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Department of Transport An Roinn Iompair

NRA An tÚdarás um Bóithre Náisiúnta National Roads Authority Archaeology

Date: December 2009
Client: Kildare County Council
Project code: KCK06

N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 – Resolution, Kilcullen to Moone and Athy Link Road.

Final Report on archaeological investigations at Site E2973, in the townland of Mullamast, Co. Kildare.

By: Liam Hackett and John Twomey
National Monuments Section Registration Number: E2973
Director: Liam Hackett
NGR: 278633/194877

Report Status: Final

Meanma agus Mianach

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Executive Summary

This final report presents the results of the archaeological resolution works carried out on behalf of Kildare County Council and the National Roads Authority as part of the Archaeological Services Contract No. 5 - Resolution, Kilcullen to Moone and Athy Link Road. The works were undertaken prior to the commencement of construction of the N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. The Minister of the Environment, Heritage & Local Government, following consultation with the National Museum of Ireland, issued Directions to Kildare County Council on 8 March 2007 for archaeological resolution works relating to the road development. The registration number, E2973, was allocated by the Department for the excavation of the present site in Mullamast townland under the directorship of Liam Hackett of Headland Archaeology (Ireland) Ltd.

An Environmental Impact Assessment was published in 2003 for the Kilcullen to Powerstown Scheme, with Valerie J Keeley Ltd preparing the Archaeological, Architectural and Cultural Heritage Assessment. This formed Chapter 10 of the EIS produced by the Roughan and O'Donovan - Faber Maunsell Alliance. Geophysical prospection was carried out on certain areas of high archaeological potential by Bartlett-Clark Consultancy as part of the Environmental Impact Assessment, on behalf of Valerie J. Keeley Ltd/Kildare County Council.

Aerial photography was undertaken along the entire route selection as part of the non-invasive assessment after the EIA stage. This work was carried out in April 2004 by Markus Casey.

Archaeological testing carried out by CRDS Ltd under N9/N10 Kilcullen to Waterford Scheme: Kilcullen to Powerstown. Archaeological Services Contract No. 2 – Test Excavations, Mullamast to Prumplestown and Athy Link Road under Ministerial Direction Number A021/168 on this site between 8 May and 28 August 2006 identified ring-ditch.

Full archaeological resolution was conducted on this site between 24 April and 4 May**.** This confirmed the presence of a ring-ditch containing cremated human remains and animal bone, and the remains of a cereal-drying kiln**.** A preliminary Report of works on the site was completed by Headland Archaeology (Ireland) Ltd on March 2009.

1 Introduction

The N9/N10 Kilcullen to Waterford Road Scheme, of which the Kilcullen to Powerstown Scheme forms part, was proposed as a High Quality Dual Carriageway/Motorway, forming the Major Inter Urban route between Dublin and Waterford. The Kilcullen to Powerstown Scheme was advanced as a single entity up to the Compulsory Purchase Order/Environmental Impact Statement and was subsequently divided into two separate construction contracts: the Carlow By-pass (Phase 1) and the Kilcullen to Carlow Scheme (Phase 3). Kildare County Council, National Roads Design Office, has responsibility for overseeing the project management of these two schemes. The entire road scheme from Kilcullen to Waterford has now been designated as Motorway.

An Environmental Impact Assessment was published in 2003 for the Kilcullen to Powerstown Scheme, with Valerie J Keeley Ltd preparing the Archaeological, Architectural and Cultural Heritage Assessment. This formed Chapter 10 of the EIS produced by the Roughan and O'Donovan - Faber Maunsell Alliance. Geophysical prospection was carried out on certain areas of high archaeological potential by Bartlett-Clark Consultancy as part of the Environmental Impact Assessment, on behalf of Valerie J. Keeley Ltd/Kildare County Council.

Aerial photography was undertaken along the entire route selection as part of the non-invasive assessment after the EIA stage. This work was carried out in April 2004 by Markus Casey.

Construction commenced on Phase 1, the Carlow By-pass, in January 2006 and the road was completed and opened in May 2008. Construction of Phase 3, the Kilcullen to Carlow Scheme, which also includes a new single carriage link road to Athy town, commenced in January 2008.

Archaeological test-trenching was undertaken in advance of Phase 1, the Carlow By-pass, by Headland Archaeology (Ireland) Ltd between June and August 2005 (Archaeological Services Contract No. 3). This work identified 64 archaeological sites, which required archaeological excavation in advance of road construction. The resolution works for these sites were undertaken by Headland Archaeology (Ireland) Ltd between January and August 2006 (Archaeological Services Contract No. 4).

Archaeological test-trenching was undertaken in advance of the construction of Phase 3, the Kilcullen to Carlow Scheme, by IAC Ltd and CRDS Ltd, between October to November 2005 and May to August 2006 (Archaeological Services Contracts No. 1 and No. 2, respectively). This work resulted in the identification of 102 archaeological sites, which required resolution in advance of construction. The resolution works for these sites were undertaken by Headland Archaeology (Ireland) Ltd between March and December 2007 (Archaeological Services Contracts No. 5 and No. 6). This report details the results of one of those excavations, undertaken under NMSR Number E2973.

The project was funded by the Irish Government and the European Union through Kildare County Council/National Roads Authority, under the National Development Plan 2000-2006 and 2007-2013.

Construction Phases 2 and 4 relate to the section of road between Powerstown, Co. Carlow and the Waterford city By-pass and are project managed by Waterford County Council, National Roads Design Office.

2 Site description and location

Site E2973 was located in the townland of Mullamast, parish of Narraghmore, barony of Kilkea and Moone approximately 1.5 km southwest of Ballitore village, Co.Kildare and *c* 200 m west of a tertiary road that leads northward to Peelhall Crossroads on National Grid Reference 278633/194877 (Figure 1). The site was situated in a grass field on a very gently rising slope near the eastern summit of Mullamast Hill with a height of 130 m OD overlooking lowlands to the east with extensive views of the foothills of the Wicklow Mountains.

Two monuments are depicted in the Record of Monuments and Places within 850 m of this site (Figure 2). These are an enclosure site (KD036-044) and a 19th century landscaping feature (KD036-045). To the east a Bronze Age flat cemetery with a later enclosure ditch and cereal-drying kilns (E2980) (Hackett 2009) was excavated as part of the same road project as well as a multi-period site (E2972) (Hackett and O' Connell 2009), where a number of cereal-drying kilns and a crouched inhumation were located.

3 Aims and methodology

The objective of the work was the preservation by record of any archaeological features that would be impacted by the proposed development, in advance of the road construction programme.

Topsoil stripping of the site was conducted using a 360° tracked machine fitted with a 1.9 m wide ditching (toothless) bucket under constant archaeological supervision. An initial area of 400 m² was recommended to be stripped. However, it was decided during the resolution stage to extend this area northward to check for any potential features on that side of the ring-ditch. This revealed the remains of the cereal-drying kiln. The extension to the north gave a final total area of 528 m² that was stripped of topsoil. The resulting surface was cleaned and all potential features investigated by hand. Archaeological contexts were recorded by photograph and on *pro forma* record sheets. Plans were drawn at scales of 1:50 and 1:20, and sections at 1:10. Registers are provided in the appendices (Appendices 1-5). Ordnance Datum levels and feature locations were recorded using Penmap and a total station theodolite.

Environmental samples and animal bone samples were taken on any deposits suitable for analysis or dating as per Headland archaeology (Ireland) Ltd environmental guidelines and following consultation with environmental archaeologist and archaeobotanist Karen Stewart and zooarchaeologist Dr. Auli Tourunen. In addition, cremations were recovered as per Headland Archaeology (Ireland) Ltd treatment of human remains guidelines and following consultation with osteoarchaeologist Carmelita Troy. Artefacts recovered during the excavation were assigned unique numbers and treated in accordance with National Museum of Ireland guidelines. A total of 100% of the soil samples taken during the excavation were selected for processing and environmental assessment/analysis (Appendix 7).

Full archaeological resolution was conducted on this site between 24 April and 4 May 2007. The crew on site E2973 consisted of 1 director, 1 deputy site manager and 5 site assistants.

Following excavation, environmental samples, artefacts, human and faunal remains were analysed by the appropriate specialists and reports produced on the findings for incorporation into this report (see appendices).

4 Excavation results

Ring-ditch

The sub-circular ring-ditch (011) (Figures 3 and 4, Plates 1 and 5) had a 9.75 m external diameter and measured between 6.5 m and 7.25 m internally. The ditch was 1.5 m - 1.9 m wide and 0.8 m deep with gradually sloping sides to a depth of 0.2 m at which point they became steeper, and a predominately flat base. The external edge of the ring ditch is circular however the internal edge is almost sub-square. This would suggest that the initial guide line for the ditch was excavated on the external edge, and then widened in four separate attempts, forming a sub-square internal edge. Its basal fill (012) was compact light reddish brown gravelly silty clay with occasional inclusions of small stones and very occasional charcoal flecks, between 0.2 and 0.5 m in depth. This deposit was analysed and found to be archaeologically sterile therefore it can be assumed that this deposit was created as a result of natural silting and not by deliberate deposition (Appendix 7). This also suggests that the ditch was open for some time prior to its being used as a ritual site, which further allows us to be confident that a degree of planning and preparation went in to the excavation of the ring ditch. This is also evident in the degree of silting in the eastern half of the feature, which is down-slope and therefore more pronounced than in the western half.

The secondary fill (013) consisted of compact light brown silty clay with frequent small to medium sized compacted sub-rounded and sub-angular stones that were particularly concentrated in the southern portion of the ditch. This deposit contained 2033 unburnt animal bones: 19 cattle, 17 horse, 106 dog, 40 large mammal, 160 medium mammal and 1691 unidentified fragments and pieces that could not be attributed to species (Sample E2973:005-006; Appendix 8); a high concentration of these were located in the southern portion of the ring-ditch. The 106 dog bones comprised the almost fully articulated remains of a fully grown male dog, possibly ritually deposited within the lower levels of the exposed ring ditch (Plate 6). A cattle mandible from an elderly animal and a horse mandible suggest that the deposit might be ritual in nature (Appendix 8). This deposit yielded eleven chert and one flint fragments (E2973:013:001-012). On analysis of these artefacts, only three showed evidence of alteration (E2973:013:001, 002, 011); the remainder were considered to be natural chunks and non-archaeological in nature (Appendix 11). The knapped assemblage consisted of two indeterminate chert chunks (E2973:013:001-002), presenting a random pattern of extraction scars on both surfaces, some of which could be suggestive of bipolar reduction technique. Bipolar technique consists of placing the nodule to reduce on a stationary anvil becomes increasingly frequent from Middle Neolithic and well through Late Bronze Age and is particularly dominant in late prehistoric times (Appendix 11). The radiocarbon date obtained from the ring ditch supports this conclusion (see below and Appendix 10). The single flint find (E2973:013:011) is a primary flake exhibiting a broad plain platform with no further diagnostic attributes (Appendix 11).

The deposit (013) and the basal fill (012) were the only layers that did not contain any cremated human remains, and no animal bones or lithics were found in the deposits above that did contain human remains.

The interface between the three upper fills of the ring-ditch was not always clear, suggesting that they were deposited in relatively quick succession to each other. The first of these was the tertiary fill (014); a moderately compact dark brown silty clay, 0.2 m deep on average, with occasional to moderate charcoal fleck and occasional burnt bone fleck inclusions (Sample E2973:008). A token cremation burial was found in the northern portion of the ditch, deposited in a localised area, but probably scattered as loose fragments rather than in a deliberate placing of the remains, say in a covering of organic material like leather or wicker. All the fragments (total weight 2 g) were from the skull of an individual and had been oxidised completely (i.e. above 800°C). A radiocarbon date from a sample of

the cremated bone from this token burial returned a date of 360-40 cal BC (2 σ) (SUERC - 25484) (Appendix 10) which places this phase of activity in the Iron Age.

Next in sequence was a compact deposit of mid- to dark brown gravelly silty clay with moderate charcoal fleck inclusions (015), 0.16 m deep on average. A second token cremation burial (Sample E2973:009) was retrieved from this deposit again in the northern portion, consisting of 37 g of cremated human bone. However, only 5.7 g of this burial was identifiable as skull fragments, the remainder was too fragmented to be identified. This burial was also slightly different to the burial in deposit (014) as only 50% of the retrieved bone was oxidised above 800°C, and mostly on the outer surfaces of the bone, therefore suggesting a less efficient pyre than the (014) burial (Appendix 9).

The upper fill (016) of the ring-ditch was a moderately compact dark grey to black silty clay with moderate charcoal fleck inclusions, 0.12 m deep, with very occasional burnt bone fragments (Sample E2973:010) (Figure 4, Plates 2, 3 and 4). A token cremation burial collected from this deposit, in the northern portion, yielded 16.1 g of cremated human bone. Only 0.3 g could be identified, again belonging to the skull of an individual. This burial also showed slight differences to the others, in that 80% of these remains were oxidised above 800°C, slightly more efficient than the (015) burial, but not as effective as the (014) burial (Appendix 9).

No internal or external features associated with the ring-ditch were identified at the site. After the excavation of the ring-ditch fills a large section was cut across the extent of the feature in an attempt to detect any surviving remains of an internal mound or external bank. None were found.

Cereal-drying Kiln

A cereal-drying kiln (004) (Figures 3 and 5, Plate 7) was located 2.8 m north of the ring-ditch. It was 'figure of eight' shape in plan, measuring 2.3 m in length along a north/south axis. Its sub-circular fire-pit located to the north had a 1.2 m diameter and was 0.65 m deep with gradually sloping sides to a depth of 0.3 m where they became sharp with a flat base. A flue, 0.3 m long and 0.7 m wide with sharp sides extended upwards towards the drying chamber on the south. The drying chamber was oval in plan measuring 0.9 m east/west by 0.8 m north/south and 0.4 m in depth, with gradually sloping sides and a concave base.

Where the fire-pit cut through a naturally occurring gravel horizon at a depth of approximately 0.3 m it was lined with moderately compact red brown clay with occasional charcoal flecks that was heavily oxidized (008) and was archaeologically sterile when analysed (Appendix 7). A thin black charcoal rich silty clay lens (005), 0.03 m deep, overlay the scorched clay and is likely to represent a single firing episode within the kiln. Environmental analysis of the sample taken from this deposit revealed charred cereal grains, predominantly barley (*Hordeum vulgare*) with lesser amounts of oat (*Avena* sp.), bread wheat (*Triticum aestivo-compactum*), emmer wheat (*Triticum dicoccum*) and rye (*Secale cereale*). A radiocarbon date has been returned from charred bread wheat grains (*Triticum aestivo-compactum*), from the sample taken from this deposit, with a date range of 250-550 cal AD (2 σ) (SUERC – 25467, Appendix 10) placing the activity in the Iron Age/early medieval transitional period. The upper portion of the fire-pit and flue contained a moderately compact mid-brown silty clay backfill with moderate inclusions of medium sized stones and very occasional charcoal flecks (006), 0.05 m deep. Occasional animal bone inclusions were identified and retrieved from this deposit (Sample E2973:013) which consisted of one cattle, four large mammal and one hundred and four unidentified fragments (Appendix 8). Moderately compact red brown silty clay (007), 0.4 m deep, filled the drying chamber which was archaeologically sterile upon environmental analysis (Appendix 7).

5 Discussion

The ring ditch

The location of the ring-ditch is perhaps significant, overlooking lowland to the east and commanding extensive views of the foothills of the Wicklow Mountains. Cremated human bone from deposit (014) has been dated to 360-40 cal BC, placing the activity in the Early Iron Age. It is interesting to note the areas of deposition of the animal bone and lithics in the southern portion of the ring ditch in the lower, secondary fill (013), and the deposition of the cremated human remains in the northern portion in the three upper fills (014, 015, 016). This was probably a deliberate act, of ritual significance to the Iron Age community or group that constructed the ditch and points to a well organised, systematic approach to burial rites.

