gortaroe may have been more conducive to efficient water-boiling because, for instance, the soil profile



Illus. A3.5 The posterior density estimates for the start and end of activity at the burnt mound clusters at Attireesh/Gortaroe (Model 3) and Deerpark East (Model 4) (Ben Spillane).

retained more water, or was more suitable for the construction of troughs, or there was better access here to stone or fuelwood (Hawkes 2014b, 351–2). A combination of these reasons, and a host of other potential causes, may have influenced the longevity of burnt mound activity at Attireesh/Gortaroe. Also, we do not have a full archaeological picture of the environs and it is likely that there are other, undiscovered burnt mounds in both areas. This highlights another benefit of employing a Bayesian approach: if new

sites are investigated and dated in the future, the information used for this study can be incorporated into future chronological models.

Case study activity: Model 5

Model 5 incorporated all 30 dates from the Attireesh, Gortaroe and Deerpark East burnt mounds. They were placed in a bounded phase model using the sum parameter to investigate the local pattern of burnt mound

Table A3.5—Percentage probabilities of the relative order of the start and end posteriors for the burnt mound clusters at Attireesh/Gortaroe (Model 3) and Deerpark East (Model 4)—expressed as the probability of the ‘event’ in the left-hand column occurring prior to the ‘event’ in the top row (Ben Spillane)

Probability $t_1 < t_2$				
t_1	t_2			
	Model 3_Start	Model 4_Start	Model 3_End	Model 4_End
Model 3_Start		95%	100%	100%
Model 4_Start	5%		100%	100%
Model 3_End	0%	0%		29%
Model 4_End	0%	0%	71%	

activity compared to the wider trends identified in Model 2 of the road project analysis.

The model (Illus. A3.6) shows good overall agreement, with an Amodel value of 101.8%. It estimates that burnt mound activity in the case study area began in the period 2880–2530 *cal BC* (95.4% probability), probably in 2730–2590 *cal BC* (68.3% probability), and ended in the period 1120–830 *cal BC* (95.4% probability), probably in 1080–950 *cal BC* (68.3% probability).

