1371

Archaeological Excavation in Advance of the Extension of the Dolbenmaen Water Treatment Works and Dolbenmaen to Cwmystradllyn Water Pipeline

Final Excavation Report

Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

Archaeological Excavation in Advance of the Extension of the Dolbenmaen Water Treatment Works and Dolbenmaen to Cwmystradllyn Water Pipeline

Final Excavation Report

Project No. G2231 and G2293

Report No. 1371

Prepared for: Black & Veatch Limited

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Cover photograph: Iron Age enclosure ditch around probable settlement (PRN 62618)

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01	Final pollen report added and summary text up-dated where necessary		
02	Corrections following comments from GAPS		

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Project Codes: G2231 and G2293

Report 1371

1 SUMMARY

Gwynedd Archaeological Trust (GAT) was commissioned by Black & Veatch Limited on behalf of Dŵr Cymru Welsh Water (DCWW) to undertake a programme of archaeological work prior to, and during, the development of Dolbenmaen Water Treatment Works (WTW), Dolbenmaen (centred on SH49634290) and during the groundworks for a pipeline between the Dolbenmaen WTW and the Cwmystradllyn WTW (SH54714286).

The work at Dolbenmaen WTW was undertaken between May and August 2013 and consisted of a watching brief during the enabling works, monitoring all topsoil removal within the development area; as well as a controlled strip of a significant part of the area, leading to detailed excavations. The pipeline works were undertaken between February and July 2014 and consisted of targeted trial trenching, a series of watching briefs, and a phase of controlled stripping and evaluation.

Numerous features were recorded along the pipeline route but most of these were ditches, field boundaries and drains of post medieval date with some pits of unknown date. Two sites were of particular significance. These were a burnt mound dating to the late Neolithic (SH5280542328, PRN 62636) and an Iron Age enclosed settlement (SH5012243093, PRN 62618), just clipped by the working corridor. The excavations at the Dolbenmaen Water Treatment Works revealed a small medieval settlement or farmstead (SH4986043022, PRN 62644*) dating to the 12th and 13th centuries AD with use into the 15th century, which was set within a probably contemporary field system (centred on SH5001043006, PRN* 62645*). This settlement seems to have been preceded by an early medieval settlement (SH4988043016, PRN* 62642*) of which relatively little survived except for the postholes of a four-poster granary and a corn drier out in the fields.*

Two ring gullies (PRNs 62646 and 62647*) interpreted during excavation as the ring ditches round Bronze Age barrows were shown to probably not be barrow ditches and most probably were circular gullies around haystacks or similar storage areas and associated with the medieval settlement.*

Two small pits (PRN 62640 *and* 62641*, SH5008843006 and SH4992742938) filled with burnt stone proved on radiocarbon dating to be early Neolithic earth ovens representing traces of temporary settlement near the river.*

The features discovered therefore cover a wide range of periods and present a new understanding of the occupation of this area, particularly filling in some periods, such as the very early Neolithic and early medieval periods for which evidence is often rare.

Pollen analysis provided a background for this activity showing how the vegetation of the area had changed. Traces of Neolithic farming could be seen at isolated sites down the valley but the pollen indicated that considerable areas of woodland survived through into the medieval period and the alder carr of the valley bottoms was present into recent times. The development of the current acid heathlands and bogs could be seen resulting from clearance and soil depletion due to agriculture from the Iron Age onwards.

2 INTRODUCTION

Gwynedd Archaeological Trust (GAT) was commissioned by Black & Veatch Limited on behalf of Dŵr Cymru Welsh Water (DCWW) to undertake a programme of archaeological work prior to, and during, the development of Dolbenmaen Water Treatment Works (WTW), Dolbenmaen (centred on SH 4963 4290) and during the groundworks for the pipeline transfer scheme between the Dolbenmaen WTW and the Cwmystradllyn WTW (SH 5471 4286) (Figure 1).

The work at Dolbenmaen WTW was undertaken between May and August 2013 and consisted of a watching brief during the enabling works, monitoring all topsoil removal within the development area; as well as a controlled strip of a significant part of the area, leading to detailed excavations.

The pipeline works were undertaken between February and July 2014 and consisted of targeted trial trenching, a series of watching briefs, and a phase of controlled stripping and evaluation.

Project designs were prepared for each phase of work and are included in the appendices.

The project was carried out in accordance with the *Management of Archaeological Projects 2* (MAP 2, English Heritage 1991) and the Institute for Archaeology (IfA) *Standards and Guidance* (IfA 2008a, b, c and 2001). Five stages are specified:

- Phase 1: Project planning
- Phase 2: Fieldwork
- Phase 3: Assessment of potential for analysis
- Phase 4: Analysis and report preparation
- Phase 5: Dissemination

This report has been produced as **Phase 4: Analysis and report preparation,** and has been used to produce reports for publication as part of **Phase 5.**

3 SITE LOCATION

The Dolbenmaen WTW is located to the west of the village of Dolbenmaen (Figure 1). The land used for the extension of the works had consisted of a series of fields of improved pasture lying to the southeast of the steep cliffs of Craig y Llan and the rising ground of Bryniau Ystumcegid to the south. The development area was bounded to the north and west by roads, to the south by the Afon Dwyfor, and by fields of improved pasture to the east.

The transfer pipeline route runs between the Dolbenmaen WTW (SH 4986 4926) and Cwmystradllyn WTW (SH 5471 4286) (Figure 1), and measures *c*.5km in length. The pipeline route starts at the Dolbenmaen WTW and runs eastwards for 300m across an open field before turning south for 80m and crossing the Afon Dwyfor. It continues south-westwards for 560m, then runs parallel to the south side of the A487 trunk road for 190m, where it then crosses this road and follows the route of a local road for 550m. Continuing east for 720m it crosses a series of irregular fields before turning south-east for 780m, and then continuing north-east for a further 1.87km to terminate at the Cwmystradllyn WTW. The final *c.*2km of the pipeline route is located within the Snowdonia National Park.

Along the western part of the pipe route the fields are characteristically floodplain pasture land, generally enclosed by *cloddiau* (stone-faced earth banks). Where the route follows the Afon Henwy the land is boggy in character with no good pasture, the area, however is still enclosed with *cloddiau*. Beyond Ynys Pandy the route begins to climb and passes through enclosed upland pasture to reach Cwmystradllyn WTW at approximately 195m OD.

The geology of the area consists of glacial till over Ordovician extrusive rocks to the southwest and alluvium over undifferentiated Llanvirn Rocks (mudstone, siltstone, and sandstone) to the north-east (British Geological Survey 1982 and Geology of Britain website).