The burial rite

The fills of the ring ditch on this site provide a possible insight into the ritual aspect of the burial rites in the Iron Age. The basal fill (012) is the result of natural silting, and is of considerable depth, but does not seem to have come from an internal or external raised bank, as no particular side is favoured in its deposition. This allows us to infer that the excavation of the ditch preceded the use of the site for burial by a period of time; however, despite this hiatus, the ring ditch was most likely constructed with a burial or ritual function in mind. It is possible that the ditch was excavated at the time of death of the individuals, but the ritual of cremation, the pyre, the collection and/or washing or crushing of the bones and other rites may have meant the ditch was left exposed for that period of time. The secondary fill (013) is possibly the most informative deposit in regard to Iron Age rituals. Unburnt animal bone, in the form of disarticulated elderly cattle, horse, large mammals and a predominantly unidentified amount of bone in conjunction with the articulated skeleton of a mature dog may be the only trace of a ritual feast or the passing on of material wealth in the form of livestock to the next world. The deposition of the dog skeleton may have come in the form of sacrifice, to accompany the deceased to the next world also. It is of interest to note that no burials were in this deposit and the only lithics recovered were.

The token cremation burials retrieved from the three upper fills (014, 015, 016) of the ring ditch correspond to the symbolic burial of three individuals, the remainder of their bodies may have been scattered in the wind or ritually deposited elsewhere. Token burials first made their appearance in the Middle Bronze Age. These token deposits mark the waning of an earlier tradition of interring most, if not all, of the burnt remains of an individual into a burial pit. Iron Age burial rites contain elements of those that were in use in the latter part of the Bronze Age, including ring-barrows, the dominance of cremation and token cremations such as these. (Cooney *et al.* 1999). Due to the abraded and fragmentary nature of the cremated bone from each burial, no sex, age or pathological data could be inferred to any individual. The main point of information gleaned from the analysis was that there was a conscious and deliberate choice of bones from the skull for each burial. This is mirrored in many token cremation burials from this period, where the choice of the skull, as the most striking and symbolic body part, is chosen to represent the individual in the burial rite (Appendix 8). Similar deposits of token burials of skull fragments have been excavated at Ballybar Lower, Co.Carlow (E2622; Hackett and Hanbidge 2009), Burtown Little, Co. Kildare (E2989; Moloney 2009), and Ballymount, Co. Kildare (E2870; Twomey 2009).

Comparative sites

Excavations undertaken in Ballybronoge South Co. Limerick, in advance of the construction of the Adare to Annacotty section of the N20/N21 motorway, revealed a ringditch with parallels to the site at Mullamast. The ring ditch at Ballynabronoge had an external diameter of 7 m and a ditch up to 0.5 m in depth. The cremated remains of at least two individuals were retrieved from the ditch of this ringditch (Eogan and Finn, 2000).

Within the present scheme, the inhumation cemetery E2980 (Hackett 2009) to the east and a number of recorded sites within the townland of Mullamast indicate that this area was a focus for prehistoric funerary activity; these include three barrows (KD036-009; KD036-011; KD036-014) and two barrow sites (KD036-012; KD036-013), one of which contained a cist burial (KD036-01201). Archaeological excavation at the site of a temporary compound for use during the construction of the N9/N10 road scheme from Carlow to Kilcullen and the Athy to Moone/Timolin link road under licence number (08E0100) and just over 1 km to the west contained revealed a Bronze Age burial site and also evidence of domestic use of the site. A socketed and looped bronze spearhead was recovered from this excavation, along with a cremation pyre dump, crouched inhumation and various shards of possibly Late Bronze Age pottery and stone tools (Hackett 2008).

Corn-drying kiln
The kiln corresponds to the classic 'figure of eight' shape of early medieval cereal-drying kilns. The kiln was earth-cut with a lower scorched fire-pit connected by a flue to a higher drying chamber. No structural evidence such as post holes or wind breaks was detected.

Such features would have played a crucial role in the processing of cereal grains, avoiding the possible rotting of the cereal crop in the damp Irish climate and ensuring the survival of grain seed for the following year. The drying process would have been carried out throughout the year as required, with a concentration in late summer/early autumn in preparation for winter storage or immediate use after harvesting. Cereal drying kilns are classified according to their shape in plan with the five main categories being; keyhole shaped, L-shaped, figure-of-eight shaped, dumb-bell shaped, and irregular (Monk and Kelleher 2005, 79). The figure-of-eight and dumb-dell shaped examples are seen as being precursors to the keyhole shaped kilns. A fire lit in the fire bowl would provide the necessary heat required for the dying process. Recently harvested cereals would have been placed on a wooden rack or straw bed and the heat from the fire would travel through the flue to the drying chamber which would have been covered by a roof of clay or thatch. Evidence for such thatching was recovered in association with a kiln at site E2996 in Ballyvaas Co. Kildare (Doyle 2008).

Charred bread wheat grain taken from the sample from deposit (005) of the kiln has been dated to 250-550 cal AD (2 σ) (SUERC – 25467), placing the activity in the Late Iron Age/Early Medieval period. The grain assemblage was dominated by barley with lesser amounts of oat, bread wheat, emmer wheat and rye present. This is comparable to the grain assemblages from kilns on the adjacent sites E2972 and E2980, as well as being broadly comparable with the assemblages from kiln sites nationally (Appendix 7). As no weed seeds or chaff fragments were identified within the assemblage it would appear that it was a clean crop that was being dried with all traces of weed seeds having been previously removed.

Seven similar cereal-drying kilns were excavated approximately 200 m downhill on site E2972 (Hackett and O' Connell 2009) and a further three on site E2980 (Hackett 2009), also dating to the Iron Age/early medieval transitional period. Of these, six shared the north/south orientation of this feature with the fire bowl to the north, the rest following an east/west axis. This may reflect the utilisation of different kilns in response to the wind direction at the time of drying, and a preference for a northerly breeze, or alternatively may show a desire to shield the fire bowl from a prevailing wind.

Site	Context Nr	Orientation	Radiocarbon Date (2 σ)	SUERC-Number
E2973	(004)	North/south	Cal AD 250 - 550	SUERC - 25484
E2972	(070)	North/south	-	-
E2972	(088)	North/south	-	-
E2972	(103)	North/south	-	-
E2972	(116)	East/west	-	-
E2972	(133)	North/south	Cal AD 540 - 680	SUERC - 25851
E2972	(176)	East/west	-	-
E2972	(187)	North/south	Cal AD 560 - 770	SUERC - 25479
E2980	(123)	East/west	-	-
E2980	(155)	North/south	cal AD 340 - 580	SUERC - 25456
E2980	(188)	Northeast/ southwest	cal AD 130 - 380	SUERC - 25313

Table 1: Cereal-drying kilns on E2973 and nearby sites

The majority of farms or small groups of farms would have had its own grain drying kiln. When compiled with the results from the nearby sites the results show the continued undertaking of cereal-drying in this locality over a number of centuries in the late Iron Age/early medieval period.

All the archaeology related to this site within the CPO has been resolved.

6 Archive quantities

The site archive is comprised of the following materials:

Item	Quantity
Context Sheets	14
Plans	2
Sections	6
Photographs	13
Registers	6
Notebooks	1

The archive material is contained within 1 box.

Storage of the archive in a suitable format and location is required in order to provide for any future archaeological research. It is proposed that in addition to the paper archive a digital copy is prepared. The archive is currently stored in the offices of Headland Archaeology (Ireland) Ltd., Unit 1, Wallingstown Business Park, Little Island, Co. Cork. It is proposed that following completion of post-excavation analysis, the archive is appropriately deposited in consultation with the National Museum of Ireland.

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- Graphics department, Headland Archaeology (Ireland) Ltd.
- T.J O'Connell, Site Supervisor, Headland Archaeology (Ireland) Ltd.
- The excavation team.

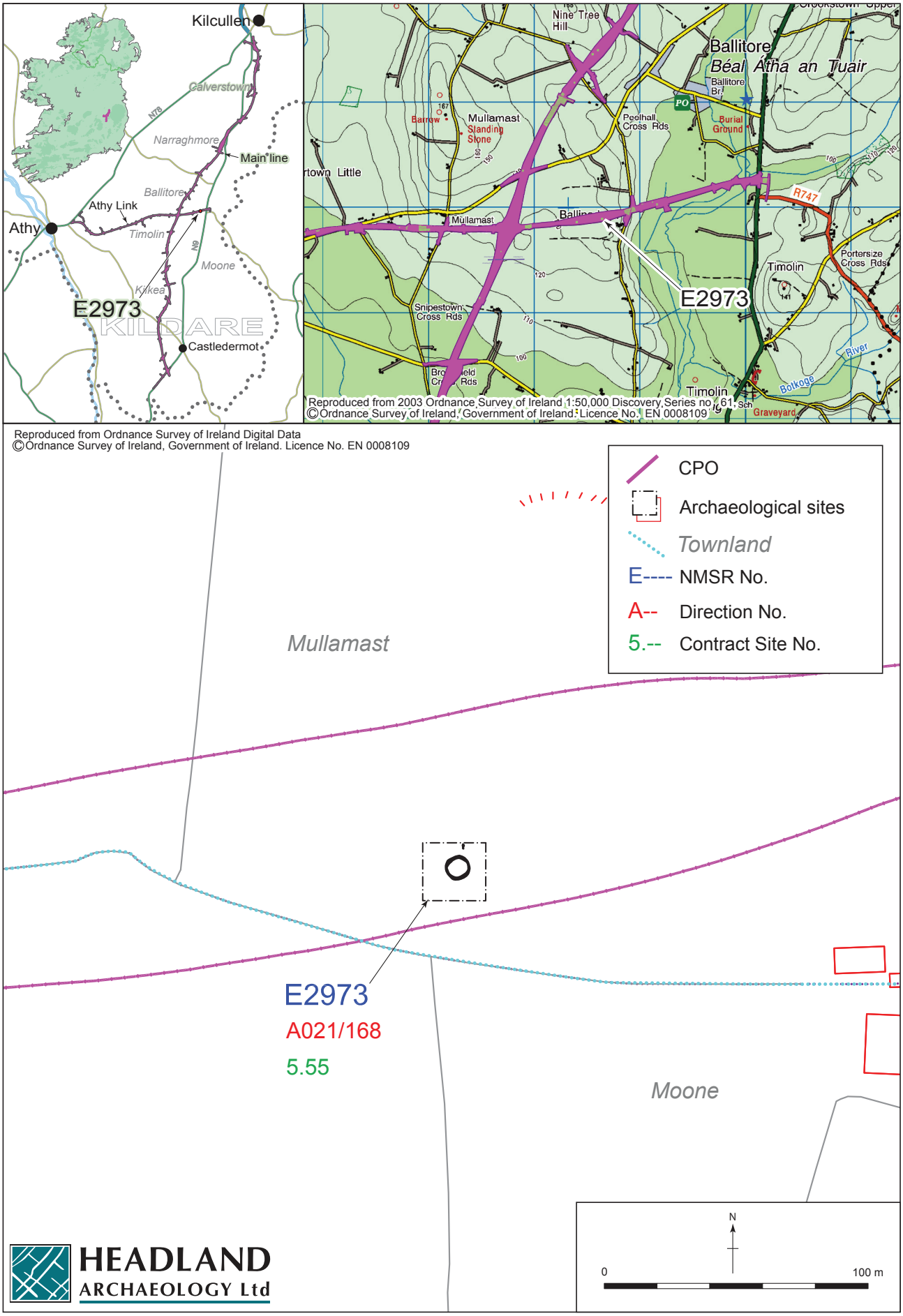


Figure 1 - N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 - Resolution, Kilcullen to Moone and Athy Link Road: E2973 site location.

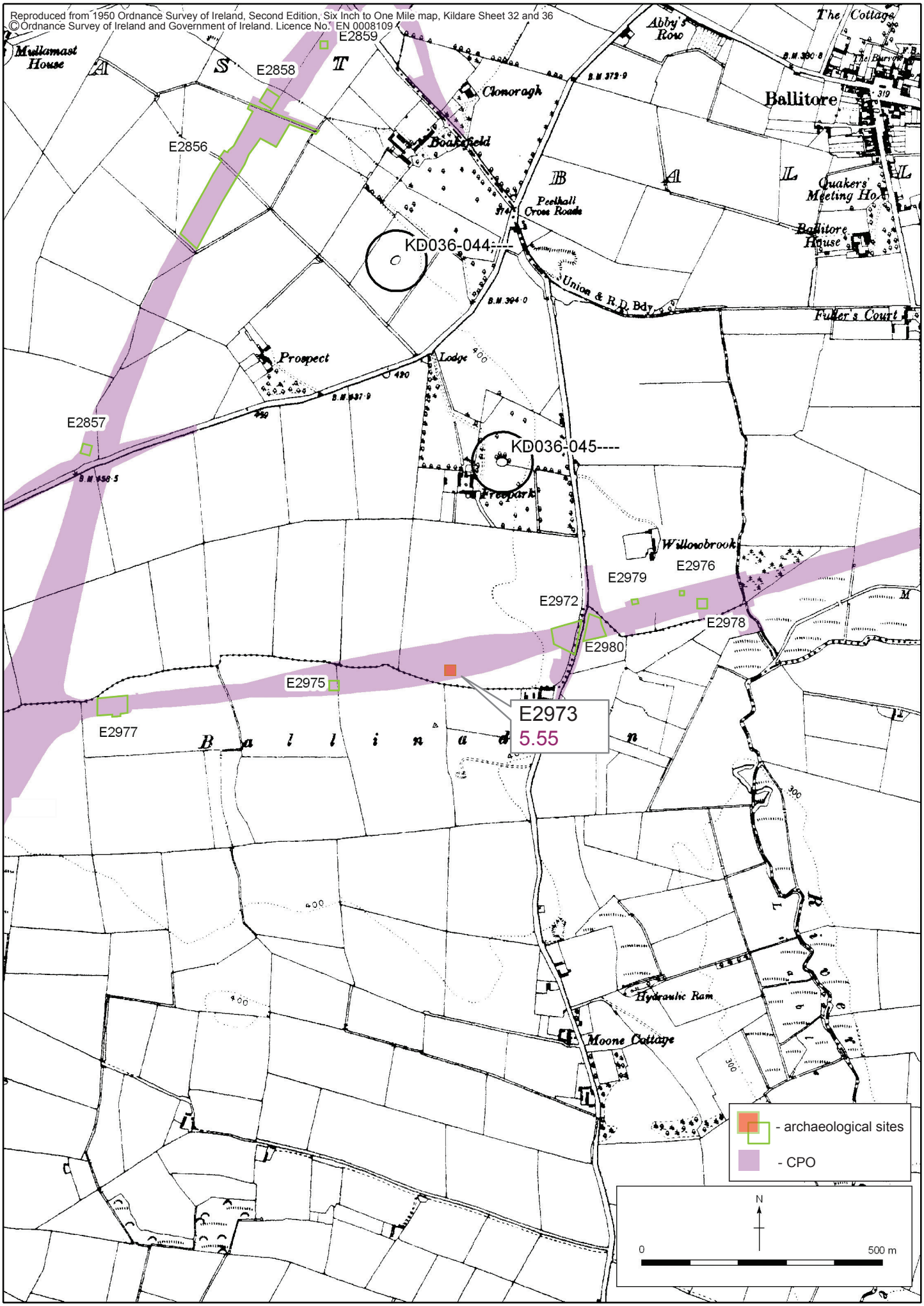


Figure 2 - N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 - Kilcullen to Moone and Athy Link Road: E2973 extract from RMP.