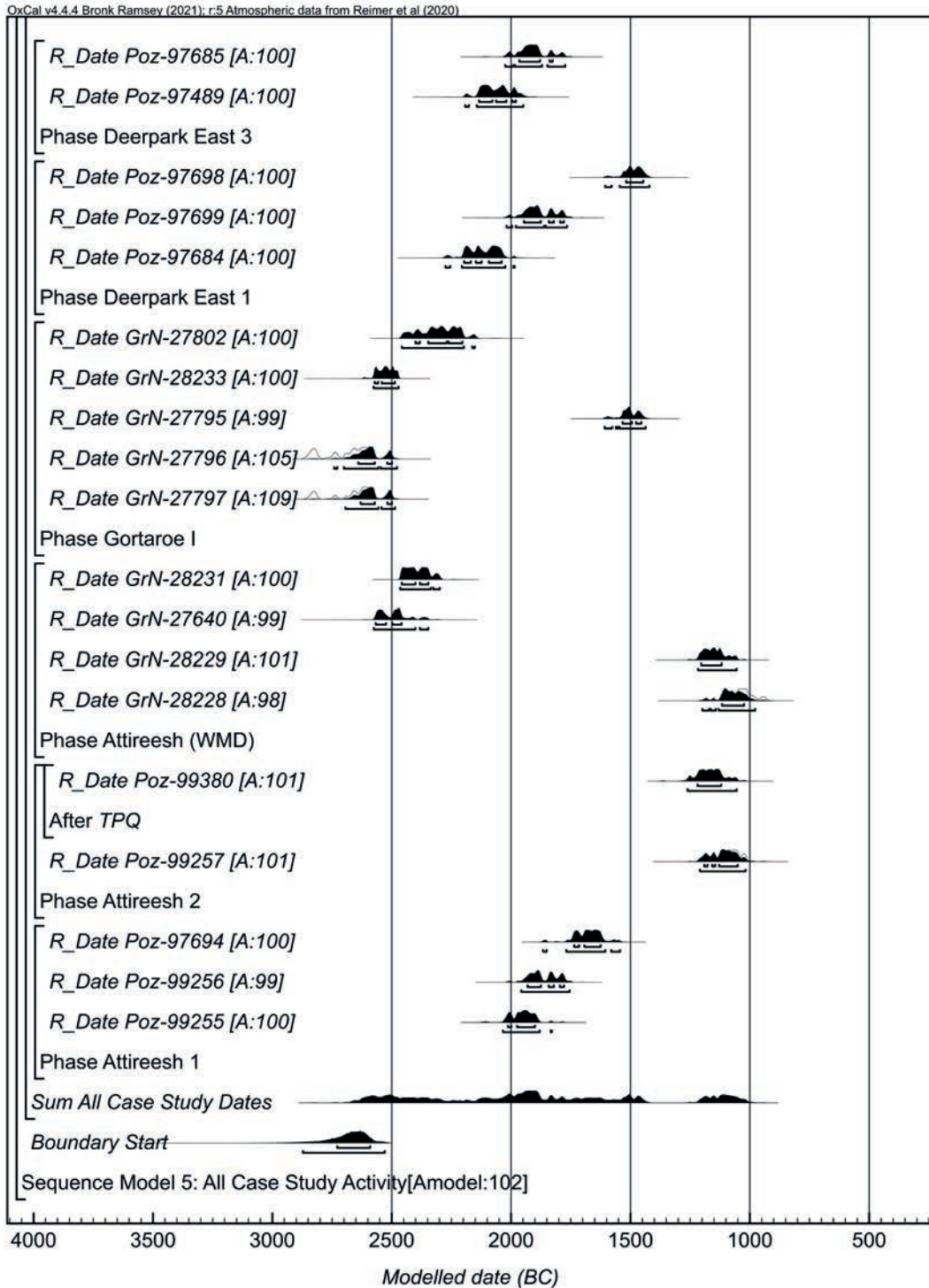
The sum probability of the ‘posterior density estimates’ shows that the dates do not form a uniform prior distribution. Instead, there are four main pulses from which most of the dates are derived. The first is from 2630 BC to 2450 BC. Following this, there is a lower, yet relatively uniformly distributed span of dated probabilities from 2450 BC to 2175 BC. A further pulse in dated probabilities is present between 2130 BC and 1850 BC. After the end of this pulse, at 1850 BC, the dates are relatively uniformly distributed with minor fluctuations and a slight pulse in activity between 1550 BC and 1450 BC. There is an almost complete hiatus in dated probabilities between 1450 BC and 1250 BC. From 1250 BC to the end of the phase, around 1000 BC, there is a final pulse in dated probabilities.

Comparison between burnt mound activity in case study area and road project

A comparison between the summed probability distributions of the burnt mound dates from the case study area (Model 5) and from the road project route overall (Model 2) shows several similarities, along with some notable differences (Illus. A3.7). For one, there is an earlier distribution of