4 ARCHAEOLOGICAL BACKGROUND

See Figure 1 for location of archaeological sites.

4.1 Prehistoric sites

The route of the water main lies within a rich archaeological landscape with extensive archaeological evidence from many periods. Evidence of prehistoric activity and settlement occurs along the whole length of the route. The only Neolithic sites or finds in the area are a burial chamber known as Coetan Arthur or Ystum-Cegid Burial Chamber (PRN 157, SH 4989 4132), north of Ystumcegid Isaf and a polished stone axe found near Bryncir Old Hall (PRN 2366, SH 5230 4360).

Approximately 700m west-south-west of the Dolbenmaen WTW stands the probable Bronze Age standing stone of Beudy Cil-Haul (PRN 192, SH 5078 4240). The stone is described as an elongated glacial boulder approximately 1.8m high and 0.8m square. A prehistoric burnt mound known as Glan-Dwyfach (PRN 154, SH 4815 4400) is located on the eastern bank of the Afon Dwyfor. The assessment of the pipe route also identified two probable burnt mounds near Corsoer (PRN 62613, SH 5130 4267) (Richards and Smith 2013, 20). At the eastern end of the pipeline is a Bronze Age standing stone (PRN 2360, SH 5495 4297) at Meini Hirion, approximately 190m south-east of the Cwmystradllyn WTW. The Bronze Age may also be represented by a cairn on Gyrn Goch, which appears to be the denuded remains of a burial cairn (PRN 190, SH 5033 4406). A cremation urn was found in the mid-19th century near Llwyn-y-Mafon-Isaf (PRN 2377, SH 5200 4120).

The Dolbenmaen WTW is surrounded by Iron Age or Roman period roundhouse settlements. To the north is the enclosed hut group west of Ty Newydd (PRN 145, SH 4994 4345), comprising a partially robbed-out rectangular stone building and two hollows representing round huts. To the northeast is the stone-built hut circle of Craig y Llan (PRN

172, SH 5041 4351), and close to the modern St. David's church of Garndolbenmaen are the remains of another hut circle (PRN 150, SH 4999 4387), where the hut is terraced into the hill slope.

To the southeast of the WTW, on the southern bank of the Dwyfor, are two hut groups, the closest being two heavily robbed circular huts (PRN 170, SH 5019 4276). Further east is the Craig-y-Tyddyn hillfort (PRN 164, SH 5059 4272) with the adjacent enclosed hut group of Craig-y-Tyddyn (PRN 165, SH 5052 4280). The latter site includes the slight remains of an enclosure wall around two roundhouses. Further south is the Ystumcegid-uchaf hut circle (PRN 160, SH 4981 4234). Towards the eastern end of the route are the hut circles at Cil Drygwr (PRN 166, SH 5359 4301) and Cae Du (PRN 168, SH 5294 4309), to the west of the Cwmystradllyn WTW. There are numerous roundhouse settlements on the higher ground to the south-east of the Cwmystradllyn WTW (PRN 167, 1335, 2368, and 2381), and yet more further east on the hills around Llyn Cwmystradllyn.

4.2 Roman sites

A Roman copper cake has been found at Clenenney (PRN 2357, SH 5320 4246), approximately 320m north of the proposed route, near the confluence of the Dwyfor and Henwy. A number of such cakes have been found throughout Gwynedd.

The current A487 road may follow the line of the Segontium – Pen Llystyn – Tomen y Mur Roman road (general PRN 17553). This route is discussed in detail in GAT Report 572 (Hopewell 2005) as a route connecting Segontium with the fort at Pen Llystyn and a bathhouse at Tremadog (*ibid.* 12). Roman Road Section PRN 17558 is postulated to run along the route of the current A487 from the northwest as far as the junction with the local road to Garndolbenmaen; section PRN 17559 is postulated to run from the north via the local road through Garndolbenmaen and then the local road through Dolbenmaen to then continue southeast along the A487; section PRN 17821 is postulated to run across open fields to the northwest as far as the junction with the local road to Dolbenmaen, where it then continues along the current A487 route to the southeast, on the same alignment as section PRN 17559. There are currently no traces of Roman road construction along any of these sections.

The nearest confirmed Roman site is Pen Llystyn fort (PRN 144) approximately 2.3km to the north-west.

4.3 Medieval

The only early medieval site previously in the HER is an inscribed stone (PRN 189, SH 5402 4170) found near Gesail Gyfarch. Its inscription has been dated to possibly the 6th century AD. Though it has been suggested that the small hillfort of Castell Caerau, Gyrn Goch (PRN 163, SH 5090 4392) may date to the post-Roman period. However Dolbenmaen is mentioned in the Mabinogion (Jones and Jones, 59) and it is possible that the small natural knoll known as Pen Bryn yr Orsedd (PRN 61895, SH 49893 43099), which is situated directly to the north of the Dolbenmaen WTW and within the same field, may have served as an assembly mound for the retinue of a peripatetic early medieval court. This possibility is discussed below, and could indicate that the location was of considerable importance in the early medieval period.

The western-most part of the area studied lies within the medieval centre of Dolbenmaen in the commote of Eifionydd, and formed part of the medieval township of Dolbenmaen (PRN 7341). The current village core is to the east of the Dolbenmaen WTW. North of the A487 is a stone built rectangular hut platform (PRN 188, SH 5023 4360), that is listed as being prehistoric but its rectangular form makes a medieval date more likely. There are two other hut platforms near Craig y Llan (PRN 184, SH 5042 4353) and (PRN 187, SH 5089 4345). Cefn y Fan Hall, Bryniau'r Tyddyn (PRN 159, SH 5057 4208), to the south of the river, is a ruined medieval hall said to have been burnt by Owain Glyndwr in 1403.

Dolbenmaen motte (PRN 161 (SAM CN063), SH 5065 4307) is located to the south of Dolbenmaen. The castle mound and ditch stand on a low ridge running parallel to the river Dwyfor at a fordable crossing point on an important route way. The motte’s early history is unclear and it may either be Welsh or Norman built. The possible site of a bailey, if one existed, is now covered by farm buildings and Plas Dolbenmaen, and may be the location of the royal llys (court), later a manor. The parish church of St Mary (PRN 2367, SH 50670 43149) dates to the 15th century, although much rebuilt.

Progressing eastwards along the pipeline route, approximately 450m north of the hamlet of Ynys Pandy, is the Clenennau house and barn (PRN 158, SH 5316 4246). The house is believed to be medieval in date. Further upstream on the Afon Henwy there are medieval hut platforms at Cil Drygwr (PRN 182, SH 5370 4294), approximately 550m north of the proposed alignment. Approximately 850m east of Ynys Pandy is the medieval settlement remains at Gesail Gyfarch (PRN 181, SH 5415 4192 centred). The settlement contains at least six long houses and associated agricultural remains. Amongst the roundhouse settlements on the higher ground to the south-east of the Cwmystradllyn WTW there are also rectangular house platforms and long huts (PRN 183, 1334, 1336, 6009, 6010, 6011, 6726 and 6727).