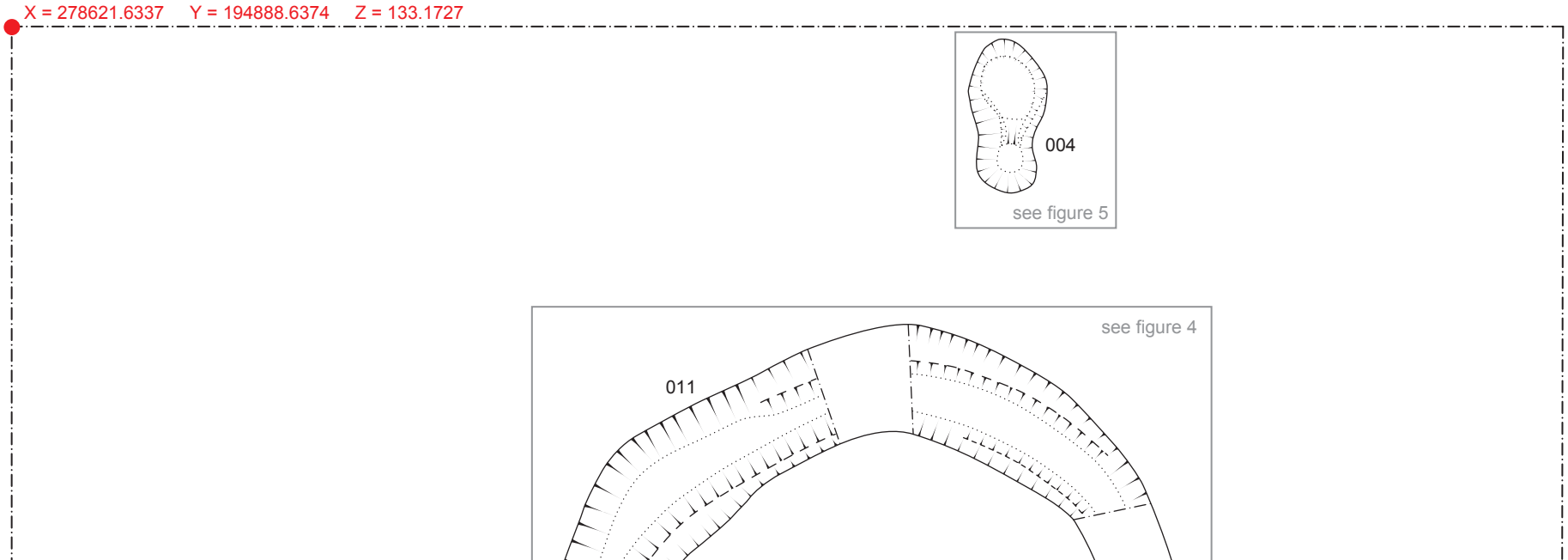
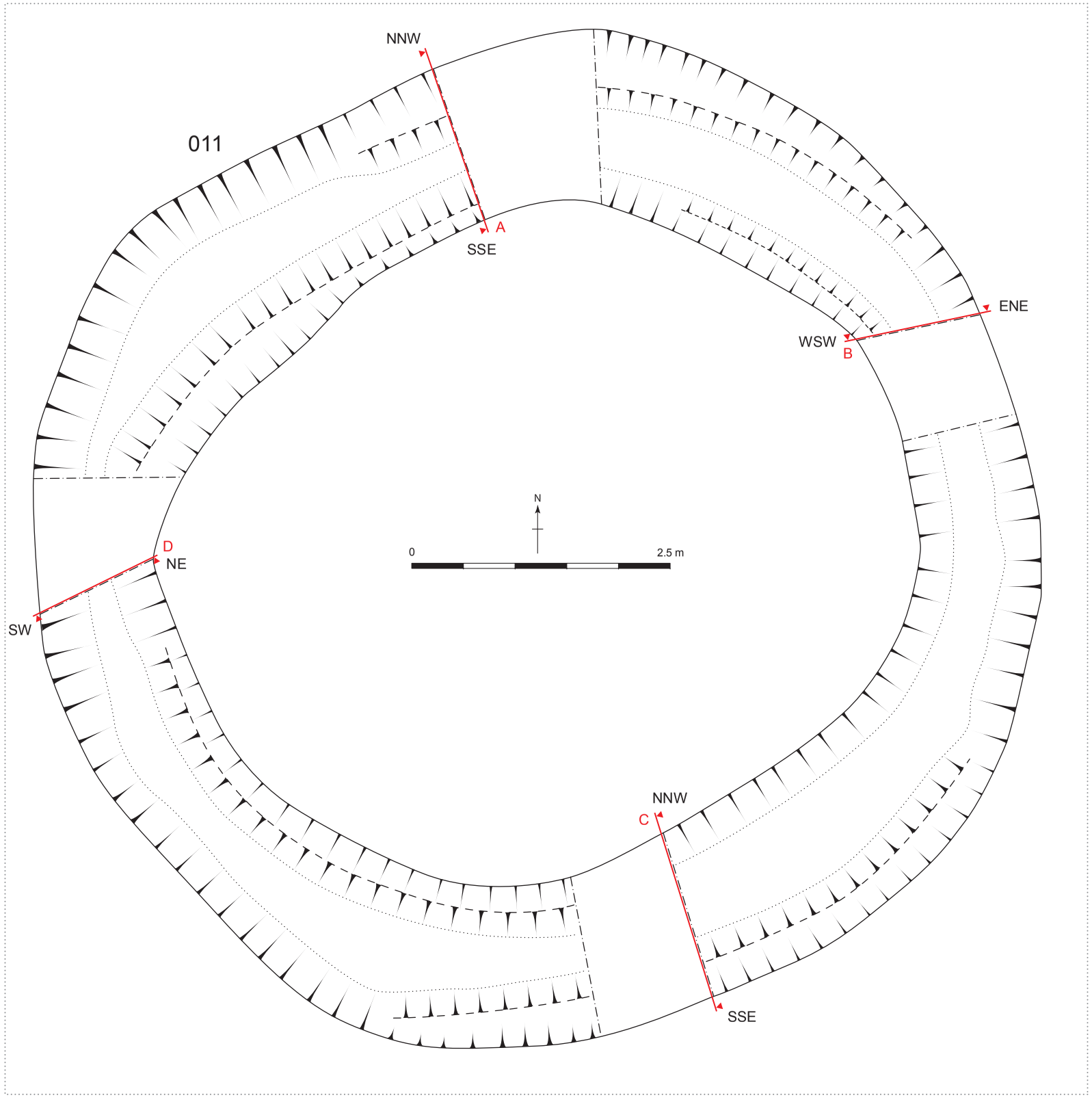


Figure 3 - N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 - Kilcullen to Moone and Athy Link Road: E2973 site layout.



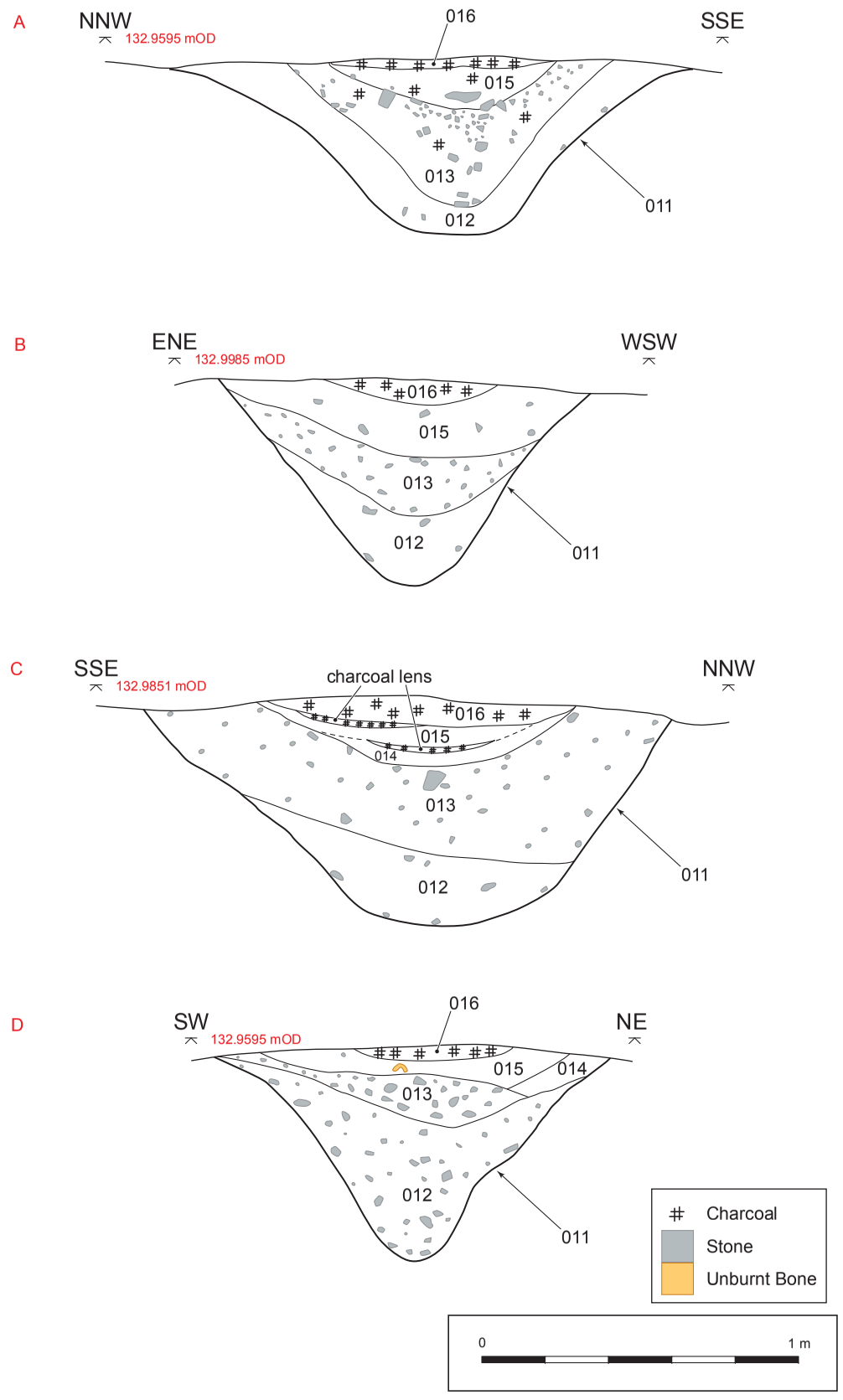


Figure 4 - N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 - Kilcullen to Moone and Athy Link Road: E2973 plan and WSW, NNW, ENE and SE-facing sections of ring ditch (011).

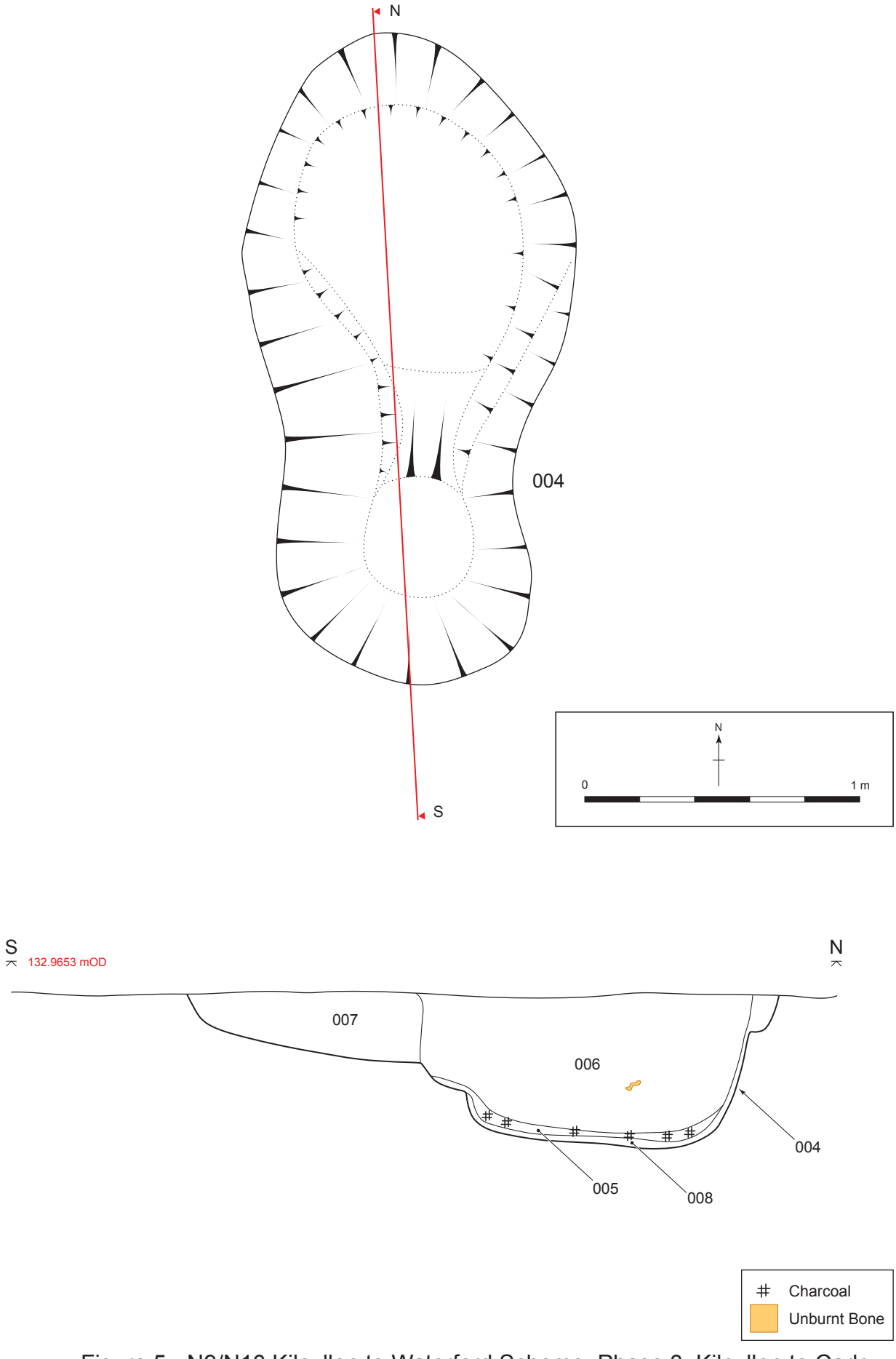


Figure 5 - N9/N10 Kilcullen to Waterford Scheme: Phase 3, Kilcullen to Carlow. Archaeological Services Contract No. 5 - Kilcullen to Moone and Athy Link Road: E2973 plan and east-facing section of cereal-drying kiln (004).

Plate 1 - Pre-excavation photo of site, facing east.