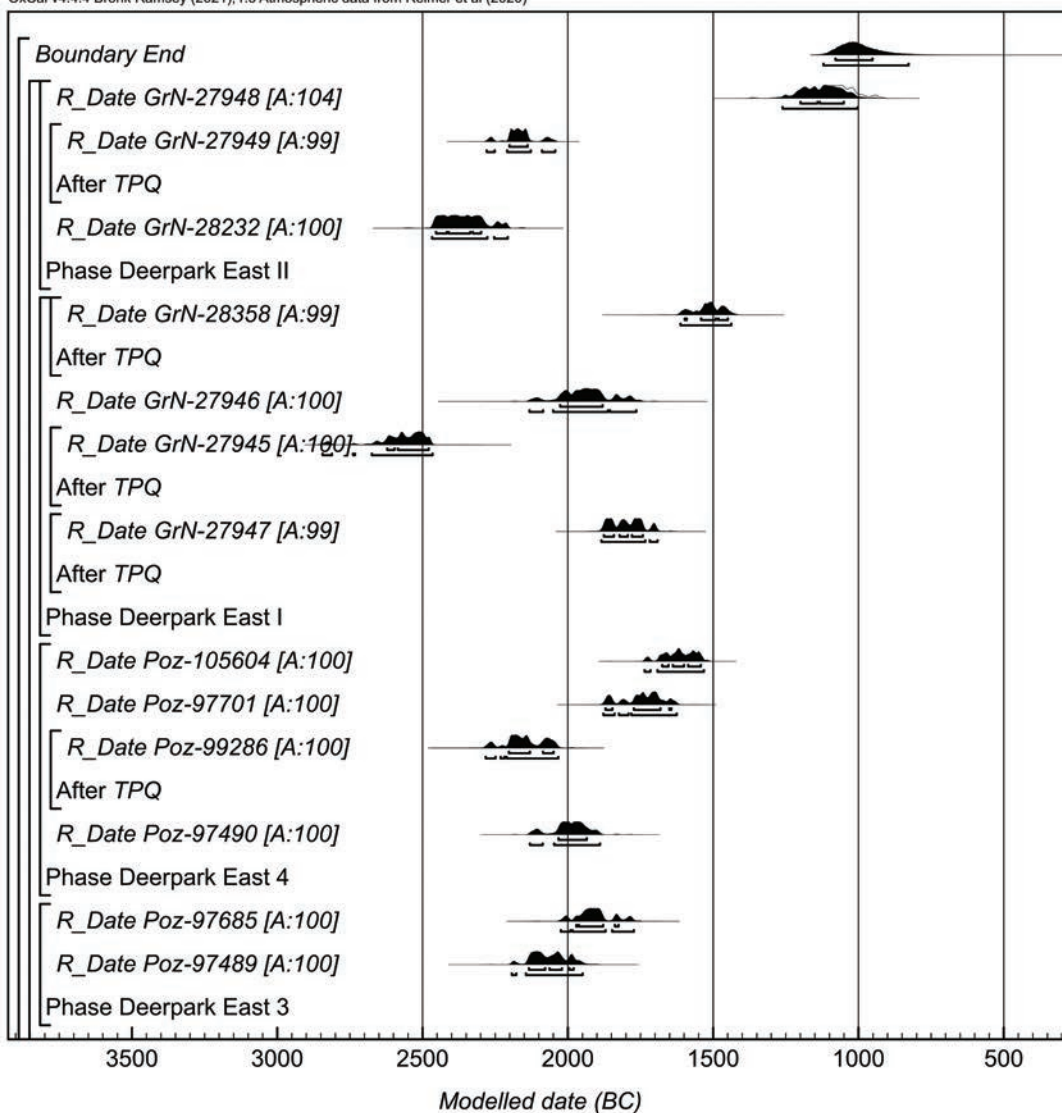
dated probabilities from the Late Neolithic/Chalcolithic period in the case study area between c. 2600 BC and 2200 BC. This suggests that hot-stone water-boiling activity was present in Attireesh, Gortaroe and Deerpark East earlier than elsewhere in the road project landscape. Following this, the chronological pattern is quite similar, with a spike in activity seen in both distributions during the Early Bronze Age, from c. 2150 BC to 1850 BC. In the road project route, there was slightly decreased activity after a spike between c. 1900 BC and 1500 BC, followed by a short and pronounced resurgence during the Middle Bronze Age, between c. 1600 BC and 1400 BC. In the case study area, there seems to be more steady activity after the Early Bronze Age spike until c. 1500 BC. The latter stages of both chronological distributions are quite similar, particularly a significant decrease in activity between c. 1400 BC and 1200 BC, during a possible recessionary period in the Middle to Late Bronze Age transition. The final pulse in activity during the Late Bronze Age, from c. 1300 BC to 1000 BC, is present in both distributions, although more pronounced for the case study model. While there is continued hot-stone water-heating in the road project landscape during the early to mid-first millennium BC (the Late Bronze Age/Early Iron Age transition), in the case study area, very little activity is visible after 1000 BC.