Two long huts and a possibly medieval enclosure (PRN 5609, 6733 and 6742) can be found to the north-west of Cwmystradllyn WTW. Further from the pipeline on the slopes of Craig y Garn was a bloomery furnace of probable medieval date (PRN 162, SH 5156 4432), located not far from a group of platform houses (PRN 6012) and remains of a possibly medieval field system (PRN 5027 and 6008).

4.4 Post-Medieval and Modern

An Exchequer survey dated 1589-90 shows that the boundary of the township of Dolbenmaen was almost exactly the same as the parish as given of the Tithe Map of 1838 (Gresham 1973). The development area is recorded by the 17th century as being part of a farm known as Tyddyn Rhwng y Ddwyryd.

In 1637 the lands were demised to John Griffith of Cefn Amlwch by his father-in-law Sir Richard Trevor, by which time, or shortly after, the lands were purchased from the Crown. John Griffith’s heir and brother sold the township in 1719 to Williams Brynker, son of James Brynker of Brynkir. A rental of 1721 includes the farm of Plas Dolbenmaen, which is the earliest found reference of the farm under this name. William ran into financial problems, and the lands with the exception of Dolwgan, were sold to William Owen of Clenennau and Brogyntyn in 1736, and so passed by marriage to the Ormesby (later Ormesby-Gore) family (Davidson and Evans 2011).

Plas Dolbenmaen (PRN 5257, SH 5068 4307) dates to between the 16th and 18th centuries. Tax returns from 1662 shows it to be one of only two houses in the district with two hearths. The First Edition Ordnance Survey records the buildings as the Dolbenmaen Castle public house. The building itself is an early 18th century L-plan building of stone rubble walls under a slate roof framed by tall gable end chimney stacks. The principal elevation is to the northeast and is a two storey four bay front. There are a range of associated outbuildings including a stable, a byre, and a washhouse.

4.5 Previous Work

The staged programme of works carried out by GAT in advance of the extension of the existing Dolbenmaen WTW included an archaeological assessment (Smith 2012), an archaeological watching brief during geotechnical investigation works (Smith 2013), and a series of archaeological trial trenches targeting anomalies identified during the geophysical survey (McNicol 2013).

A geophysical survey, using a magnetometer, was completed by Stratascan in February 2013 (Smalley 2013). The survey covered an area of 8.4ha incorporating the main Water Treatment Works site within the central field and two ancillary zones. Approximately 20 linear and curvilinear anomalies, along with a number of positive and negative anomalies were identified across the site.

In advance of the work on the pipeline route an archaeological assessment was carried out by GAT (Richards and Smith 2013) and also on the Cwmystradllyn WTW (Richards 2012). A geophysical survey, using a magnetometer, was completed by Stratascan in February 2014 (Prestidge 2014) along the route of the proposed pipeline route. The survey covered an area of approximately 16.2ha consisting of a 30m corridor along the 5.42km route of the pipeline. Some areas of the route were unsurveyable due to protruding rocky outcrops. A number of features of possible archaeological origin were identified, predominately towards the western end of the pipeline route. These included a number of linear and curvilinear cut features along with evidence of ploughed out embankments and earthworks. Trial trenching was carried out by GAT to investigate some of the identified features and the results of that work have been incorporated into the present report.

5 Aims and Objectives

The original aim of the programme of work was to identify any archaeological remains revealed prior to the construction works and other groundworks. Appropriate mitigation measures were developed for all archaeological remains revealed.

The purpose of post-excavation work is to ensure appropriate analyses are undertaken, that site records are studied, compiled and that a coherent report on the results is produced with appropriate illustrations. It also involves ensuring that site records, both paper and digital are in a format suitable for long term storage.

The original aims of the archaeological work were to:-

- verify the efficacy of the geophysical survey for identifying archaeological remains within the site;
- establish the extent to which archaeological remains survive at the site;

- establish the date and nature of archaeological remains at the site and assess their implications for understanding the historical development of the area;
- establish the depth of archaeological remains and the quality, value and level of preservation of any deposits;
- and assess the level of risk any surviving remains may pose to development

6 METHODOLOGY

6.1 Fieldwork Methodology

6.1.1 Pipeline route

6.1.1.1 Trial Trenching

The archaeological trial trenching targeted anomalies identified in the magnetometer survey and features seen on the Lidar data. All of the trenches were located within the working areas of the scheme and varied in shape and dimensions (tailored to the targeted features) (Figure 2).

All the trenches were excavated using plant with a toothless, flat, ditching bucket under constant direction by an archaeologist. The trenches were accurately located with a Trimble R6 GPS system.

Each trench was excavated until archaeological deposits were identified or the underlying natural deposits are encountered. Where deep alluvial or colluvial deposits were encountered the trench was not excavated beyond the proposed depth of the pipe trench. All identified features within the trenches were cleaned by hand and partially excavated to attempt to determine date and function.

See appendix III for details of deposits recorded in each trench.

6.1.1.2 Controlled Stripping

An archaeological controlled strip was carried out for the following construction stages (see Figures 3 and 4 for locations):

- the topsoil stripping within the compounds and at all turning points;
- the 13.8m wide topsoil strip within the easement;
- the 4.8m wide transfer pipeline trench down to the archaeological horizon;
- the directional drilling zone to cross Afon Dwyfor;
- and the 50mm Dolbenmaen village branch pipeline, from Dolbenmaen WTW as far as the A487 crossing point

6.1.1.3 Watching Brief

An archaeological watching brief was maintained for the following construction stages:

- the 50mm branch pipeline along Dolbenmaen village road;
- the crossing of the A487 road;
- all instances of minor intrusive works, including 5 pipeline cross connections that will connect the transfer main to existing smaller diameter branch pipes, replacing the existing set up for the 18” main.

6.1.1.4 Auger Survey and Coring

The whole of the pipeline route was walked and the ground probed at all locations where peat deposits potentially occurred. All locations where the soft sediments were established at over 0.4m depth were flagged for subsequent hand augering, all areas where the probe hit underlying stones or clays in less than 0.4m were ignored and the probing survey moved on.

After the whole route had been surveyed a total of eleven areas had been flagged for hand augering. At each of these locations a series of auger holes were made generally at 5 or 6m intervals (except Transect 11 where auger holes were up to 100m apart) and the deposits recorded. After hand augering a selection of locations was made for core sampling. All hand auger points and core samples were surveyed in using a GPS.