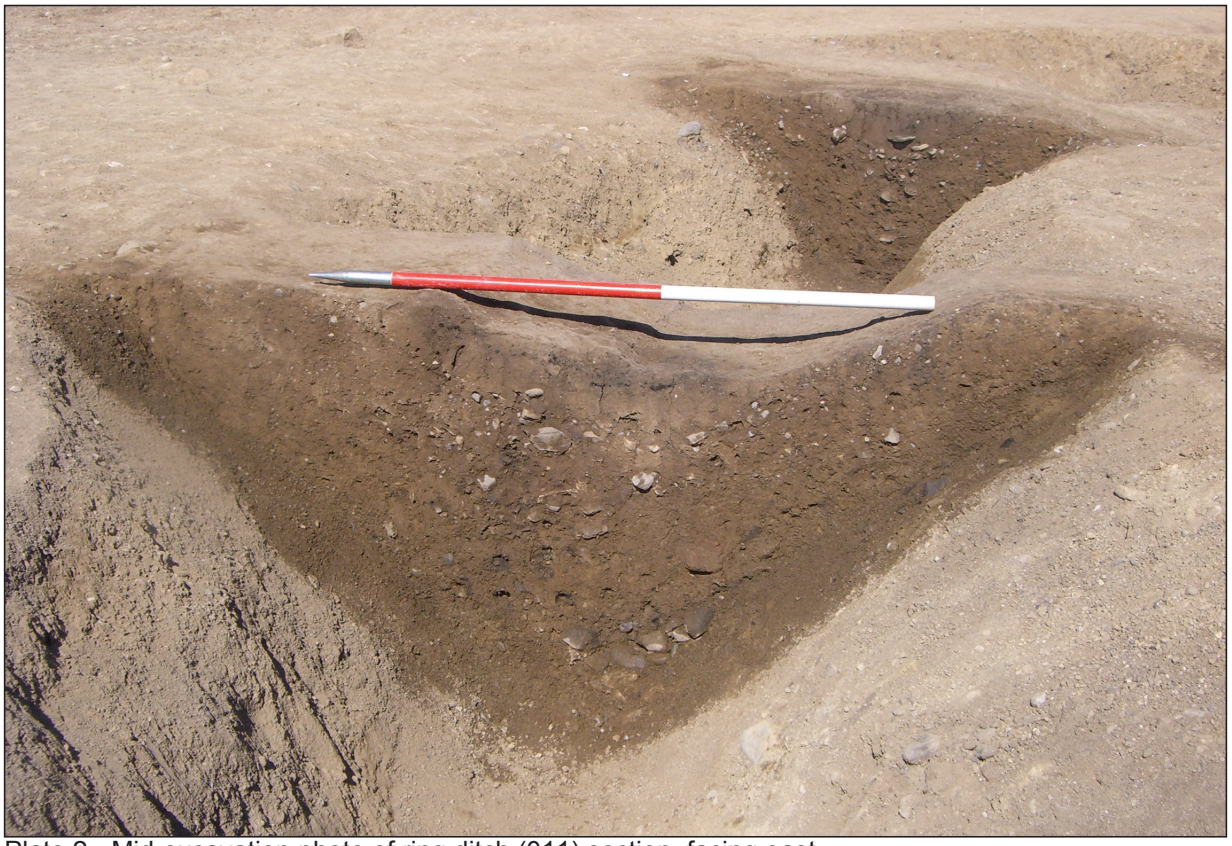


Plate 2 - Mid-excavation photo of ring ditch (011) section, facing east.

Plate 3 - Mid-excavation photo of ring ditch (011), facing north.

Plate 4 - Mid-excavation photo of ring ditch (011), facing west.

Plate 5 - Mid-excavation photo of site, facing east.

Plate 6 - Mid-excavation photo of animal bone in deposit (013). Vertical shot.

Plate 7 - Post-excavation photo of kiln (004), facing west.

Appendix 1 – Context Register for Site E2973

Context no.	Type	Fill of:	Filled by:	D (m)	W (m)	L (m)	Description	Interpretation
1	Topsoil	-	-	0.6	-	-	Mid-brown silty clay.	Topsoil
2	Subsoil	-	-	-	-	-	Light yellow brown silty clay.	Subsoil
3	Natural	-	-	-	-	-	Mid-grey-yellow clay and sandy gravel.	Natural
4	Cut	-	(006), (007), (008)	0.65	1.2	2.3	Figure of eight shaped kiln aligned N/S with a sub-circular fire pit to the north with sharp to gradually sloping sides and a flat base, a small flue with sharp sides and a base that sloped upwards to an oval drying chamber with gradually sloping sides and a concave shaped base.	Kiln
5	Fill	(004)	-	0.03		0.8	Black charcoal rich silty clay layer.	Fill of kiln
6	Fill	(004)	-	0.05	1.2	1.3	Moderately compact mid-brown silty clay with moderate inclusions of medium sized stones and occasional charcoal, bone and shell.	Fill of kiln
7	Fill	(004)	-	0.4	0.8	0.9	Moderately compact red brown silty clay.	Fill of kiln
8	Fill	(004)	-	0.01	0.9	0.8	Moderately compact, oxidised red brown clay with occasional charcoal flecks.	Fill of kiln
9								Void
10								Void
11	Cut	-	(012), (013), (014), (015), (016)	0.8	1.5-1.9	9.75 (external diam) 6.5-7.25 (internal diam)	Sub-circular, annular ring-ditch with gradual to sharply sloping sides and a flat base.	Ring-ditch

Context no.	Type	Fill of:	Filled by:	D (m)	W (m)	L (m)	Description	Interpretation
12	Fill	(011)	-	0.2-0.5	0.7	Continues throughout.	Compact light reddish brown gravelly silty clay with occasional inclusions of small stones and very occasional charcoal flecks.	Fill of ring-ditch
13	Fill	(011)	-	0.35	0.9	Continues throughout.	Compact light brown silty clay with frequent inclusions of small to medium sized compacted sub-rounded and sub-angular stones. Occasional inclusions of animal bone.	Fill of ring-ditch
14	Fill	(011)	-	0.2	1	Continues throughout.	Moderately compact dark brown silty clay with inclusions of occasional to moderate charcoal flecks and occasional burnt bone flecks.	Fill of ring-ditch.
15	Fill	(011)	-	0.16	0.7	Continues throughout.	Compact mid to dark brown silty clay with occasional with moderate charcoal and burnt bone fleck inclusions.	Fill of ring-ditch.
16	Fill	(011)	-	0.12	0.65	Continues throughout.	Moderately compact dark grey to black silty clay with very occasional burnt bone flecks and moderate charcoal flecks.	Fill of ring-ditch.

Appendix 2 – Finds Register for Site E2973

Find no.	Material	Type	Identification	Description
E2973:013:001	Stone	Chert	Prehistoric	Chert debitage
E2973:013:002	Stone	Chert	Prehistoric	Chert debitage
E2973:013:003	Stone	Chert	Prehistoric	Natural chunk
E2973:013:004	Stone	Chert	Prehistoric	Natural chunk
E2973:013:005	Stone	Chert	Prehistoric	Natural chunk
E2973:013:006	Stone	Chert	Prehistoric	Natural chunk
E2973:013:007	Stone	Chert	Prehistoric	Natural chunk
E2973:013:008	Stone	Chert	Prehistoric	Natural chunk
E2973:013:009	Stone	Chert	Prehistoric	Natural chunk
E2973:013:010	Stone	Chert	Prehistoric	Natural chunk
E2973:013:011	Stone	Flint	Prehistoric	Primary flint flake
E2973:013:012	Stone	Flint	Prehistoric	Natural chunk

Appendix 3 – Sample Register for Site E2973

Sample no.	Context no.	Description
E2973:001	(007)	Moderately compact red brown silty clay. Kiln fill.
E2973:002	(006)	Moderately compact mid-brown silty clay with moderate inclusions of medium sized stones and occasional charcoal, bone and shell. Kiln fill.
E2973:003	(005)	Black charcoal rich silty clay layer. Kiln fill.
E2973:004	(012)	Compact light reddish brown gravelly silty clay with occasional inclusions of small stones and very occasional charcoal flecks. Basal fill of ring-ditch.
E2973:005	(013)	Animal bone from secondary fill of ring-ditch.
E2973:006	(013)	Animal bone from secondary fill of ring-ditch.
E2973:007	(013)	Compact light brown silty clay with frequent inclusions of small to medium sized compacted sub-rounded and sub-angular stones. Secondary fill of ring-ditch.
E2973:008	(014)	Moderately compact dark brown silty clay with inclusions of occasional to moderate charcoal flecks and occasional burnt bone flecks. Tertiary fill of ring-ditch.
E2973:009	(015)	Compact mid to dark brown silty clay with occasional with moderate charcoal and burnt bone fleck inclusions. Fill of ring-ditch.
E2973:010	(016)	Moderately compact dark grey to black silty clay with very occasional burnt bone flecks and moderate charcoal flecks. Upper fill of ring-ditch.

Appendix 4 – Photo Register for Site E2973

Shot no.	Direction	Description
E2973:001	West	Working shot.
E2973:002	West	Pre-excavation shot of site.
E2973:003	East	Pre-excavation shot of site.
E2973:004	East	Pre-excavation shot of site.
E2973:005	South	Animal bone in (013)
E2973:006	South	Animal bone in (013)
E2973:007	East	Animal bone in (013)
E2973:008	South	Animal bone in (013)
E2973:009	East	Mid-excavation section view of ring-ditch (011)
E2973:010	East	Mid-excavation section view of ring-ditch (011)
E2973:011	West	Post-excavation view of kiln (004)
E2973:012	North	Post-excavation view of kiln (004)
E2973:013	East	Post-excavation view of site

Appendix 5 – Drawing Register for Site E2973

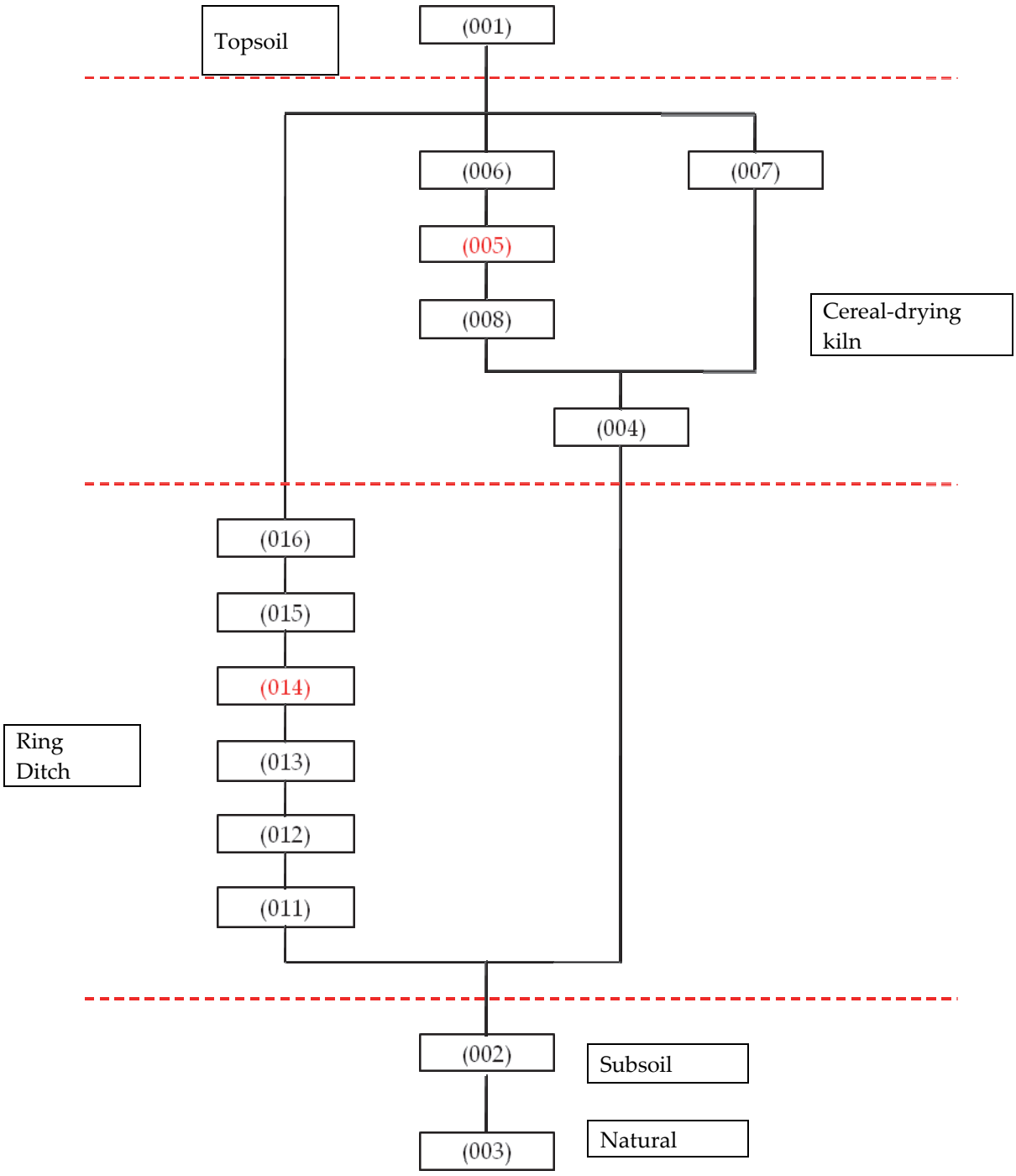
Plans

Drawing no.	Scale	Description
1	1:50	Pre-excavation plan of site
2	1:50	Post-excavation plan of site

Sections

Drawing no.	Scale	Description
1	1:20	East facing section of kiln (004).
2		Void
3	1:10	West facing section of ring-ditch (011).
4	1:10	East facing section of ring-ditch (011).
5	1:10	West facing section of ring-ditch (011).
6	1:10	North facing section of ring-ditch (011).
7	1:10	South facing section of ring-ditch (011).

Appendix 6: Site Matrix for Site E2973



005=cal AD 250-550 (2σ)
014=360-40 cal BC (2σ)

Appendix 7 – Paleonvironmental samples assessment for Site E2973

By: Sarah-Jane Haston and Scott Timpany

Introduction

Eight environmental samples were taken during the excavation of Mullamast, County Kildare E2973, and a site consisting of a sub-circular ring ditch and associated features and the remains of a grain-drying kiln. All of the samples were processed in order to retrieve any palaeoenvironmental material.

Methodology

Samples of approximately 10 L were taken on site under the direction of an environmental archaeologist. Samples were processed in laboratory conditions using a standard flotation method (cf. Kenward *et al.*, 1980). This was then sorted by eye and any material of archaeological significance removed. All plant macrofossil samples were analysed using a stereomicroscope at magnifications of x10 and up to x100 where necessary to aid identification. Identifications were confirmed using modern reference material and seed atlases including Cappers *et al.* (2006).

Results

The results are summarised below in Tables 2 (Composition of retents) and 3 (Composition of flots). All plant material was preserved by charring. Sample 001 taken from (007) and Sample 4 taken from (012), were found not to contain any material of archaeological significance.

Wood charcoal

Wood charcoal was recovered from every processed sample not found to be archaeologically sterile. In most cases, the concentrations of charcoal were low and found to be either rare (+) or occasional (++) with only one sample, Sample 009, found to contain an abundant amount (see Tables 2 and 3). In all cases, the charcoal was very fragmented, and only two samples 007 and 009 were found to contain charcoal fragments of a size suitable for identification and/or Accelerated Mass Spectrometry (AMS) dating (see Tables 2 and 3).

Cereal Grain

Charred cereal grain was present within only one sample, Sample 003 (see Tables 2 and 3). The grain assemblage includes primarily barley (*Hordeum vulgare*) with lesser amounts of oat (*Avena* sp.), bread wheat (*Triticum aestivo-compactum*), emmer wheat (*Triticum dicoccum*) and rye (*Secale cereale*).

Discussion

Samples 004, 007, 008, 009 and 010 were taken from the ring-ditch (011). The sample from the basal fill of the ring-ditch (Sample 004) was archaeologically sterile. The carbonised plant remains of the upper four fills were restricted to small quantities of mostly oak (*Quercus* sp.) charcoal. The majority of the wood charcoal fragments are small-sized, less than 1.0 cm², and may have been transported across the site by mechanisms such as windblow and surface run-off. Larger fragments of charcoal (up to 1.2 cm) were recovered within two of the samples taken from the ring-ditch, Samples 007 and 009. The large size of fragments suggests that they were either deliberately deposited (e.g. discarding of domestic waste) or are close to the source of a burning event.

Samples 001, 002 and 003 were taken from the grain-drying kiln (004). No plant remains were recovered from Sample 001 taken from the fill of the drying chamber. A rare amount of charcoal and

occasional pieces of unburnt bone were recovered from Sample 002, taken from the fire base of the kiln.

Sample 3 (005), the basal fill of the fire-pit did, however, stand out with the largest concentration of charred plant remains recovered from any of the samples taken. Radiocarbon dating of charred bread/club wheat grains from this sample date the kiln to cal AD 250-550 (2 σ) (SUERC – 25484) (Table 1). The cultivated plant remains are dominated by the grains of hulled barley. Other cereals present include small amounts of poor to excellently preserved grains of oat, emmer wheat, club/bread wheat and rye along with an occasional amount of small fragments of charcoal. No weed seeds were recovered from any of the kiln samples. The absence of weed seeds and chaff would suggest that it is the clean crop that is being dried with all traces of weed seeds having been removed prior to charring.