The similarities in the summed distributions (particularly the shape of the Early Bronze Age pulse) may be influenced by the inclusion of some of the same dates in both overall models (i.e. where the north-of-Westport study area overlaps with the road project). That said, the inclusion of the Westport Main Drainage Scheme dates provides enough nuance within the case



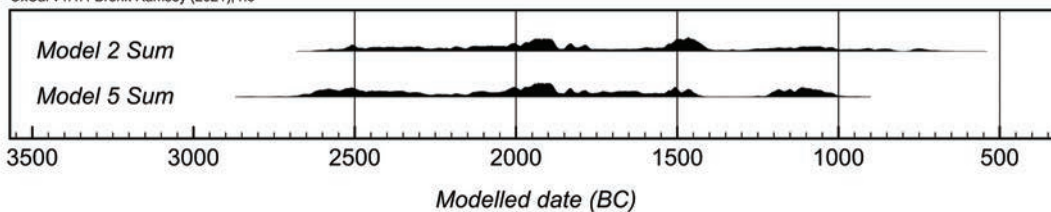
Illus. A3.6 Chronological model for all burnt mound activity in the case study area (Ben Spillane).

OxCal v4.4.4 Bronk Ramsey (2021); r5 Atmospheric data from Reimer et al (2020)



Illus. A3.6 Chronological model (continued)

OxCal v4.4.4 Bronk Ramsey (2021); r5



Illus. A3.7 The sum probabilities of the posterior density estimates from Model 2 (Chapter 2) and Illus. A3.6 (above) (Ben Spillane).

study summed distribution to conclude that there are notable chronological similarities between burnt mound use in the three case study townlands and in the wider landscape. It can therefore be suggested that the patterns in the Attireesh, Gortaroe and Deerpark East area are a microcosm of

chronological developments in burnt mound activity in the wider road project landscape, with the caveat that this activity occurred earlier, in the Late Neolithic/Chalcolithic period, and ended earlier, during the Late Bronze Age.

Appendix 4 TII Digital Heritage Collections

The Final Excavation Reports produced for archaeological investigations on the N5 Westport to Turlough road project and the Barleyhill to Kilmeena section of the N59 Westport to Mulranny road project are available on the Internet, free to view

and download, in the TII Digital Heritage Collections hosted by the Digital Repository of Ireland (repository.dri.ie/catalog/v6936m966). The reports are listed here in alphabetical order by site name and can be accessed using the links provided.

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E004679 Aghadrinagh 1	Siobhán McNamara	https://doi.org/10.7486/DRI.j673ds351
Early medieval charcoal-making pits		
E004680 Aghadrinagh 2	Siobhán McNamara	https://doi.org/10.7486/DRI.z3173r89q
Middle Bronze Age burnt mound		
E004681 Aghadrinagh 3	Siobhán McNamara	https://doi.org/10.7486/DRI.z8915j57w
Middle Bronze Age burnt mound		
E004682 Aghadrinagh 4	Siobhán McNamara	https://doi.org/10.7486/DRI.542601558
Late Bronze Age burnt mound		
E004683 Aghadrinagh 5	Siobhán McNamara	https://doi.org/10.7486/DRI.1g05v1651
Early medieval land clearance		
E004684 Aghadrinagh 6/7	Siobhán McNamara	https://doi.org/10.7486/DRI.61098211t
Middle Bronze Age burnt mound		
E005153 Aghadrinagh	Declan Moore	Nil report in DRI
Two burnt mounds (undated) recorded by testing and preserved <i>in situ</i>		
E004685 Aghalusk 1	Siobhán McNamara	https://doi.org/10.7486/DRI.gq67zd75w
Early medieval hearth		