Seven of the eleven transects were chosen for core sampling. Core sampling was undertaken using a 110mm diameter plastic earth pipe cut down to the size appropriate for that core. The pipe was driven by hand vertically into the soft peats for the full depth recorded during the auger survey. A slot was then dug on one side of the pipe and the pipe removed with the core intact inside it. Each 110mm core tube was cut open to expose the core within. This was cleaned, described and logged and photographed. A radiocarbon sample was taken from suitable material near the base of each sequence. The radiocarbon samples were submitted to the Radiocarbon Laboratory at the Scottish Universities Environmental Research Centre (SUERC) for dating.

Samples for pollen analysis were taken at 4cm intervals through each core, bagged, labelled and stored in a fridge. The cores were then wrapped in cling film to seal them for storage. Pollen analysis was carried out according to the methodology in appendix XI.

6.1.2 Dolbenmaen WTW

The WTW site was located across three irregular shaped enclosed fields:

- the main WTW area within the central field (39,110m^2)
- Zone A (6,890m^2) - main site compound;
- Zone B (6,055m^2) - main soil storage area.

For location of these areas see Figure 5.

The groundworks were completed in two main stages:

- Stage 1 – enabling works: including the establishment of the main site compound in Zone A and the soil storage area in Zone B, as well as the removal of topsoil across the entire site.

- Stage 2 – main works: the construction of the water treatment works and associated landscaping, which includes two earth bunds.

The archaeological mitigation included:

- An archaeological watching brief of Stage 1 enabling works, monitoring all topsoil removal within the development zone.
- An archaeological controlled strip of the main WTW area prior to Stage 2.
- An archaeological controlled strip of Zone B prior to Stage 2.

6.1.3 Fieldwork procedures

All works were carried out in accordance with the Project Design for the works (appendices I, II and XIII) and the GAT standard operating procedures as set out in the GAT fieldwork Manual (*in prep)*).

All groundbreaking was undertaken using a 360º tracked excavator with a toothless, flat, ditching bucket under constant archaeological supervision. All archaeological features encountered were hand excavated. Where appropriate features were half sectioned in order to record the stratigraphy and then excavated in full. All sections were drawn at a scale of 1:10.

A written record of all identified features was completed using standard GAT pro-forma sheets and a running photographic record was maintained using a Nikon digital SLR camera set to maximum resolution. All features were digitally surveyed using a Trimble TSC2 controlled GPS receiver (Trimble R6 Unit), with the results tied into the National Grid. Hand drawn plans were produced at a scale of 1:20 where appropriate and also tied into the National Grid.

Bulk soil samples (a minimum of 10 litres and maximum of 40 litres) were taken for flotation of charred plant remains. These bulk samples were taken from all probably prehistoric contexts containing charcoal and/or finds to allow the recovery of both charred plant remains and small artefacts not easily recovered by hand. At the Dolbenmaen WTW several pits were identified on site as potential cremation burials and these were fully excavated by hand and a 100% sample or as near as possible was taken from each.

Sections were drawn by hand generally to a scale of 1:10. Planning was done using a survey quality Trimble Global Positioning System (GPS). Where considerable detail was to be recorded, especially stones forming part of a feature photographs were taken using a digital camera providing overlapping frames across the full area to be recorded. A number of control points on the ground were digitally surveyed using the Trimble GPS receiver so that the results could be accurately scaled and tied into the National Grid. The photographs were converted to JPEGs (2mb maximum size) and used to produce a 3D model using photogrammetry software program Agisoft PhotoScan. An orthomosaic was produced of a vertical view of the area and this was imported into AutoCAD and details were traced from it to produce the detailed plan.

In the case of features 1602 and 1678 at Dolbenmaen WTW no detailed plan was produced on site because the features were considered of fairly low significance. These features were reinterpreted during post excavation work and plans were produced from the site photographs, taken as general record shots not specifically for this purpose. The photographs were combined in Agisoft PhotoScan and orthomosaics were produced and scaled rather approximately using outlines of the features surveyed by GPS. These plans are not as accurate as if the photographs had been taken specifically for this purpose and points had been surveyed in to georeferenced them in Agisoft PhotoScan.

6.2 Post Excavation Methodology

The site records have been scanned for security and where appropriate databases or spreadsheets have been created of the site registers. A database of the site photographs has been produced to enable active long-term curation of the photographs and easy searching. The site records have been checked and cross-referenced and photographs, plans, finds, and samples have been cross-referenced to contexts. The field drawings have been combined with the survey data to produce plans and appropriate sections have been drawn up for the report.

All paper field records have been scanned to provide a backup digital copy. The photographs have been organised and precisely cross-referenced to the digital photographic record so that the Royal Commission of Ancient and Historical Monuments of Wales can curate them in their active digital storage facility.

The finds have been catalogued and grouped by material type. All finds, where appropriate, have been cleaned. All finds have been packaged in suitable containers and conditions for long-term storage. Conservation has been carried out where necessary. The finds have been assessed by specialists to describe and catalogue the collections and identify pieces to be drawn and any requirement for further study. Insignificant items recommended for discard have also been identified.

Assessment of potential reports have been written for the Dolbenmaen WTW and the pipeline (McNicol 2015a and b) itemising what had been found and identifying further work required. The specialist work carried out for the assessment of potential reports has also been included in the relevant appendices of this report. The further specialist work was carried out and has been included in this final report and has been incorporated into the discussion and interpretation of the various sites. The current report brings together both the Dolbenmaen WTW and pipeline work into a single report.

A database of sites has been created to allow easy entry of sites on to the Gwynedd Historic Environment Record (HER). All significant sites have been allocated Primary Record Numbers (PRNs), but insignificant isolated and late features have not necessarily been given separate PRNs.

6.2.1 Discard policy

Most of the pottery recovered from this project dates to the post-medieval period. This is a small and scattered assemblage and of very low archaeological potential. It was therefore proposed that the post medieval pottery should be discarded, but as the numbers are so low it will be retained.

All the glass fragments recovered date to the post-medieval period, are of very low archaeological potential and have been discarded.

Three of the stone objects (SF1, 2, and 3) from Dolbenmaen WTW were deemed to be natural and have been discarded.

All other finds have been retained and will be deposited in Storiel, Gwynedd Museum and Art Gallery, Bangor. The accession number for these finds is 2017/2.