The remaining grain, (still a small amount with less than 50 whole grains represented) is likely to reflect the last use of the kiln before abandonment. The majority of farms or small group of farms would have had its own grain drying kiln with processing of a crop likely to have been carried out piecemeal throughout the year with grain being dried when necessary (Holden 1998). The lack of large numbers of grain suggests the kiln was cleaned out regularly with any rake-out material having been lost through the passage of time.

The cereal grain assemblage recovered from the Sample 003, dominated by barley with lesser amounts of oat, is similar to other assemblages from excavated grain-drying kilns across Ireland including Brehon's Chair, Taylor's Grange, County Dublin (Monk and Kelleher 2005) and similar figure-of-eight shaped kilns along the N7 Nenagh to Limerick at Site E2469 Carrigatogher (Harding), Co. Tipperary (Hackett and Clark 2008), and Site E3266 Kilnacranna, Co. Tipperary (Macleod & Cosham 2008).

Barley and rye have been cultivated from the prehistoric period to the present day, while oat, in its cultivated form, primarily dates from the early medieval period in Ireland (Monk 1985/1986). The small number of wheat grains present within the samples is also similar to other grain assemblages of the early medieval period, though the incidence of wheat is seen to increase as the medieval period progresses (Monk 1985/1986).

Recommendations

- Sufficient charcoal for AMS dating was recovered from Samples 007 and 009 and the carbonised cereal grain from Sample 003, if this is required. Identification of the species of wood represented would need to be undertaken prior to dating.

- Further analysis of the cereal grain assemblage recovered from Sample 003 is of very little interpretative value and would add little to the information gained by this assessment. A summary of methodology and results from this assessment should, however, be added to any final publication report.

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Monk, M.A. 1985/86 'Evidence from macroscopic plant remains for crop husbandry in prehistoric and early historic Ireland: a review', *Journal of Irish Archaeology* Vol. 3, 31-36.

Monk, M. & Kelleher, E 2005 'An assessment of the archaeological evidence for Irish corn drying kilns in the light of the results of archaeological experiments and archaeobotanical studies', *Journal of Irish Archaeology*, Vol. 14, 77-114.

E-Number	SUERC-No.	Lab code	Sample ID	Material	δ13C	Radiocarbon age BP	Calibrated Age Ranges (1 σ)	Relative probability	Calibrated Age Ranges (2 σ)	Relative probability
E2973	SUERC - 25484	GU - 19470	sample #003, context 005	charred bread wheat grains	-22.2	1635 +/- 50	cal AD 340 - 460	46.4	cal AD 250 - 300	5.2
							cal AD 480 - 540	21.8	cal AD 320 - 550	90.2
E2973	SUERC - 25467	GU - 19359	sample #008, context 014	(cert: cremated human) burnt bone	-25.8	2145 +/- 50	350 - 290 cal BC	19.8	360 - 40 cal BC	95.4
							230 - 220 cal BC	1.3		
							210 - 90 cal BC	47.1		

Table 1 – Result of radiocarbon dating

Context Number	Sample Number	Total flot Vol (ml)	Cereal grain:	*Triticum aestivo-compactum*	*Triticum dicoccum*	*Avena* sp.	*Hordeum vulgare*	*Secale cereale*	Charcoal Quantity	Charcoal Max size (cm)	Material available for AMS
5	3	20		++	++	++	+++	+			
6	2	2							+	<0.5	
7	1	5									
12	4	10									
13	7	60							++	1.2	Charcoal +
14	8	20							++	<1	
15	9	80							+++	1.1	Charcoal +
16	10	5									

Key: + = rare, ++ = occasional, +++ = common and ++++ = abundant
NB charcoal over 1cm is suitable for identification and AMS dating

Table 2 – KCK06 E2973 Flotation Sample Results

Context Number	Sample Number	Retent Vol (l)	Worked stone	Burnt Bone	Unburnt Bone	Charred Cereal Grains	Charcoal Quantity	Charcoal max size (cm)	Material available for AMS	Comments
5	3	1.5				++++	++	<1		
6	2	2.0			++					
7	1	1.5								Archaeologically sterile
12	4	6.0								Archaeologically sterile
13	7	2.0	+							
14	8	4.0		++			++	<1		
15	9	1.5					++++	1	Charcoal +	
16	10	2.0					++	<1		

Table 3 – Composition of retent

Key: + = rare, ++ = occasional, +++ = common and ++++ = abundant
NB charcoal over 1cm is suitable for identification and AMS dating

Appendix 8 – Final report on the faunal remains from Mullamast (E2973), Co. Kildare
By: Albína Hulda Pálsdóttir MA

Introduction

This report discusses the results of the animal bone analysis from Mullamast, Co. Kildare (E2973). The resolution of the site revealed a Middle Iron Age ring-ditch and the remains of a cereal-drying kiln which probably dates to the medieval period (Hackett 2009). The animal bone specimens were recovered by hand-picking and from soil samples by sieving. The animal bones analysed for this report derive from fills (005, 006) of kiln (004) and fill (013) of ring-ditch (011).

Methodology

During the analysis each specimen was identified and recorded according to species, skeletal element, age and sex where possible. The animal bone reference collection located in Headland Archaeology (Ireland) Ltd, Unit 1 Wallingstown Business Park, Little Island, Co. Cork was utilised. The York System bone database program was used for recording (Harland *et al.* 2003). The material was quantified by using the number of identified specimens (NISP). The categories "large mammal" (lm) and "medium mammal 2" (mm2) were used for specimens (mainly ribs and vertebrae) which could not be assigned to a species. The specimens categorised as large mammal are likely to belong to either cattle or horse; red deer was absent in the assemblage. Medium mammal specimens are most likely to consist of dog bones since no sheep/goat or pig bones were present in the assemblage. Tooth eruption and wear were recorded according to Grant (1982). Mandibles were further divided into age groups presented by O'Connor (2003, 160). Measurements were taken following von den Driesch (1976). In addition, during the analysis pathological changes, carnivore and rodent gnawing, signs of burning and butchery marks were recorded. All data is stored in digital and written form in Headland Archaeology (Ireland) Ltd, Unit 1 Wallingstown Business Park, Little Island, Co. Cork.

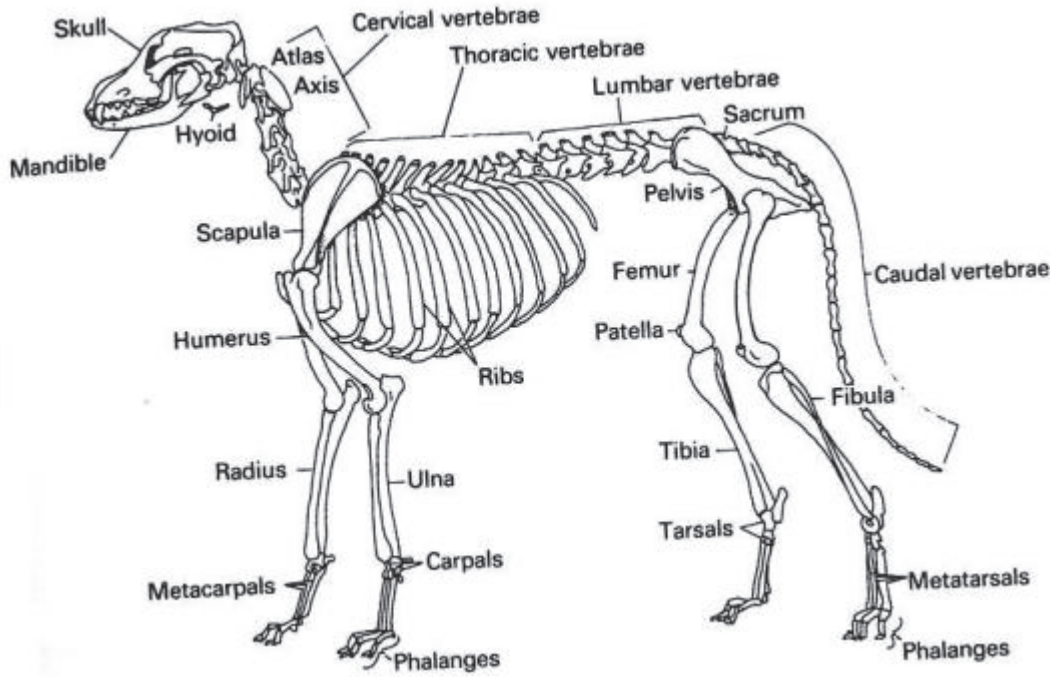

Figure 1 – Location on animal skeleton of terms referred to in text (Davis 1987, 54, in Reitz & Wing 1999)

Results

A total of 2143 bone specimens were analysed from the site (Table 1).

Context	*Cattle*	*Horse*	*Dog*	*Lm*	*Mm2*	*Unidentified*	***NISP***
005						1	1
006	1			4		104	109
013	19	17	106	40	160	1691	2033
Total	20	17	106	44	160	1796	**2143**

Table 1 – Species representation of sample (NISP). Lm = large mammal, Mm2 = medium mammal, carnivore

Kiln
A total of 110 bones were recovered from fills (005, 006) of the kiln (004). All of the bone was unburnt except for one calcined tooth fragment. This is somewhat unusual for bones coming from a kiln which tend to have a high ratio of burnt material. The majority were unidentifiable fragments (Table 2).

Element	*Cattle*	*Large mammal*	*Unidentified*	***NISP***
Pelvis	1			1
Shaft		4		4
Unidentified			105	105
Total	1	4	105	**110**

Table 2 – Species representation of sample (NISP) and element distribution

Ring-ditch
A total of 2033 bones were found in fill (013) of ring-ditch (011) which dates to the Late Iron Age. The majority of the bones were unidentifiable. None of the animal bones were burnt. The fill contained a cattle mandible (Table 4), a horse mandible and a nearly complete dog skeleton (Table 3). A small number of burnt bones, some clearly human, were also recovered from fill (013) of the ring-ditch (011) (Troy 2009, Appendix 9).

Element	*Cattle*	*Dog*	*Horse*	*Lm*	*Mm2*	*Unidentified*	***NISP***
Astragalus	1						1
Atlas		1					1
Axis	1	1					2
Baculum		1					1
Calcaneus		2					2
Carpal/tarsal		7					7
Cervical vertebra		4					4
Femur		2					2
Humerus		4					4
Mandible	2	5	1	6			14
Metapodial		14					14
Pelvis	1	2					3
Phalanx		8					8
Radius	1	3					4
Radius/ulna			1				1

Element	*Cattle*	*Dog*	*Horse*	*Lm*	*Mm2*	*Unidentified*	***NISP***
Rib				11	84		95
Scapula		1					1
Shaft				6	7		13
Skull		36			40		76
Teeth	14	9	15	14	4	349	405
Thoracic vertebra				1			1
Tibia		2					2
Ulna		2					2
Unidentified		2			25	1442	1469
Vertebra				6			6
Total	20	106	17	44	160	1791	**2138**

Table 3 – Element distribution in the ring-ditch (011) fill (013) at Mullamast

Age

Only one cattle mandible from Mullamast could be aged using tooth wear (Table 4).

Context	*Species*	*P4*	*M1*	*M2*	*M3*	*Age class*
13	Cattle	e	l	k	j	Elderly

Table 4 – Tooth wear (Dp4-M3) according to Grant (1982). Division of mandibles into age categories, (O'Connor 2003, 160)

Dog

One nearly complete dog skeleton was recovered from fill (013) of the ring-ditch (011) (Table 5).

	Dog	Dog	Dog	Dog	Mm2	
Element	*Left*	*Right*	*Both*	*Not sided*	*Not sided*	***NISP***
Skull	6	4	3	23	40	76
Mandible	4	1				5
Teeth	6	2		1	4	13
Atlas			1			1
Axis			1			1
Cervical vertebra			4			4
Rib					84	84
Scapula	1					1
Humerus	3	1				4
Radius	2	1				3
Ulna	1	1				2
Baculum			1			1
Pelvis	1	1				2
Femur	1	1				2
Tibia	1	1				2
Calcaneus	1	1				2
Carpals/tarsals				7		7
Metapodial				14		14

	Dog	Dog	Dog	Dog	Mm2	
Element	*Left*	*Right*	*Both*	*Not sided*	*Not sided*	***NISP***
Phalanx				8		8
Shaft					7	7
Unidentified				2	25	27
Total	27	14	10	55	160	266

Table 5 – Element distribution for the nearly complete dog skeleton recovered at Mullamast. Mm2 = medium mammal, carnivore

Despite the fact that the dog skeleton was very fragmented it was possible to take a number of measurements (Table 6).

Element	*LP4*	*BP4*	*LM1*	*BM1*	*LM2*	*BM2*	*4*	*8*	*19*	*16*
Mandible	13.36	7.25	23.72	10.25	10.36	7.68	125.05	72.6	26.07	
Maxillari teeth left			14.18	17.41	9.03	10.99				20.37
Maxillari teeth right			14.37	17.33	9.02	11.2				

Table 6 – Dog skull measurements. LP4 = length of P4, BP4 = breath of P4, LM1 = length of M1, BM1 = breath of M1, LM2 = length of M2, BM2 = breath of M2, 4 = length: the condyle process aboral border of the canine alveolus, 8 = length of cheek tooth row, M3-P1, 19 = height of mandible behind M1, 16 = length of the molar row

A number of the long bones of the dog skeleton were also measurable (Table 7). The withers height can be calculated from the greatest length (GL) of the femur, humerus and radius which give a range of 57-61 cm, the average being 59 cm (Harcourt 1974, 154). According to McCormick (1991, 9) this withers height falls into the large dog category.

Element	*GL*	*GLC*	*GB*	*SD*	*Bp*	*Dp*	*DC*	*Bd*
Calcaneus	45		17.93					
Femur	197			14.04			19.87	31.5
Humerus		176		13.96		44.33		
Radius	177			13.17	19.43			25.87
Tibia	191			13.48	34.53			24.21

Table 7 – Dog long bone measurements GL = greatest length, GLC = greatest length from caput (head), GB = greatest breath, SD = smallest breath of diaphysis, Bp = proximal breath, Dp = depth of proximal end, DC = greatest depth of caput femoris, Bd = distal breadth

From the fact that for all elements present there was no overlap when siding and diagnostic zones had been taken into account it can be assumed that the dog bones represent the remains of one individual. Since the baculum (penis bone) was present it can be assumed that the dog was male (Table 5). All of the long bones from the dog skeleton were fully fused but teeth did not show a significant amount of wear. No pathologies were observed on any of the dog bones and they were all unburnt.

Preservation

In general the material from Mullamast was well preserved, yet the bones were fragmented and fragile. Some of the fragmentation had occurred during the burial process, but post-mortem breaks were common. A sample could include a high number of specimens within a few anatomical elements, because of the high fragmentation rate. Signs of burning or carnivore gnawing were not observed in any of the animal bones from the site.

Discussion

Despite its small size the bone assemblage from Mullamast is extremely interesting. The low ratio of burning in the kiln material is unusual; most likely the bones were deposited in the kiln after it fell out of use. The presence of a nearly complete large adult male dog skeleton along with a cattle mandible from an elderly individual and a horse mandible in the ring-ditch fill suggests that the deposit might be ritual in nature. The absence of sheep/goat and pig bones is also interesting but due to the small size of the sample and possible recovery bias not much can be read into this. This assumption is further strengthened by the presence of three separate human bone token deposits in the ring-ditch (Troy 2009, Appendix 9). It seems likely that with the amount of Iron Age faunal material recovered in excavations, in recent years, ideas about animal exploitation in the time period will change. The bone material from Mullamast, Co Kildare is too small for conclusive comparison against other assemblages. However, some general observations can be made.