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E004686 Aghalusky 2	Ian Russell	Nil report in DRI
Nil archaeological site identified by testing possible pits		
E004687 Attireesh 1	Joe Nunan	https://doi.org/10.7486/DRI.zg657b25c
Early Bronze Age burnt mound		
E004688 Attireesh 2	Joe Nunan	https://doi.org/10.7486/DRI.zk5287097
Late Bronze Age burnt stone spread		
E004621 Carrowbeg 1	Donald Murphy	Nil report in DRI
Chalcolithic period burnt stone spread fully investigated during testing		
E004690 Carrownaclea 1	Ian Russell	https://doi.org/10.7486/DRI.0287dj89q
Late Bronze Age burnt mound		
E004691 Carrownaclea 2	Ian Russell	https://doi.org/10.7486/DRI.0v83np613
Early Bronze Age burnt mound		
E004692 Claggarnagh East 1	Siobhán McNamara	https://doi.org/10.7486/DRI.1v53zm01h
Early modern cottage site		
E004693 Claggarnagh East 2/3	Siobhán McNamara	https://doi.org/10.7486/DRI.57130x39z
Early Bronze Age burnt mound		
E004694 Claggarnagh East 4/5	Siobhán McNamara	https://doi.org/10.7486/DRI.2v248j89n
Early/Middle/Late Bronze Age burnt mounds		
E004695 Claggarnagh East 6	Siobhán McNamara	https://doi.org/10.7486/DRI.gf06vr23c
Late medieval smithing hearths		
E005310 Claggarnagh East	Declan Moore	Nil report in DRI
Burnt mound (undated) recorded by testing and preserved <i>in situ</i>		
E004696 Claggarnagh West 1	Joe Nunan	https://doi.org/10.7486/DRI.3198bb574
Chalcolithic period burnt mound		
E004697 Claggarnagh West 2	Joe Nunan	https://doi.org/10.7486/DRI.dv14cj752
Middle Bronze Age burnt mound		

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E004698 Claggarnagh West 3	Joe Nunan	https://doi.org/10.7486/DRI.dr27bn916
Late Bronze Age burnt mound		
E004699 Claggarnagh West 4	Joe Nunan	https://doi.org/10.7486/DRI.fn10mp470
Early Bronze Age burnt mound		
E004700 Claggarnagh West 5	Joe Nunan	https://doi.org/10.7486/DRI.fj23ks634
Middle Bronze Age burnt mound		
E004701 Claggarnagh West 6	Siobhán McNamara	https://doi.org/10.7486/DRI.t435w451w
Burnt stone spread (undated)		
E005015 Claggarnagh West 7	Donald Murphy	https://doi.org/10.7486/DRI.zp3995420
Early Bronze Age stone spread		
E004702 Cloondeash 1	Joe Nunan	https://doi.org/10.7486/DRI.4x51x787m
Middle Bronze Age burnt mound		
E004703 Cloondeash 2	Joe Nunan	https://doi.org/10.7486/DRI.k643qp75n-1
Late medieval pits and deposits (land clearance)		
E004704 Cloondeash 3	Joe Nunan	https://doi.org/10.7486/DRI.t722x135r
Middle Bronze Age burnt mound		
E004705 Cloondeash 4	Joe Nunan	https://doi.org/10.7486/DRI.8910zk698
Middle/Late Bronze Age burnt mound; Iron Age pit		
E004706 Deerpark East 1	Siobhán McNamara	https://doi.org/10.7486/DRI.8c980g530
Early/Middle Bronze Age burnt mound		
E004707 Deerpark East 2	Siobhán McNamara	https://doi.org/10.7486/DRI.hh646j47z-1
Nil archaeological site identified; modern spoil (railway workings?)		
E004708 Deerpark East 3	Siobhán McNamara	https://doi.org/10.7486/DRI.hq388f09x
Early Bronze Age burnt mound		
E004709 Deerpark East 4	Siobhán McNamara	https://doi.org/10.7486/DRI.hm517j25s
Early/Middle Bronze Age burnt mound		