7 QUANTIFICATION OF RESULTS

7.1 Dolbenmaen WTW (G2293)

Field records

Context sheets	231
Drawings	85 drawings on 11 sheets
Digital photographs	455

Environmental Samples

Samples containing burnt bone: 14 x 10 litre tubs from 10 contexts
Total Samples: 102 x 10 litre tubs from 58 contexts

Finds

Stone	5
Cu Object	1
Burnt Bone	>19
Slag	>1
Pottery	2
Glass	1
Fe Objects	2
Total	**>31**

7.2 Dolbenmaen to Cwmystradllyn Pipeline (G2231)

Field records

Context sheets	359
Drawings	58 drawings on 14 sheets
Digital photographs	1179

Environmental Samples

Total Samples: 41 x 10 litre tubs from 26 contexts

Finds

Stone	8
Metal	3
Pottery	7
Total	**18**

For detailed lists of finds see appendices IV and XV.

8 Fieldwork Results

8.1 Dolbenmaen to Cwmystradllyn Pipeline (G2231)

8.1.1 Introduction

This section provides a summary of the results of the archaeological work along the route of the pipeline. A total of 98 features were recorded, dating from the prehistoric to modern period, along with 63 upstanding post-medieval field boundaries (Figure 2) (see appendix VI for basic descriptions of each field boundary).

The majority of the features uncovered were concentrated in three areas: Field 1, Field 9, and Field 39, with the remaining features spread out throughout the site (see Figure 6 for field locations). These are discussed by area below. For a detailed description of all the features and deposits uncovered during the archaeological works see appendix V.

A total of 20 archaeological trial trenches were excavated across the site (Figure 2) specifically located to target anomalies shown up by the geophysical survey. Only eight features were uncovered within the trial trenches, and these will be discussed below along with the other features uncovered during the controlled stripping. See appendix III for descriptions of deposits found in the trial trenches.

A controlled topsoil strip was to be carried out on a c.13.8m wide strip of the entire length of the easement route, along with the three compound areas. However, during the works this changed to a wider strip of land (*c.*18-21.8m wide) along the majority of the easement route (Figure 3).

A controlled strip down to the archaeological horizon was carried out on a *c.*4.8m wide strip of land along the entire length pipeline route as well as the within the footprint for the directional drilling works. This was changed to a full width strip within a number of areas along the pipeline route during the groundworks (Figure 4).

A watching brief was maintained during the construction of the 50mm branch pipeline along the Dolbenmaen village road; the crossing of the A487 road; the construction of the transfer spurs connecting the main pipeline to existing, smaller branch pipelines; and the excavation of the pipe trench within areas of deep peat deposits where a controlled strip was not possible.

No features were uncovered during the various watching briefs undertaken throughout the scheme or during the topsoil stripping. However, archaeological features may still survive in areas which were undisturbed by the groundworks. The negative results on this element of the work are due to the following factors:-

- Topsoil stripping was unlikely to reveal archaeology as most features would be obscured below the topsoil.
- The watching briefs were on trenches only wide enough to insert the pipe and most of the areas monitored purely under a watching brief were sections of the route that ran along roads. These sections were monitored in this way due to the low probability of archaeology surviving here and the watching briefs confirmed that no significant archaeology was visible in the narrow trenches.

The controlled strip along the length of the pipeline, along with the further excavation areas, will be discussed together. The controlled strip covered a strip of land, between 5m and 22m wide, running for approximately 5km. The ground was a mix of upland pasture and the topography was mostly sloping, with some steeper slopes in places. The natural geology comprised of a light to mid brown sandy loam with large areas of gravels dispersed throughout. All features uncovered were cut into the natural geology and sealed by a layer of subsoil unless stated otherwise.

8.1.2 Field 1

At the western end of Field 1 a small circular pit (**01013**), measuring 0.65m in diameter and with a depth of 0.15m was uncovered (Figure 7). It was filled with a single greyish brown clayey silt deposit containing a large amount of stones (**01014**), suggesting that this may have been a deliberately dumped deposit. Directly to the east of this pit, a larger, sub-oval pit (**01015**) was uncovered measuring >2.35m by 2.6m. A large natural boulder was located within this feature and it is likely that the pit was created as an attempt to remove this stone, but upon failure to do so, the hole was backfilled with a deliberately dumped deposit of stones (**01016**).

Further to the east, a large curvilinear ditch (**01001**) was uncovered running in and out of the southern limit of excavation (Figures 7 and 8, Plate 1). The exact shape of the ditch is uncertain, however both ends appear to be curving round and the ditch may have enclosed a sub-circular or sub-rectangular area. The ditch had fairly steep sides with a concave, almost V-shaped base, and measured approximately 2.3m wide with a maximum depth of 1.38m. Four sections of the ditch were excavated (Figures 8, 11-14) which revealed it was filled with on average seven to eight deposits (Plate 2), the majority of which were most likely the result of natural silting. However three distinct episodes of possible deliberate backfilling were observed within all the sections. An initial stony deposit (**01018**, **01025**, **01047**, and **01066**) between 0.2 and 0.4m thick was located near the base of each ditch section. A further stone-rich deposit (**01002**, **01005**, **01045**, and **01062**), on average 0.38m thick, was located near the middle of the sequence of backfilling in each of the ditch sections excavated. Near the top of each of the ditch sections a final stony deposit (**01003**, **01004**, **01006**, and **01054**) was revealed, measuring on average 0.27m thick. Due to the high concentration of stones within these deposits it is likely that they represent three separate, but deliberate, backfilling events, or possibly erosion from a stone-faced bank.

A small, roughly square pit (**01069**) was revealed possibly truncating the outer edge of enclosure ditch **01001** (Figure 8). However both the upper fill of the pit (**01067**) and the deposit located at the edge of the ditch in this area consisted of a very similar greyish brown clayey silt deposit, and therefore the exact nature of their relationship is uncertain. The pit measured 0.95m by 0.86m, with a depth of 0.2m and was filled with two distinct deposits. The basal fill comprised of a charcoal-rich *in situ* burning deposit (**01068**) 0.07m thick. This was sealed by a 0.13m thick greyish brown clayey silt deposit (**01067**), most likely representing natural silting up of the pit after it had gone out of use.

A small fairly straight gully (**01070**), aligned roughly east-west, was uncovered running for approximately 5m alongside the northern side of enclosure ditch **01001** (Figure 8). The gully had fairly steep sides with a concave base and measured 0.65m in width with a maximum depth of 0.25m. It was filled with a single greyish brown sandy silt deposit (**01071**) and was truncated by a circular pit (**01053**) towards its eastern end. A similar gully (**01073**) was revealed continuing along on the same alignment from the western terminus of gully **01070**, and it may be that this represents a shallower and more heavily truncated continuation of the same feature. This gully measured between 0.2 and 0.5m in width with a maximum depth of 0.1m and ran for approximately 5.5m before petering out. Pit **01053** which truncated gully **01070** was circular in shape with a diameter of 1.1m and a depth of 0.45m. The main fill of this pit consisted of a dark brown silty sand deposit (**01052**), 0.45m thick. Two layers of re-deposited natural (**01050** and **01051**) were uncovered sealing this deposit at the southern edge of the pit.