Of the small number of Iron Age animal bones assemblages analyzed and published in Ireland, most derive from high-status ceremonial sites (McCormick and Murray 2007, 31). For example, in Dún Ailinne Co. Kildare cattle, pig, sheep/goat and horse bones were identified, interpreted to relate to ritual activities (Crabtree 2002). Large dog remains have been previously found in Late Bronze Age ritual sites but few dog bones have previously been recovered from the Iron Age (McCormick 1991, 8). At Tara, some of the dog bones showed signs of butchery and this is thought to reflect ritual activity (McCormick & Murray 2007, 33). Recent excavations in the Carlow/Kildare area have revealed a number of Iron Age sites some of which yielded faunal assemblages. A large number of animal bones dating to the Late Iron Age were recovered from the fills of an enclosure ditch Moone, Co. Kildare (E2980). Cattle dominate the sample, followed by pig, sheep or goat and horse. The assemblage also included horse, dog, red deer, wood mouse and a whale bone In addition, material included a few bones of small songbirds (Passeriformes) and (unidentified) fish bones. Some pig bones derive from very large and robust individuals, either from wild boar or very large domestic animals (Tourunen and Pálsdóttir 2010a). Faunal remains dating to the Late Iron Age have been found at Prumplestown Lower, Co. Kildare (E2967) where a number of cattle, sheep/goat, pig and horse bones were recovered from a context that also contained cremated human bone (Tourunen and Pálsdóttir 2010b). From Mullamast, Co. Kildare (E2860) burnt cattle and sheep/goat bones were recovered from a hearth fill as well as unidentified bone coming from both the hearth and associated pits all dating to the Late Iron Age to early medieval period (Tourunen and Pálsdóttir 2009). At Hallahoise, Co. Kildare (E2948) burnt bone unidentifiable as either human or animal was recovered from a pit dated to the Late Iron Age (Pálsdóttir 2010). From Ballybannon, Co. Carlow (E2612) a small faunal assemblage dating to the Early Iron Age was recovered from a fill of a re-cut of an enclosure ditch. Most of the identified bones derive from cattle and red deer, with dog also being represented in the sample. The cattle bones derived mainly from head and limb bones but the red deer bones in the sample consisted solely of pieces of antler (Tourunen 2009). At Knockgraffen, Co. Tipperary (09E0123) a small assemblage dating to the Early Iron Age with cattle and pig bones and a skeleton of a large dog were found associated with a ring-ditch. Like the Mullamast collection no sheep/goat bones were recovered at Knockgraffen (Tourunen and Pálsdóttir 2010).

Context	*Sample*	*Species*	*Element*	*NISP*	*Side*	*Gt50*	*Proxfus*	*Distfus*	*Modifications*	*Admin*	*Notes*	*Percent*	*Texture*	*Burning*	*Recovery*
005	003	unid	isoteeth	1							Root fragment.	30		cal	1
006	002	lm	sha	3									3		1
006	002	lm	sha	1						fb	Broken in 2.		3		1
006	002	unid	ui	104									3		1
006	002	cow	pel	1	r	2				fb	Fused.		3		1
013	006	lm	rib	11						fb			3		hc
013	006	horse	isoteeth	1							M1/2. Mandible.	90			hc
013	006	cow	rad	1	l	256789K	f	u		fb	Broken in 4.		3		hc
013	006	cow	mand	1	r	345				fb	Fused. Broken in 3.	30	2		hc
013	006	cow	isoteeth	1						fb	M1/2. Maxilla. Broken in 2.	90			hc
013	006	cow	isoteeth	13						fb	Tooth fragments.	10			hc
013	006	lm	isoteeth	9						fb	Tooth fragments, possibly from shattered cow and horse teeth.	10			hc
013	006	unid	isoteeth	133						fb	Tooth fragments, possibly from shattered cow and horse teeth.	10			hc
013	006	horse	isoteeth	12						fb	Tooth fragments.	10			hc
013	006	dog	skull	1	l						Zygomatic. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	3		hc
013	006	dog	skull	1	l					fb	Temporal. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	l					fb	Premaxilla with i3 and i2. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	isoteeth	1	l						p2/3. Maxilla. Probably part of shattered dog skull. Probably part of partial dog skeleton.	90			hc
013	006	dog	isoteeth	1	l						p1. Maxilla. Probably part of shattered dog skull. Probably part of partial dog skeleton.	90			hc
013	006	dog	skull	1	l					fb	Maxilla with m1 and m2. Probably part of shattered dog skull. Measurements: 16 = 20.37 M1L = 14.18 M1B = 17.41 M2L = 9.03 M2B = 10.99. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	r					fb	Fragment of maxillare with alveoli. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	b					fb	Fragment of parietal and frontal with slightly visible sutures. Broken in 4. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	b					fb	Interparietal. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	l					fb	Occipital. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	r					fb	Occipital. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	b					fb	Palatine. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	r					fb	Frontal. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1	l					fb	Fragment of temporal. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	dog	skull	1						fb	Fragment of frontal. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc

Context	*Sample*	*Species*	*Element*	*NISP*	*Side*	*Gt50*	*Proxfus*	*Distfus*	*Modifications*	*Admin*	*Notes*	*Percent*	*Texture*	*Burning*	*Recovery*
013	006	dog	skull	1						fb	Pars petrosa. Probably part of shattered dog skull. Probably part of partial dog skeleton.	10	2		hc
013	006	mm2	skull	40						fb	Probably part of shattered dog skull. Probably part of partial dog skeleton.		2		hc
013	006	lm	thor	1								30	3		hc
013	006	lm	sha	2						fb			3		hc
013	006	unid	ui	960						fb					hc
013	006	unid	isoteeth	204						fb	Tooth fragments.				hc
013	006	cow	astr	1						fb		50	4		hc
013	006	lm	vert	6						fb			3		hc
013	006	unid	ui	18						fb	Possibly lm vertebra and skull fragments.		3		hc
013	006	cow	ax	1	b					fb		10	3		hc
013	005	horse	rad/uln	1	r		f			fb	Most of proximal end and 2/3 of shaft of radius, very proximal end of ulna missing. Broken in 3.	70	2		hc
013	005	horse	isoteeth	2							M1/2. Maxilla.	90			hc
013	005	cow	mand	1	l	1267BCDE				fb	Broken in 8, with M3 and P3 loose.		2		hc
013	005	horse	mand	1	l	16BCDE				fb	Broken in 11 with loose teeth. M3, M2, M1, P4, P3 present.	70	2		hc
013	005	lm	mand	6						fb	Possibly fragments from horse mandible.		2		hc
013	005	lm	isoteeth	5						fb	Tooth fragments.	10			hc
013	005	unid	isoteeth	12						fb	Tooth fragments.				hc
013	005	mm2	rib	72						fb	Probably part of partial dog skeleton.	10	2		hc
013	005	mm2	rib	12						fb	Proximal ends of ribs. Probably part of partial dog skeleton.	10	2		hc
013	005	dog	bac	1	b					fb	Broken in 3. Probably part of partial dog skeleton.	70	2		hc
013	005	mm2	rib	12						fb	Proximal ends of ribs. Probably part of partial dog skeleton.	10	2		hc
013	005	dog	bac	1	b					fb	Broken in 3. Probably part of partial dog skeleton.	70	2		hc
013	005	dog	skull	1	r					fb	Maxillare. m2, m1, p4, p3, present. Measurements m1L = 14.37 m1b = 17.33 m2L = 9.02 m2B = 11.20. Probably part of partial dog skeleton.	30	2		hc
013	005	dog	fem	1	l	123456	f	f			Measurements: GL = 197, DC = 19.87, BD = 31.5, SD = 14,04. Probably part of partial dog skeleton.		2		hc
013	005	dog	rad	1	r		f	f			Measurements: GL = 177, SD = 13.17, Bd = 25.87, Bp = 19.43. Probably part of partial dog skeleton.	90	2		hc
013	005	dog	tib	1	r	123456	f	f			Probably part of partial dog skeleton.		2		hc
013	005	dog	hum	1	r	1234	f	f			Probably part of partial dog skeleton.		2		hc
013	005	dog	pel	1	r	123				fb	Fused. Broken in 2. Probably part of partial dog skeleton.		2		hc
013	005	dog	fem	1	r	123456	f	f		fb	Broken in 3. Probably part of partial dog skeleton.		2		hc
013	005	dog	scap	1	l	12		f		fb	Broken in 3. Probably part of partial dog skeleton.		2		hc
013	005	dog	hum	1	l	23				fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	tib	1	l	12	f			fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	rad	1	l	23				fb	Broken in 2. Probably part of partial dog skeleton.		2		hc
013	005	dog	rad	1	l	12	f			fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	ulna	1	r	23				fb	Broken in 2. Probably part of partial dog skeleton.		2		hc
013	005	dog	ulna	1	l	23				fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	isoteeth	1	r						Canine. Maxilla. Probably part of partial dog skeleton.	90			hc
013	005	dog	isoteeth	1	l						Canine. Maxilla. Probably part of partial dog skeleton.	90			hc
013	005	dog	isoteeth	1	l						Canine. Mandible. Probably part of partial dog skeleton.	90			hc

Context	*Sample*	*Species*	*Element*	*NISP*	*Side*	*Gt50*	*Proxfus*	*Distfus*	*Modifications*	*Admin*	*Notes*	*Percent*	*Texture*	*Burning*	*Recovery*
013	005	dog	isoteeth	1	l						M1. Mandible. Probably part of partial dog skeleton.	90			hc
013	005	dog	isoteeth	1	l					fb	p4. Maxilla. Probably part of partial dog skeleton.	70			hc
013	005	dog	mand	1	l	3				fb	M2 present. Broken in 2. Probably part of partial dog skeleton.	50	2		hc
013	005	dog	mand	1	l	1				fb	P3, P2, small canine present, loose. Probably part of partial dog skeleton.	30	2		hc
013	005	dog	cerv	4	b		f	f			Probably part of partial dog skeleton.	90	2		hc
013	005	dog	mand	2	l					fb	Probably part of partial dog skeleton.	10	2		hc
013	005	dog	ax	1	b		f	f		fb	Broken in 3. Probably part of partial dog skeleton.	90	2		hc
013	005	dog	at	1	b		f	f		fb	Broken in 2. Probably part of partial dog skeleton.	90	2		hc
013	005	dog	skull	21						fb	Probably part of partial dog skeleton.	10	2		hc
013	005	dog	hum	1	l	12	f			fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	phal	8			f	f			Probably part of partial dog skeleton.	90	2		hc
013	005	dog	m/p	2		123	f	f			Probably part of partial dog skeleton.		2		hc
013	005	dog	m/p	8		23		f		fb	Probably part of partial dog skeleton.	50	2		hc
013	005	dog	m/p	4		13	f			fb	Probably part of partial dog skeleton.	50	2		hc
013	005	dog	hum	1	l	4		f		fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	pel	1	l	2				fb	Probably part of partial dog skeleton.	30	2		hc
013	005	mm2	sha	7						fb	Probably part of partial dog skeleton.		3		hc
013	005	mm2	isoteeth	4						fb	Tooth fragments. Probably part of partial dog skeleton.	10			hc
013	005	mm2	ui	25						fb	Probably part of partial dog skeleton.		2		hc
013	005	dog	isoteeth	1	r						i3. Maxilla. Probably part of partial dog skeleton.	90			hc
013	005	dog	isoteeth	1							Incisor, probably mandible, worn. Probably part of partial dog skeleton.	90			hc
013	005	dog	mand	1	r	123					All teeth present except for M3. Probably part of partial dog skeleton.		2		hc
013	005	dog	calc	1	l					fb	Probably part of partial dog skeleton.	90	2		hc
013	005	dog	calc	1	r		f	f		fb	Probably part of partial dog skeleton.	90	2		hc
013	005	unid	ui	360							Probably the majority of the fragments come from the partial dog skeleton.				hc
013	005	dog	carp/tars	7							Probably part of partial dog skeleton.	90	2		hc
013	005	dog	ui	2						fb	Probably part of partial dog skeleton.		2		hc
013	006	unid	ui	4						fb			3		hc

Table 8 – Complete list of animal bones

Key to complete list of animal bones:

Species
cow = cattle
lm = large mammal
mm2 = medium mammal carnivore
unid = unidentified

Elements
Mammals:
astr = astragalus
at = atlas
ax = axis
bac = baculum
calc = calcaneum
carp / tars = carpals/tarsals
cerv = cervical vertebrae
fem = femur
hum = humerus
isoteeth = isolated teeth
mand = mandible
m/p = metapodial
pel = pelvis
phal = phalanx
rad = radius
rad/uln = radioulna
scap = scapula
sha = shaft
thor = thoracic vertebrae
tib = tibia
unid = unidentified mammal
vert = vertebra

Side
r = right
l = left
b = both

GT50
For mammal and bird diagnostic zones, the York System (Harland et al. 2003) follows the Environmental Archaeology Unit's (EAU) recording protocol (Dobney, Jaques and Johnstone 1999) with minor re-coding.

Fusing proximal and distal
f = fused
u = unfused
fs = fusing

Admin
fb = fresh brekage

Texture
1 = excellent
2 = good
3 = fair
4 = poor

Recovery
hc = hand-picked
1 = sieved with 1 mm sieve

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Appendix 9: The osteological remains from Mullamast, Co. Kildare (E2973)
By: Carmelita Troy MA

Summary

This document is submitted as a report of the post-excavation treatment and analysis of cremated human bone and unidentified burnt bone retrieved from Mullamast, Co. Kildare E2973. Full archaeological resolution confirmed the presence of a ring-ditch and the remains of a corn drying kiln (O'Connell and Hackett 2009a).

This site revealed four fills of a ring-ditch which contained Iron Age cremated human bone in the form of probable 'token' deposits. The total weight of cremated human bone from this site is 66.3 g. The cremated bone was moderately efficient, with evidence of temperatures of over 800°C to allow for the full oxidisation of over 70% of the bone present in the sample.

Introduction

This document is submitted as a report on the osteological analysis of cremated human bone recovered during archaeological excavations at Mullamast, E2973, under the direction of Liam Hackett of Headland Archaeology Ltd. The cremation deposits from this site consist of bone from three deposits (013, 014, 015 and 016) of ring-ditch (011).

Site E2973 was located in the town land of Mullamast, approximately 1.5 km southwest of Ballitore village and *c.* 200 m west of a tertiary road that leads northward to Peelhall Crossroads. Two monuments are depicted in the Record of Monuments and Places within 850 m of this site (Figure 2). These are an enclosure site (KD036-044) and a 19th century landscaping feature (KD036-045). To the east a prehistoric inhumation cemetery (E2980) (Hackett 2009) was excavated as part of the same road project as well as a multi-period site (E2972) (O'Connell and Hackett 2009b), where a number of corn drying kilns were located. This site (E2973) was situated in a grass field on a very gently rising slope near the eastern summit of Mullamast Hill with a height of 130 m OD overlooking lowlands to the east with extensive views of the foothills of the Wicklow Mountains (O'Connell and Hackett 2009a)

Methodology

Processing
All contexts containing a considerable amount of human bone were carefully wet-sieved through a sieve bank of 10 mm, 5 mm and 2 mm mesh sizes, under the supervision of a qualified osteologist. However there were some samples that were processed through a floatation tank because of the small amount of cremated bone that was believed to be in them. Any grave goods, pyre debris and charcoal recovered during this process were retained for examination by the appropriate specialist.

The cleaned bone was dried and bagged according to mesh size, and packed in museum standard boxes prior to analysis.

Analysis

Following procedures laid down by McKinley (1994b; 2004), and Gejvall (1969), the remains from each burial were assessed for:

- Weight
- Degree of fragmentation
- Skeletal elements
- Demographic data - sex, age, minimum number of individuals
- Pathology data
- Efficiency of cremation

Results

In all, four possible cremation deposits were fully excavated, see Table 1 below.