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E004710 Derrinlevaun 1	Joe Nunan	https://doi.org/10.7486/DRI.hm517f319
Nil archaeological site identified; modern land improvements		
E004711 Doogary 1	Leo Morahan	https://doi.org/10.7486/DRI.1831s797j
Chalcolithic period burnt stone spread		
E004712 Dooleague 1	Joe Nunan	Nil report in DRI
Nil archaeological site identified; single pit (undated) recorded		
E004713 Dooleague 2	Joe Nunan	https://doi.org/10.7486/DRI.jd47gk03h
Nil archaeological site identified; modern finds and worked chert pieces in disturbed area		
E004714 Dooleague 3	Joe Nunan	https://doi.org/10.7486/DRI.k069nx077
Early medieval charcoal-making pit		
E004715 Drumaleheen 1	Ian Russell	https://doi.org/10.7486/DRI.fj23kq67t-1
Early/Middle Bronze Age barrow and post-holes; medieval/post-medieval ditches		
E004717 Drumaleheen 2	Ian Russell	https://doi.org/10.7486/DRI.j960fp19w-1
Identified by testing as Drumaleheen 2; excavated as a single site with Drumaleheen 1		
E004718 Drumaleheen 3	Siobhán McNamara	https://doi.org/10.7486/DRI.fq97nh358
Middle Iron Age ring-ditch; late medieval pit		
E004719 Drumaleheen 4	Siobhán McNamara	https://doi.org/10.7486/DRI.h4163011r
Late Bronze Age pit; Middle Iron Age charcoal from a soil deposit		
E004720 Drumaleheen 5	Siobhán McNamara	https://doi.org/10.7486/DRI.gb19tv391
Late Bronze Age hearth remnant		
E004721 Drumaleheen 6	Siobhán McNamara	https://doi.org/10.7486/DRI.66839t79j
Burnt mound remnants (undated)		
E004722 Drumaleheen 7	Siobhán McNamara	https://doi.org/10.7486/DRI.h9904r79g
Late Bronze Age pit with disturbed fill		
E004723 Drummindoo 1	Ian Russell	https://doi.org/10.7486/DRI.5b001t239
Burnt mound remnants (undated)		

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E004724 Drummindoo 2	Ian Russell	https://doi.org/10.7486/DRI.gx4216437
Middle Bronze Age pit and charcoal-rich spread		
E004725 Drummindoo 3	Ian Russell	https://doi.org/10.7486/DRI.1257qg294
Early Bronze Age burnt mound		
E004726 Drummindoo 4	Leo Morahan	https://doi.org/10.7486/DRI.xd07wk50x
Early Bronze Age burnt mound with multiple troughs		
E004727 Drummindoo 5	Ian Russell	https://doi.org/10.7486/DRI.gh93wn076
Early medieval charcoal-making pit and smithing hearth		
E005330 Drummindoo	Declan Moore	Nil report in DRI
Two burnt spreads (undated) recorded by testing and preserved <i>in situ</i>		
E004728 Drumneen 1	Joe Nunan	https://doi.org/10.7486/DRI.5t3568439
Middle Bronze Age burnt stone spread		
E004729 Drumneen 2	Joe Nunan	https://doi.org/10.7486/DRI.1n79wt339
Early/Middle Neolithic post-hole; Early Bronze Age cremation burial; Late Bronze Age four-post structure; also undated post-holes, pits and deposits		
E005177 Drumneen	Declan Moore	Nil report in DRI
Burnt mound (undated) and metallated pathway recorded by testing and preserved <i>in situ</i>		
E005179 Drumneen	Declan Moore	Nil report in DRI
Burnt mound (undated) recorded by testing and preserved <i>in situ</i>		
E004730 Kilbree Lower 1	Joe Nunan	https://doi.org/10.7486/DRI.0574ff732
Late medieval smithing hearths, pits and troughs		
E004731 Kilbree Lower 2	Ian Russell	https://doi.org/10.7486/DRI.4t64wc03j
Late Bronze Age burnt mound		
E004732 Knockbrack 1	Joe Nunan	https://doi.org/10.7486/DRI.x920vp669
Chalcolithic period burnt mound		
E005016 Knockbrack 2	Donald Murphy	https://doi.org/10.7486/DRI.x633ts82f
Early Bronze Age burnt mound		