Four postholes (**01017** (Figure 9), **01032**, **01040** (Figure 10), and **01042**) (Plates 3 and 4) were revealed towards the southern limit of the excavation area within the area enclosed by ditch **01001** (Figure 8). All four postholes were approximately 0.3m in diameter with a depth of between 0.25m and 0.39m, and were filled a mid-dark brownish grey stony clayey silt deposit (**01031**, **01033**, **01041**, and **01043** respectively). Given their similarity and proximity to each other it is likely that they are contemporary, and may indicate the presence of more archaeological activity close by within the unexcavated area directly to the south.

Modern pottery and glass fragments were found in the fill of pit **01053**, which might be intrusive or could indicate that this is a late feature. A tiny flake of burnt flint and fragments of burnt bone were recovered from the fills of ditch **01001** during wet sieving. The burnt bone is likely to be animal bone, and may indicate domestic waste was dumped in the ditch. A tiny eroded sherd of Samian ware (SF3) was found in the ploughsoil in trial trench 01, which cut across the ditch and internal area.

A further three features were uncovered in the area between ditch **01001** and the group of four postholes (Figure 8). However, upon excavation, two of these were shown to be the result of bioturbation (**01034** and **01038**), while the third (**01036**) was most likely a modern posthole due to its very loose fill (**01037**).

To the east of these features a straight ditch (**01010**) aligned north-north-east to south-south-west, was uncovered measuring approximately 1.3m in width and with a maximum depth of 0.27m (Figure 7). It was filled with a single dark reddish brown silty loam deposit (**01011/ 01012**), and most likely represents an old field boundary.

The ditch **01001** and related features were centred on SH5012243093 and have been allocated PRN 62618.

Towards the eastern end of Field 1 a further five pits and two ditches were uncovered during the archaeological works (Figure 15). Two of the pits (**01100** and **01107**) contained post-medieval material and were therefore not fully excavated. The remaining three pits were all roughly oval in shape and measured between 0.65m by 0.4m and 1.2m by 1.9m, with depths of between 0.13m and 0.4m. The fills of pits **01101** and **01102** were both very loose (**01108** and **01104** respectively) suggesting that they were fairly modern in date. Pit **01103** was filled with a single charcoal-rich deposit (**01105**), however, given its shallow nature (0.13m deep) and uneven base and edges it is possible that this feature represents a burnt out tree bowl. The two ditches (**01109** and **01111**) uncovered were both located within the pipeline spur excavation area within Field 1. Ditch **01109** measured 0.8m in width, with ditch **01109** measuring 1.14m wide, and both had an approximate depth of 0.14m. They were both filled with a single mottled greyish brown clayey silt deposit (**01110** and **01112** respectively). The ditches were straight, aligned approximately north-south and were located adjacent to each other. These ditches were not visible within the main area of Field 1 to the south, and it is likely that they either terminated or turned prior to this area.

A small flint end scraper was found in the ploughsoil in Field 1. This is probably Later Mesolithic or Early Neolithic in date, and cannot be directly related to any of the excavated features. This find has been allocated PRN 62670. Its find location was not accurately recorded so it can only be approximately located to Field 1 (about SH50194310).

The pits were centred on *c.*SH5026443080 and have been allocated PRN 62619. The ditches were centred on SH5030043115 and have been allocated PRN 62620.

8.1.3 Field 9

At the north-western end of Field 9 the remains of a small wall (**09032**), aligned north-west to south-east, were uncovered (Figure 16, Plate 5). The wall measured approximately 0.6m in width and was set within a shallow depression (**09031**). It appeared to turn to the north-east at its south-eastern end, however at this point a modern pit (**09029**) truncated the wall. A modern pit (**09034**) was also revealed truncating the north-western end of the shallow depression/cut (**09031**) which the wall sat within. A fragment of post-medieval pottery was recovered from the single fill of the depression, suggesting that the wall dates to this period.

Roughly on the same alignment as the wall, but possibly curving towards the west and south at its north-western and south-eastern ends respectively, a cobbled road (**09026**) was revealed running for approximately 27m. Large flat stones had been laid along both sides of the cobbled road to form the edges (Plate 6), although some of these had been removed, most likely by ploughing. The stones were sealed by a compacted gravel surface (**09025**) which was also visible along the outer edges of the road (Figure 16). Both ends of the road appear to have been truncated at some point, with the south-eastern end most likely the result of ploughing, whereas the north-eastern end was truncated by a modern water pipe and was also probably affected by ploughing within this area. A section in the middle of the road had also been truncated by a large modern pit (**09027**), which had been created as a stone dump when the field was cleared. A small concentration of stones (**09030**) was uncovered at the south-western end of the road and these may represent the heavily ploughed out remains of the road. However, no gravel surface was visible in this area, and they may purely be a natural concentration. Three iron horseshoes were recovered from beneath the cobbles, which suggests that the road dates to either the medieval or post-medieval period. Given the close proximity of the wall and the road, it is probable that they were contemporary, and given the post-medieval date of the wall, then it is most likely that the road also dates to this period.

Wall **09032** was centred on SH5092042819 and has been allocated PRN 62623. The road **09026** was centred on SH5093042810 and has been allocated PRN 62624.

A further 21 features were uncovered within this area during the archaeological works, however upon excavation five were revealed to be bioturbation (**09003**, **09005**, **09007**, **09023**, and **09050**), four to be the remains of furrows (**09047**, **09048**, **09049** and **09058**), one to be a stone hole (**09051**), and one to be a post-medieval stone dump (**09055**). The remaining features consisted of a probable post-medieval field boundary ditch (**09009**), two possible hedge banks (**09053** and **09057**), the collapsed remains of a wall (**09054**), two possible pits (**09019** and **09021**), and two post-medieval field drains (**09011** and **09041**).

Feature **09041** was probably a stone-filled drain, which continued the line of the cobbled trackway (**09026**) to the south-east. Feature **09011** was a fine stone-lined field drain or small culvert with side slabs and capping stones but no basal slabs. It was exposed for a length of 5m but must have run right across the easement. It was aligned north-east to south-west.

The two possible pits were located to the southeast of the cobbled road (**09026**), with pit **09019** consisting of a roughly square pit filled with a charcoal-rich deposit (**09020**) and showing signs of *in situ* burning. The pit was cut into the single dark reddish brown clayey silt fill (**09022**) of irregular-shaped feature **09021**. Given its irregular nature, and probably heat-affected fill, it is likely that this feature represents a natural depression which has had a small fire pit dug into it.