Context No.	Sample No.	Description
013	005, 006	Secondary fill of ring-ditch (011)
014	008	Tertiary fill of ring-ditch (011)
015	009	Fill of ring-ditch (011)
016	010	Fill of ring-ditch (011)

Table 1 – Samples for cremation analysis

The sub-circular ring-ditch (011) had a 9.75 m external diameter and measured between 6.5 m and 7.25 m internally. The ditch was 1.5 m - 1.9 m wide and 0.8 m deep with gradually sloping sides to a depth of 0.2 m at which point they became steeper, and a predominately flat base. The interface between the three upper fills of the ring-ditch was not always clear, suggesting that they were deposited in relatively quick succession to each other. The first of these was the secondary fill (013) which consisted of compact light brown silty clay with frequent small to medium sized compacted sub-rounded and sub-angular stones that were particularly concentrated in the western portion of the ditch. This deposit contained occasional unburnt animal bones (Sample E2973:005-006); a high concentration of these were located in the southern portion of the ring-ditch. This deposit yielded ten chert and two flint fragments (E2973:013:001-012). The tertiary fill (014); moderately compact dark brown silty clay with occasional to moderate charcoal fleck and occasional burnt bone fleck inclusions (Sample E2973:008). Next in sequence was a compact deposit of mid- to dark brown gravelly silty clay with moderate charcoal fleck inclusions (015). Burnt bone flecks were identified and retrieved from this fill (Sample E2973:009). A lens of charcoal was evident towards the base of this deposit. The upper fill (016) of the ring-ditch was a moderately compact dark grey to black silty clay with moderate charcoal fleck inclusions and very occasional burnt bone fragments (Sample E2973:010) (O'Connell and Hackett 2009a).

Identification and quantification of cremated bone

In order to validate the presence of human material, identification of particular elements of the human body is important. Certain elements may have been purposefully selected following cremation. The absence of some elements, especially those that are smaller, may be due to the lack of their survival as a result of fragmentation during the cremation process, utilisation for different purposes or post-depositional preservation conditions.

The table below summarises the results of the quantification analysis:

Context No.	Total Weight of Cremated Bone (g)	Total Weight of Identifiable Human Fragments (g)	% of Identifiable Human Bone
013	11.2	3.3	29.5
014	2.0	2.0	100
015	37.0	5.7	15.4
016	16.1	0.3	1.9
Total	**66.3**	**11.3**	**17.0**

Table 2 – Summary of the quantification analysis

McKinley (1993) found that modern cremation processes resulted in the production of between 1227.4 g and 3001.3 g of bone. From this she inferred that the cremation of a whole body and deposition of the remains in an archaeological context would realistically produce between 57 g to 2200 g (McKinley 1997, 139) of cremated human bone. Therefore there were four possible partial (token) cremation deposits from Mullamast.

All 11.3 g of identifiable human elements from the three deposits were skull fragments.

Bone fragmentation

The assessment of bone fragmentation is necessary to indicate whether deliberate post-cremation processes were being utilised and give a better understanding into the pyre technology. The quality of the overall analysis is determined on the degree of fragmentation of the cremated bone. After the cremation deposit is wet-sieved through a flotation tank, bone fragmentation is assessed by processing the cremation deposit into three sieve fractions (10 mm, 5 mm, 2 mm) and comparing the proportion of bone in each fraction (McKinley 2004). Measurement of the maximum bone fragment was also recorded from each context.

Figure 1 below summarises the results of the quantification of cremated bone present by sieve fraction weight and percentage of total weight:

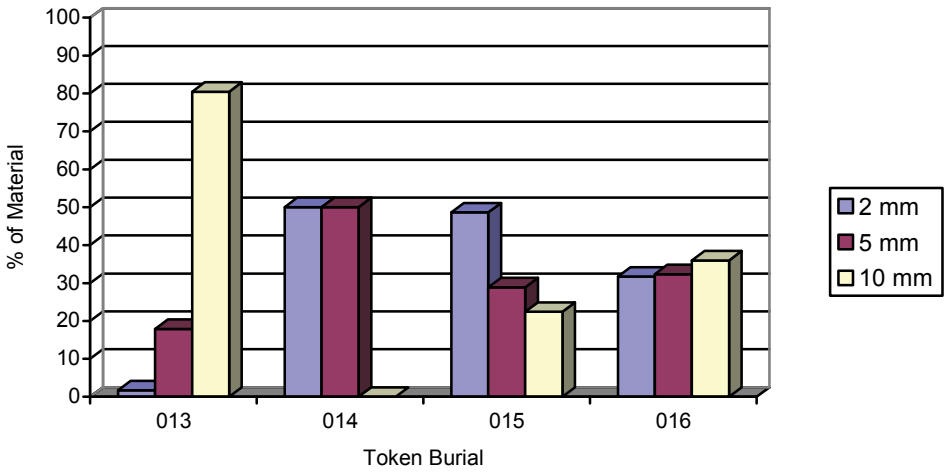

Figure 1 – Summary of cremated bone present from possible token burials by sieve fraction weight and percentage of total weight

These results indicate that 65.2% of the cremated bone recovered from all of the deposits was less than 10 mm in size. In comparison to other cremated bone collections, the Mullamast result is within the norm, which averages to approximately 70%. This indicates that there was moderate preservation and

the average maximum fragment size was 19.66 mm (30.48 mm being the maximum), only a small percentage of the bone present was of this size. The vast majority of the bone, however, was rounded and indicated that the degree of bone fragmentation observed may have been present at the time of deposition. This may, therefore, have been the result of the cremation processed employed.

Efficiency of the cremation

Levels of oxidation indicate pyre efficiency. This is understood chiefly through the colouration of the bone, on a scale from charred (black) to completely burnt (white). Pyre temperatures of 400°C or less are believed to only be enough to blacken the bone, as the temperature increases to 600°C more of the organic component of bone burns away leaving the bone a grey-blue colour. At 700 to 800°C the bone becomes white and forms a disordered chalky structure, and burns totally at 1000°C, although the mineral component has a melting point of 1645°C (Walker and Miller 2005). The average temperature of cremations ranges from 1000 to 1100°C (McKinley 2006). The extent of the burning or oxidisation of the bone represents the relative success of the cremation processed applied and contemporary knowledge of pyre technology.

Walker and Miller (2005) report that generally, the range of colours (black, blue, grey and white – Plate 1) seen in burnt bone relates to the temperature to which the bone was exposed as seen in Table 3 below:

Colour	**Temperature**
Brown/Orange	Unburnt
Black	Charred (*c*.400°C)
Blue/Grey	Incompletely Oxidised (*c*.500-700°C)
White	Completely Oxidised (>800°C)

Table 3 – Range of colours in burnt bone related to the temperature

Plate 1 – Range of colours of cremated bone – black, blue, grey and white

Patterns of warping and cracking on cremated remains provide information on the state of bone at the time of cremation. Dry or defleshed bones form a 'check' pattern of horizontal and vertical cracks. Bones which have been burned while fleshed, however, form a characteristic pattern of disorganized cracking and warping (Buikstra and Ubelaker, 1994, 96). The patterns of warping present in the assemblage indicate that the bone was fleshed when it was cremated; suggesting that the cremations

were a primary burial rite and were not employed secondary to exposure or excarnation of the remains.

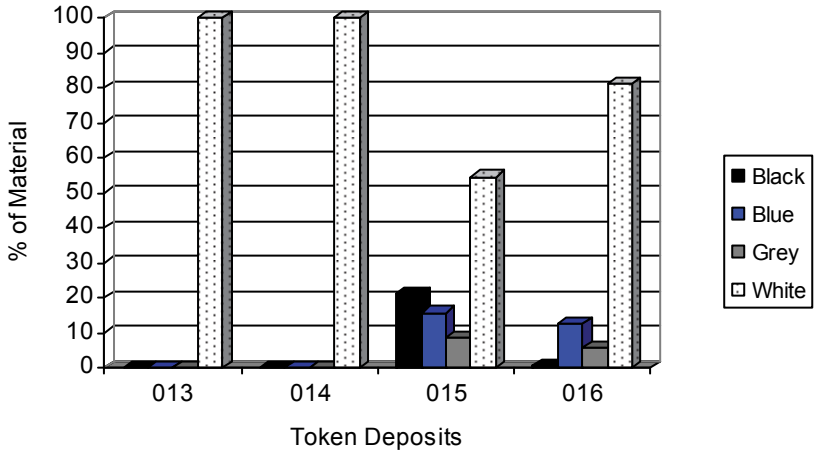

Figure 2 – Percentage of colour of cremated bone in each token burial

Figure 2 displays the percentage of colour of cremated bone in each cremation deposit and indicates that all of the deposits contained bone that had been fully oxidised which was achieved by being exposed to a adequate temperature (i.e. above 800°C), with an sufficient amount of oxidisation for a sustained amount of time to completely burn the bone. There was a small amount of bone (29.9%) that was not completely oxidised (>800°C) (Figure 2). The presence of blue/grey bone amongst completely oxidised bone was also found in the Mullamast burials. This was usually present along the internal surface (cancellous bone) of long bones. This may indicate that this bone was exposed to high enough temperatures to oxidise the outside of the bone (or cortical bone) but not for long enough for the internal surface of the bone to oxidise (Murray and Rose 1993). Figure 2 implies that the majority of the regions of the skeleton were completely burnt while a small portion did not quite reach the optimum temperature.

Dating

A sample of bone, weighing 2 g, was taken from one cremation sample and sent to SUERC, Scotland. The results in Table 4 indicate that the burials date to the Iron Age.

Lab Code	Context ID	Material	δ13C	Radiocarbon age BP	Calibrated Age Ranges (95.4%)	Relative probability	Period
SUERC-25467	c.014 s.008	Cremated bone	-25.8	2145 ± 50	360-40 cal. BC	95.4%	Iron Age

Table 4 – Radiocarbon dates

Discussion

The Iron Age 'token' cremation deposits (013, 014, 015 and 016) were located within the fills of the enclosing ditch of a ring ditch (011). The term ring ditch refers to a regularly-shaped circular or pennanular ditch cut. The two commonest monument types represented by ring ditches are roundhouses (where the 'ditch' is actually a foundation slot or eaves drip gully) and ring barrows. There were no internal or external features found associated with this ring-ditch. It appears that the ring-ditch from Mullamast (E2973) once represented a ring-barrow. A ring-barrow is a circular burial mound of earth, surrounded by a ditch with an external bank, constructed between the Neolithic and the Iron Age (O'Kelly 1989, 205). Human remains are often found in the centre of these monuments. Cremation seem to have been the exclusive rite and individual mounds were used over a period of time, perhaps as family or tribal burial place (Ó Cróinín 2005, 172). This form of monument is likely to have fulfilled a sepulchral, ceremonial or ritual function. Many elements similar to those in the latter part of the Bronze Age occur in the burials of the Iron Age. These include ring-ditches; the dominance of cremation and the presence of token burials ooccasionally in peripheral contexts (Cooney and Grogan 1999, 199), and the frequent reuse of individual sites.

At a number of ring-barrows, deposits of cremated bone have been found in ditches. The enclosing ditches of ring-barrows at Grannagh (Waddell 2000, 367) and Oranbeg (Rynne 1970) in Co. Galway contained deposits of cremated bone. Also, deposits of cremated bone were found in the fill of the ditch enclosing Tumulus 8 in the ring-barrow cemetery excavated at Carrowjames, Co. Mayo (O'Kelly 1989, 331). Ardsallagh 2, Co. Meath (Clarke and Carlin 2006) revealed a small concentration of cremated bone above the primary fill of its ring-ditch. Also on this road scheme, cremated bone deposits were present in the fill of ring-ditches from Burtown Little, Co. Kildare E2989 (Iron Age; Moloney 2009), Ballyvass, Co. Kildare E2996 (Iron Age; Doyle 2009) and Mullamast, Co. Kildare E2857 (Early/Middle Bronze Age; Stephenson 2009). This repeating pattern of the deposition of cremated remains in the surrounding ditches is revealing, not only in relation to the treatment of human remains in later prehistory but also for the use of these monuments. The inhumation cemetery of Moone, Co. Kildare E2980 (Hackett 2009), and a number of recorded sites within the townland of Mullamast indicate that this area was a focus for prehistoric funerary activity; these include three barrows (KD036-009; KD036-011; KD036-014) and two barrow sites (KD036-012; KD036-013), one of which contained a cist burial (KD036-01201).

Cremated bone from ditch deposits has sometimes been construed as 'dumped' material. It is possible, however, that this was a deliberate ritual act. It is clear that intricate post-cremation rituals were carried out, at least in both the processing and the deposition of the bones. Given the complex nature of the expression of these rituals in archaeological terms, it would be very conceited to assume that cremated human bone recovered from ditches simply represents a random disposal of waste (Lynch and O'Donnell 2007, 110).

Cremation deposits (013, 014, 015 and 016) from Mullamast ranged in bone quantity from 2 to 37 g. According to McKinley (1997, 139), the cremation of a whole body and deposition of the remains in an archaeological context would realistically produce between 57 g to 2200 g bone. Therefore it is likely that these deposits represent partial burials, also known as token deposits. Token burials make their first appearance in the Middle Bronze Age (Cooney and Grogan 1999, 129). Token burials are cremations that have been described as consisting of small, minute or token quantities. Most known burials were placed within or associated with a circular ring-ditch or barrow (Cooney and Grogan 1999, 145). According to Cooney and Grogan (1999, 136) the token and comminuted nature of the cremations is a representation of the individual in burial. These characteristics of the burial itself also suggest that other portions of the cremated bone may have been used at different stages in an

extended mortuary ritual where much of the ceremonial emphasis may have been placed on the cremation, funeral and burial rather than on just what was placed in the grave.

The only identifiable human element from Mullamast was skull fragments. It could be argued that skulls were the largest and therefore most visually striking of the human bones. The skull could also have been viewed as carrying the essence of an individual and may therefore have warranted special care after death to ensure general good fortune, such as the fertility of people and crops.

Little is really known of methods used to recover cremated bone from a pyre site for burial only that rarely, if ever, was all the bone included. Ethnographic sources record how bone may be 'scraped' together into a pit or covered by a mound (McKinley 1994a). Many fragments had clearly broken along fracture lines during the burning process and subsequently during the depositional period. Bone in pyre cremations will obviously fissure as it is rendered brittle, especially whilst hot. Bone may break as the pyre structure collapses in the later stages of the cremation or if the pyre was tended to any degree, e.g. reinstating bones which had fallen out of the main body of the pyre or slight stirring late in the process to re-oxygenate the pyre. McKinley (1994a) notes that fragment sizes observed in cremation reports can only be taken to represent the post-excavation size, not necessarily the size of deposited fragments. Fragment sizes are affected both by mode of burial and post-depositional disturbances. McKinley (1994a) states that the additional post-depositional protection offered to the bone by placing it in an urn resulted in larger recorded fragment sizes compared to those from an undisturbed unurned cremation.

Characteristic dehydration such as horizontal, longitudinal and 'U'-shaped fissuring was demonstrated on the bone. This indicates a number of factors. Firstly it seems likely that when the body was burnt there was still flesh and particularly fat attached to the bone, as opposed to the burning of defleshed (excarnated) bones. In a modern crematorium, when the body reaches a temperature of 800°C the fat in the body ignites and, essentially, the body then burns so fiercely that the gas jets may be switched off (Mays 1998; McKinley 1994b). The splitting on the bones from Mullamast indicates intense burning such as this and over two thirds of the sample was fully oxidised (white colouration) indicating the individual/s was/were moderately cremated. The bones from the cremation had been subjected to a fairly marked degree of cracking, twisting and warping. In addition, many cranial fragments had warped, causing the inner and outer tables to separate. These occurrences again indicate that a high temperature was achieved during firing (McSweeney 2005). Ubelaker (1978) suggests that marked warping can be indicative of bone being burnt while still 'fresh', i.e. soon after death. This suggestion, however, is difficult to support in an archaeological context.

Conclusions

The fills of the Iron Age ring ditch contained small quantities of cremated human bone which may represent a partial burial deposit with a funerary monument. Few formal burial sites are known from this period and it has been suggested that burial ritual took on a less formal tradition. It is now believed in Great Britain that the dead of this period were disposed mainly by excarnation and the scattering of cremated remains (Haselgrove 1999, 123), could be an explanation for the few Irish Iron Age burials.

The bodies from Mullamast, which were certainly fresh at the time of cremation, appear to have been expertly cremated. There is also evidence of meticulous collection of the bones. The cremations recovered from this site indicate that although general osteological analysis is limited on these types

of human skeletal remains, the validity of their study is unquestionable because of the invaluable information the bones may yield.