Excavated site	Excavation Director	DRI Permalink
N5 Westport to Turlough		
E005017 Knockbrack 3	Donald Murphy	https://doi.org/10.7486/DRI.0287dn679
Late Neolithic burnt mound		
E005018 Knockbrack 4	Donald Murphy	https://doi.org/10.7486/DRI.zw13bz101
Middle Bronze Age burnt mound		
E004733 Liscromwell 1	Siobhán McNamara	https://doi.org/10.7486/DRI.fn10mm515
Early modern lime kiln		
E004734 Liscromwell 2	Leo Morahan	https://doi.org/10.7486/DRI.0g35j425d
Early modern water-powered mill		
E004735 Lisnageeha (or Antigua) 1	Siobhán McNamara	https://doi.org/10.7486/DRI.jq08k7552
Nil archaeological site identified; geophysical survey anomalies investigated		
E004736 Lisnageeha (or Antigua) 2	Siobhán McNamara	https://doi.org/10.7486/DRI.hd775n633
Late medieval cereal-drying kiln		
E004737 Lisnageeha (or Antigua) 3	Siobhán McNamara	https://doi.org/10.7486/DRI.6d57cm471
Burnt mound remnants (undated)		
E004738 Lisnakirka (or Milebush) 1	Siobhán McNamara	https://doi.org/10.7486/DRI.j386cw515
Early medieval hearth		
E004739 Pheasanthill 1	Siobhán McNamara	Nil report in DRI
Nil archaeological site identified; possible burnt spread investigated		
E004740 Sheean 1	Ian Russell	https://doi.org/10.7486/DRI.0p09kw93x
Early/Middle Bronze Age burnt mound		
E004741 Sheean 2	Ian Russell	https://doi.org/10.7486/DRI.ft84pd194
Nil archaeological site identified; possible burnt mound site investigated		
E004742 Sheean 3	Joe Nunan	https://doi.org/10.7486/DRI.xs561486f
Early Bronze Age burnt mound with multiple troughs		

Excavated site	Excavation Director	DRI Permalink
N59 Barleyhill to Kilmeena		
16E0432 Conrea 1	Ian Russell	https://doi.org/10.7486/DRI.zc786d12v
Early Bronze Age burnt mound deposits (disturbed)		
16E0608 Derrylea 1	Ian Russell	https://doi.org/10.7486/DRI.zs269z483
Early/Middle Bronze Age burnt mound		
16E0279 Westport Demesne 1–3	Donald Murphy	https://doi.org/10.7486/DRI.zg657896x
Early/late medieval charcoal-making pits		







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The new N5 Westport to Turlough road traverses the hills, hollows and lakes that define Mayo's drumlin landscape. This distinctive terrain continues into Clew Bay, where partly submerged drumlins form numerous islands in the shadow of Ireland's iconic mountain, Croagh Patrick.

Before construction of the new N5 began, Archaeological Consultancy Services Unit Ltd (ACSU) carried out extensive archaeological investigations on behalf of Mayo County Council with funding from Transport Infrastructure Ireland. Numerous archaeological sites were discovered, providing new insights into aspects of daily life in the region from the Neolithic period to the 19th century—farming and food processing; craftwork, industry and trade; domestic architecture; and, at the end of life, later prehistoric funerary practices.

This book is a distillation of that work. It aims to tell these stories of the past in accessible language, in an attractive and engaging format, while maintaining the scientific integrity of the evidence. It can be enjoyed by everyone with an interest in the history and archaeology of Mayo.

Kerri Cleary is a PhD graduate of University College Cork. Her research interests are Neolithic and Bronze Age settlement, ritual and burial practices. She has published widely as an author and editor, including *Celtic from the West 3* (2016) and *Excavations at Knowth 6* (2017). Kerri joined Archaeological Consultancy Services Unit as an Editor and Research Manager in 2018.

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