Ditch **09009** was located towards the south-eastern end of Field 9 and measured 2.8m in width with a depth of 0.1m. A thin greyish brown clayey silt deposit (**09018**) was located at the base and against the sides of the ditch. This was sealed by a light bluish grey sandy silt and gravel deposit (**09010**). Parallel to it was the remains of a possible hedgeline or bank (**09053**).

Lying about 27m south-east of **09009** was a linear dump of stones (**09054**), 2.2m wide and surviving for a length of 9m, which was probably the remains of a wall. The 1889 25 inch map shows a boundary that is almost certainly represented by **09054**. This was part of a small field that remained in use well into the 20th century. The map also shows a linear hollow, probably a disused manganese level running towards features **09009** and **09053**. It is possible that these were boundaries related to a trackway leading to the level.

Feature **09057** was a fairly straight linear feature seen over a length of 10m that was probably also the remains of a hedge bank. This ran north-north-west to south-south-east close to the southern end of field 9. Furrow **09058** ran nearly parallel to it.

The following features have been given PRNs, but the other more minor or natural features have not been given separate PRNs:-

PRN	Context numbers	Grid reference	Description
62625	09019 and 09021	SH5097042779	Pit cut into a natural hollow
62626	09011	SH5099842762	Stone-lined culvert
62627	09009 and 09053	SH5109242695 C	Ditch and bank
62628	09054	SH5111142678	Remains of field wall

8.1.4 Field 39

For location of features see Figure 18.

At the north-western end of Field 39 a rough stone platform (**39001**) was uncovered (Figure 19, Plate 7). It measured approximately 5.8m by 4.1m, and was constructed from a single layer of sub-rounded and sub-angular stones set randomly into the natural. Several large flat stones were carefully placed horizontally. Although there was no surviving kerb the north-western side in particular was quite well-defined. The exposed section appeared to be part of a linear feature running north-east to south-west and may have been part of a causeway across this rather boggy area.

The platform was located at SH5272242366 and has been allocated PRN 62634.

Three circular features (**39005**, **39011**, and **39014**) were uncovered to the east-south-east of the stone platform within Field 39. Pit **39005** measured 2.81m by 2.3m, with a depth of 0.76m and was filled with five naturally silted up deposits (**39006**-**10**). Features **39011** and **39014** measured approximately 1.8m and 1m in diameter respectively. A single fragment of post-medieval pottery was recovered from the upper fill of pit **39011**, a greyish brown clayey silt deposit (**39012**). This sealed a thin re-deposited natural layer (**39016**) located at the base of the pit. Feature **39014** was filled with a single greyish brown clayey silt deposit (**39013**), 0.18m thick, and was most likely the result of bioturbation rather than a manmade feature.

The pits were centred on SH5277742349 and have been allocated PRN 62635.

At the south-eastern end of Field 39 a curvilinear ditch (**39002**) was revealed running downhill from the south-south-east to the north-north-west, before turning north-east (Figure 20). A stone-filled field drain (**39004**) cut through this ditch, and ran along roughly the same line. Another stone-filled drain (**39021**) was uncovered running south-east to north-west in this area. A layer of stone (**39027**) seems to overlay and obscure the north-western end of drain **39021**. As ditch **39022** cuts the stone layer this shows that there were several phases of drainage in this area. The stone layer (**39027**) was only partially revealed as it continued outside the limits of the excavation, however, it measured at least 3.7m by 1.9m and was approximately 0.1m thick.

Drain **39021** cut through a burnt stone spread (**39015**), which was also partially sealed by the stone dump (**39027**). The burnt deposit measured approximately 2.7m by 2.1m, with an average thickness of 0.2m. It consisted of a black silty sand deposit with large amounts of heat-affected stones (Figures 20, 21 and 22). The lower part of this layer (**39034** and **39037**) was leached and grey with less charcoal than the upper part but still with numerous heat-cracked stones. Beneath the burnt deposit was preserved in places a buried soil up to 0.17m thick (**39030**/**39035**). The burnt deposit seems to have at least partly built up in a shallow hollow.

Features (**39017** and **39019**) were partially sealed by the burnt spread, and both were cut by the drain **39021**. Pit **39017** was sub-rectangular in shape, measuring 1.1m by 1.05m, and with a depth of 0.33m. It was filled with three distinct deposits; a greyish reddish brown clayey loam deposit (**39033**) located against its south-eastern side; a greyish brown silty clay deposit (**39018**) containing a quantity of burnt stone; and a loose brownish grey clayey silt deposit (**39032**) which most likely derived from burnt spread **39015**.

Feature **39019** was only partially excavated, and therefore its exact shape and size is uncertain. However, it measured at least 2.3m by 1.2m and was filled with three distinct fills (**39023**-**5**). It was up to 0.55m deep but with gradually sloping, rather irregular sides and appeared more like a hollow than a neatly dug pit. The basal fill (**39023**) consisted of a thin brownish grey silty sand deposit, containing large fragments of charcoal, most likely representing the initial silting up of the pit after digging. This was sealed by a 0.6m thick layer of dark brownish black clayey silt (**39024**) with frequent burnt stones and charcoal, most likely representing a deliberate dump. A light brownish grey sandy loam (**39025**) was visible sealing this deposit, representing the final silting up of the pit after it had gone out of use.

The burnt material with heat-cracked stones forming deposit **39015** and filling the features **39017** and **39019** is typical of burnt mounds and this feature certainly appears to be a burnt mound with at least one small pit (**39017**). Feature **39019** may also be a pit but insufficient was excavated to understand its form. There may have been other pits and fire sites under the parts of the mound that were not removed.

The burnt mound was located at SH5280542328 and has been allocated PRN 62636.

8.1.5 Rest of the Pipe Route

Within Field 4 a large organic peaty deposit (**04003**) containing natural pieces of timber was revealed (Figure 23, Plates 12 and 13). This deposit was also detected in evaluation trench 009, where it was only 0.1m deep and overlay grey clay. The auger survey (appendix X) picked up a deposit 0.37m deep of brown fine waterlain slightly organic silts, described as possible channel fills, so the depth of the channel was probably variable.

In the control strip a length of about 51m of the peaty deposit was exposed. Adjacent to the western edge of the peat deposit was a thin burnt spread deposit (**04004**), most likely representing a burnt out tree bowl.