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Catalogue of cremated human bone

Ring-ditch (011)

Efficiency of cremation:

Fill	Cut	Sample No.	Total Weight (g)	Black % (g)	Blue % (g)	Grey % (g)	White % (g)	Identifiable Element
013	011	005, 006	11.2	-	-	-	100 (11.2)	Skull (3.3 g)
014	011	008	2.0	-	-	-	100 (2.0)	Skull (2.0 g)
015	011	009	37.0	21.1 (7.8)	15.7 (5.8)	8.6 (3.2)	54.6 (20.2)	Skull (5.7 g)
016	011	010	16.1	0.6 (0.1)	12.4 (2)	5.6 (0.9)	81.4 (13.1)	Skull (0.3 g)
		Total	**66.3**	**11.9 (7.9)**	**11.8 (7.8)**	**6.2 (4.1)**	**70.1 (46.5)**	**Skull (11.3 g)**

Bone Fragmentation:

Fill	Cut	Sample No.	Total Weight (g)	10 mm Fraction (g)	5 mm Fraction (g)	2 mm Fraction (g)	Max. Fragment Size (mm)
013	011	005, 006	11.2	9.0	2.0	0.2	30.48
014	011	008	2.0	-	1.0	1.0	7.84
015	011	009	37.0	8.3	10.7	18.0	22.31
016	011	010	16.1	5.8	5.2	5.1	18.02
		Total	**66.3**	**23.1**	**18.9**	**24.3**	**22.31**

Radiocarbon Dates

Lab Code	Sample ID	Material	δ13C	Radiocarbon age BP	Calibrated Age Ranges (1σ)	Relative probability	Calibrated Age Ranges (2σ)	Relative probability	Period
SUERC-25467	c.014 s.008	Cremated bone	-25.8	2145 ± 50	350-290 cal. BC 230-220 cal. BC 210-90 cal. BC	19.8% 1.3% 47.1%	360-40 cal. BC	95.4%	Iron Age

Appendix 10 – Radiocarbon dates and Certificates for Site E2973

E-Number	SUERC-No.	Lab code	Sample ID	Material	δ13C	Radiocarbon age BP	Calibrated Age Ranges (1 σ)	Relative probability	Calibrated Age Ranges (2 σ)	Relative probability
E2973	SUERC - 25484	GU - 19470	sample #003, context 005	charred bread wheat grains	-22.2	1635 +/- 50	cal AD 340 - 460	46.4	cal AD 250 - 300	5.2
							cal AD 480 - 540	21.8	cal AD 320 - 550	90.2
E2973	SUERC - 25467	GU - 19359	sample #008, context 014	cremated human bone	-25.8	2145 +/- 50	350 - 290 cal BC	19.8	360 - 40 cal BC	95.4
							230 - 220 cal BC	1.3		
							210 - 90 cal BC	47.1		

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RADIOCARBON DATING CERTIFICATE

2 October 2009

Laboratory Code	SUERC-25484 (GU-19470)
Submitter	Karen Stewart Headland Archaeology (Ireland) Ltd. Unit 1 Wallingstown Business Park Little Island Co. Cork, Ireland.
Site Reference	KCK06 E2973
Context Reference	5
Sample Reference	3
Material	charred grain : bread wheat
$\delta^{13}C$ relative to VPDB	-22.2 ‰
Radiocarbon Age BP	1635 ± 50

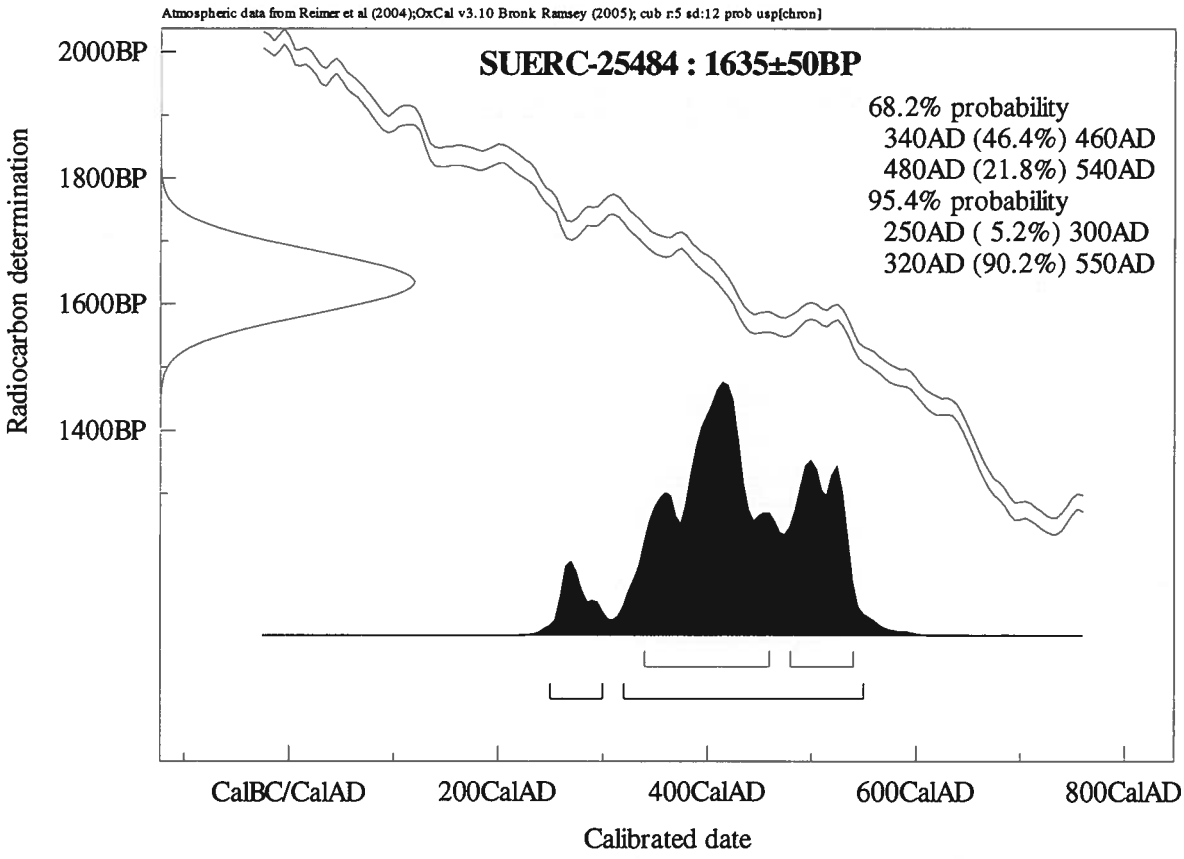
N.B.

1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).
3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or Telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 02/10/09

Checked and signed off by :- E. Dunbar Date :- 02/10/09

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

2 October 2009

Laboratory Code	SUERC-25467 (GU-19359)
Submitter	Carmelita Troy Headland Archaeology (Ireland) Ltd Unit 1 Wallinstown Business Park Little Island, Co. Cork Ireland
Site Reference	Mullamast E2973
Context Reference	014
Sample Reference	008
Material	Cremated bone : Human
$\delta^{13}C$ relative to VPDB	-25.8 ‰
Radiocarbon Age BP	2145 ± 50

N.B.

1. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

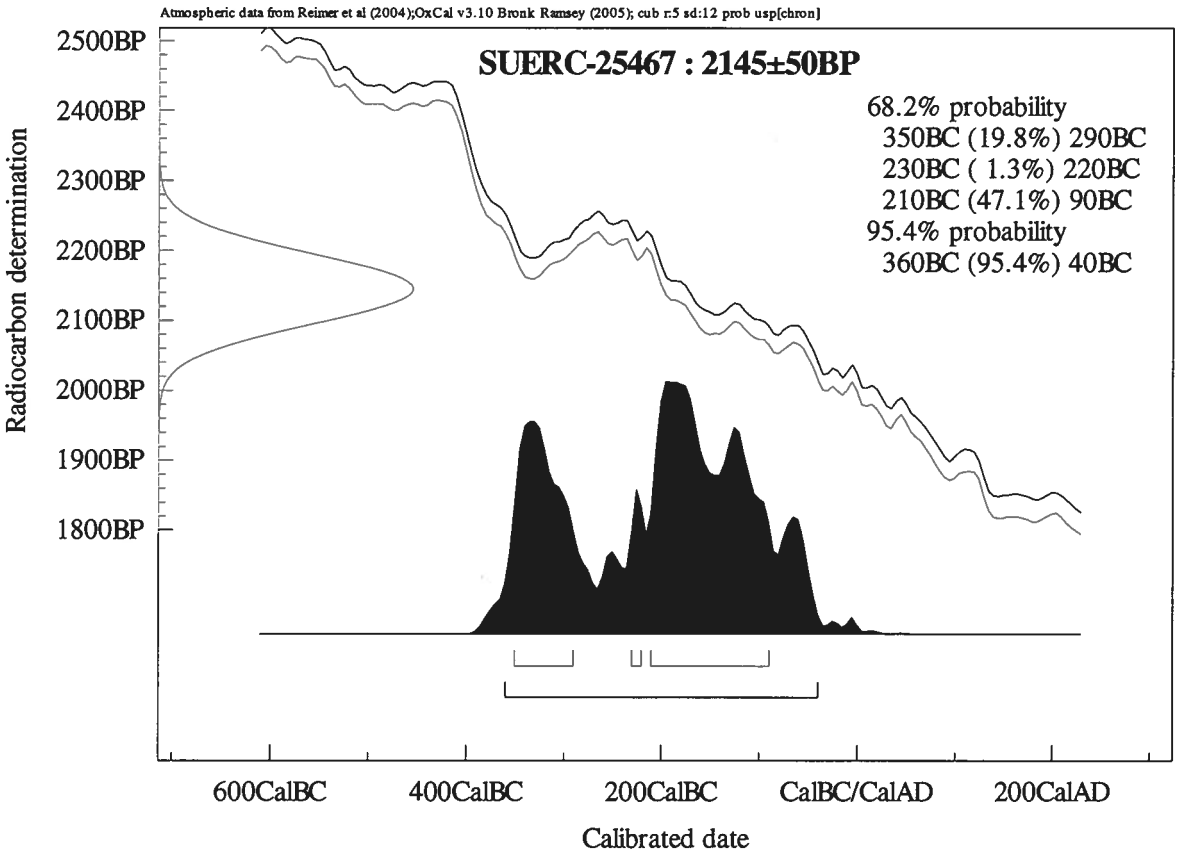
2. The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal3).

3. Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or Telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 2/10/09

Checked and signed off by :- G. Dunbar Date :- 02/10/09

Calibration Plot



Appendix 11 – The lithic assemblage from Mullamast, Co. Kildare (E2973)
By: Maria Soledad Mallia-Guest

Introduction

A total of 12 lithic finds were recovered during archaeological resolution of site E2973 (Mullamast, Co Kildare). The site consisted of a sub-circular ring ditch and a corn-drying kiln with the lithic finds being recovered from the secondary fill of the former (O'Connell and Hackett 2009). No additional finds were recovered on site.

Methodology

A macroscopic analysis of the components was carried out based upon a techno-typological approach following categories developed by Inizan *et al.* (1999). Further contextual background is provided by Woodman *et al*. (2006).

The artefacts were visually examined with the aid of an 8x hand lens, recorded and catalogued using Microsoft Excel 2003. No minimum size criterion was applied for artefact discard; therefore, any other lithic material that may have been retrieved during sample processing was incorporated to contribute to the assemblage integrity. The variables recorded include: overall metric attributes (length, width and thickness); type of raw material; fragmentation; and artefact condition to determine if post-depositional, manufacture or use-damage was present.

In addition, when macroscopic evidence of use-wear was present, subsequent basic high-power micro-wear analysis was carried out using a reflective microscope at 200x magnification. The presence/absence of use traces such as micro-polish, motion striation and edge-scarring/rounding were also recorded.

The Assemblage

A total of twelve finds (Table 1) were recovered on site E2973 in the townland of Moone (Co. Kildare). Only three examples (E2873:013:001, 002 and 011) can be classified as possible core fragments pieces and debitage while the remaining number is considered of non-archaeological significance. The finds are in rather fair to poor condition exhibiting weathered surfaces as well as cortication. The assemblage comprises two fine grained dark blackish grey chert pieces and a single weathered light grey flake also likely to be of a chert/silicified limestone variety. All the finds can be classified as debitage, this is un-retouched knapping by-products.

Debitage
The finds were retrieved from a light brown silty clay secondary deposit (013) of a ring ditch (011) which comprised frequent small to medium sized sub-round and angular pebbles.

All the finds are small, measuring less than 30 mm in length. Finds E2973:013:001 and 002 can be further classed as indeterminate chunks, presenting a random pattern of extraction scars on both surfaces, some of them could be suggestive of bipolar reduction technique. The single flint find E2973:013:011 appears to be a primary flake exhibiting a broad plain platform with no further diagnostic attributes recorded.

Natural chunks
A total of eight angular and sub-angular pebbles (E2973:013:002 -010 and E2973:013:012) with a size range between 16 and 64 mm (coarse and very coarse gravel on Wentworth scale) showed no evidence of intentional modification and were classified as non-archaeological demanding no further analysis.

Discussion

The knapped lithic assemblage retrieved at site E2973 (Mullamast, Co. Kildare) appears to be dominated by debitage pieces and sub-angular pebbles of no archaeological significance. None of the finds retrieved are typologically or chronologically diagnostic, and are possible residual material derived from an expedient primary reduction of chert nodules.

Bipolar technique which consists of placing the nodule to reduce on a stationary anvil (Whittaker 1994) becomes increasingly frequent from Middle Neolithic and well through Late Bronze Age (O'Hare 2005) and is particularly dominant in late prehistoric times. This technique facilitates the efficient reduction of small-sized nodules in order to obtain usable flakes or also as part of a rather expedient lithic strategy.

Chert has a widespread distribution over the Irish landscape as it is associated with limestone deposits of Carboniferous date. The Carlow/Kildare area is dominated by sedimentary lithologies, including sandstone, conglomerate, bioclastic and massive limestone, mudstone and shale (GSI 2007). The chert examples here described are similar in appearance to a dark variety of banded chert certainly present in the Midlands commonly known as 'Festooned' or 'Derravaragh' chert (Mitchell 1972, Little 2008, Warren *et al* 2009) which has been recorded in several sites along the N9/N10 road scheme such as E2873 in the townland of Ballymount and at site E2867 in Inchaquire (Co. Kildare) (Mallia-Guest 2009 a, b). Nevertheless, the macroscopic similarity does not rule out the possibility of these examples having been obtained from local sources.

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NMI Number	Raw Material	Category	Type	Length (mm)	Width (mm)	Thickness (mm)	State	Condition	others	Cortex	Retouch	Blank	Ripples	Comments	Colour
E2973:013:001	Chert	Debitage	Indeterminate chunk	29.6	29.1	13.3	Fractured	Poor	Corticated and lustered	No	No	No	P	Indeterminate chunks? Exhibiting random pattern of extraction on both surfaces resembling bipolar reduction.	Light blackish grey with dark banding
E2973:013:002	Chert	Debitage	Indeterminate chunk	27.6	30.1	14.3	Fractured	Poor	Weathered	Yes-30%	No	No	P	Indeterminate chunk exhibiting intense cortication at one end and heavily weathered and slightly lustered surface. Extraction pattern suggests some kind of bipolar reduction.	Light blackish grey with dark banding
E2973:013:011	?Chert/ silicified limestone	Debitage	Primary flake	10.4	19.4	5.2	Complete	Poor	Weathered	Yes	No	No	D	Primary flake exhibiting cortication and lustre,platform is broad and plain. Diffuse ripples of percussion. Undiagnostic	Light greyish white

Key: P: pronounced, D: diffuse
Table 1 – Lithic assemblage from Mullamast, Co. Kildare (E2973)