The lidar data for this area shows a faint channel curving through the fields of which **04003** was clearly part. This is an infilled palaeochannel which indicates the river, or a braided channel of the river, running along a different course to the present channel. The route of the channel can still be seen on the ground surface as a wet area marked out by reeds. The shallow peat probably developed when the channel was largely infilled and no more than a boggy linear hollow. The wood was presumably from trees growing along the edge of this hollow which fell into the peat and were preserved. The grey clay seen in trench 009 was probably the main alluvial infill of the channel.

The palaeochannel was centred on SH5058142963 and has been allocated PRN 62621.

A stone trackway (**05001**) approximately 2m wide and aligned east-north-east to west-south-west was revealed within Field 5. The trackway was composed of a scatter of slate slabs and other stone running south-west to north-east (Plate 14). The stone spread was about 2m wide and exposed for a length of 13m. See Figure 23 for the location of the trackway. At its south-western end the trackway would have met a canalised stream or ditch. A roughly built drystone structure in the side of the ditch, including stone slabs up to 0.5m in length, has been interpreted as the collapsed remains of a bridge support (Plate 15). The stone of the track was present just underneath the topsoil, suggesting a late date, and the 25 inch OS maps from 1889 show a footpath crossing the stream at just this point.

The trackway was located at SH5071342913 and has been allocated PRN 62622.

In Field 11 an area of stones was exposed (**11004**), initially thought to be the fill of a pit (**11005**) but excavation showed that the stones were embedded in the natural and were just a collection of stones within the upper, altered part of the boulder clay. A feature adjacent to the area of stones was thought to be two pits (**11002** and **11003**) but both were joined and irregular and most likely to be part of an animal burrow, possibly disturbed by roots. See Figure 17 for the location of these features.

A linear spread of stones (**14001**) was uncovered within Field 14 running parallel to the main road (SH 51286 42567) (Plate 16). This may have been the heavily robbed out remains of a wall but was too far from the line of the old road to be a road side wall and was probably a fairly recent field clearance dump along the edge of the field.

A number of features were revealed within Field 15 (Figure 24), however upon excavation the majority of these features were shown to be either modern (**15003**, **15006**, **15012**, and **15013**) or natural (**15008**, **15010**, and **15011**). Feature (**15004**) was a possible posthole, which was circular in shape with a diameter of 0.5m and a depth of 0.14m. It was filled with a fairly loose stony greyish brown clayey silt (**15005**) and was located close to modern square posthole **15006**. The lack of any other features nearby, except for the modern posthole, along with the looseness of the fill, would suggest that this was a fairly modern feature as well.

Feature **15001** was a ditch up to 2.5m wide and 0.36m deep with a grey silty clay fill (**15002**). This ditch ran north-north-east to south-south-west and was presumably for agricultural drainage. It does not correspond to any field boundaries on the 25 inch OS maps.

Ditch **15001** was centred on SH5142942524 and has been allocated PRN 62629.

A single sinuous ditch (**18003**) was uncovered within Field 18 running southeast-northwest before curving round to the west and then curving back to the north-west (Figure 24). It measured approximately 1.4m in width with a depth of 0.37m and was filled with three distinct deposits (**18001**, **18002**, and **18006**). The basal fill consisted of a 0.13m thick gravelly silt (**18002**) which was sealed by a 0.08m thick layer of bluish grey clayey silt (**18001**). This was in turn sealed by a reddish brown silty clay (**18006**), 0.16m thick. The meandering nature of this ditch would suggest it was most likely used as a drainage ditch.

Ditch **18003** was centred on SH5159942519 and has been allocated PRN 62631.

In this field there was also a spring with a small stone structure over it (**18007**). This had a capstone supported by rough drystone walls and upright slabs (Plate 17). The capstone measured about 1.55m by 0.90m though part of it was obscured under the turf. The spring fed into the adjacent stream.

The spring was located at SH5154342518 and has been allocated PRN 62630.

A post-medieval stone trackway (**20001**) was uncovered within Field 20, running roughly south-west to north-east from the existing farm track through the field (Figure 24). The track was composed of stone, including some slate and other flat stones and was 3.5m to 4.0m wide (Plate 18). It was uncovered for a length of 43m and at its north-eastern end it led to a small bridge over a ditch. The bridge was constructed of 4 large slates (about 1.5m long) laid across the ditch (Plate 19).

The 1889 and 1900 25 inch OS maps show the track but it was out of use by 1915. The maps also show the small rectangular drystone structure close to the south-western end of the track (Plate 20). This is marked as a sheepfold.

The trackway **20001** was located at SH5167342521 and has been allocated PRN 62633, and the sheepfold was located at SH5165142521 and has been allocated PRN 62632.

Two low banks (20002 and 20003) were recorded running through field 20 (Figure 24). They were up to 0.6m wide high and 2.5m wide. They were made of silty earth but had occasional large stones and were covered in marshy vegetation.

A small sub-oval pit (**27002**), measuring 0.74m by 0.47m was uncovered within Field 27 (Figure 25). It had a depth of 0.11m and was filled by a single dark brownish black clayey silt deposit containing charcoal flecks (**27001**). No other features were located close by, and it is possible that this feature represents burnt out bioturbation.

Further to the west, two intercutting features (**27003** and **27005**) were revealed. Feature **27003** was irregular in shape, with uneven sides and base, and was most likely created by bioturbation. Pit **27005** was sub-rectangular in shape, measuring 2.65m by >0.77m and with a depth of 0.65m. It contained three distinct fills (**27010**, **27011**, and **27012**) and was shown to cut through the ploughsoil, dating it to the post-medieval period.

Two straight ditches (**29002** and **29004**) were revealed running parallel to, and either side of, field boundary **29** (Figure 25) which they are most likely related to and contemporary with. They measured 1.7m and 2.1m in width respectively with an average depth of 0.39m, and were filled with a single brownish grey clayey silt (**29001** and **29003** respectively).

A possible ditch (**32006**) was uncovered running along the edge of Field 32 and most likely related to the parallel field boundary wall. A post-medieval drain (**32004**) was also uncovered cutting through the subsoil and running roughly parallel to this ditch within this field.

Two post-medieval drainage ditches (**42001** and **42003**), running downhill from the south to the north were uncovered within Field 42 (Figure 18). These could be seen as depressions within the field to the south, and were shown to have come from the same ditch before splitting into two, just before entering Field 42. The line of the ditches through the fields was also indicated on the lidar data. Both ditches measured approximately 1.1m in width with a depth of 0.2m and contained a single dark brown peaty silt deposit (**42005** and **42004** respectively).

A small possible posthole (**42006**), measuring 0.46m by 0.38m, with a depth of 0.26m was uncovered to the west of these drainage ditches (Figure 18). It was filled with a greyish brown clayey silt deposit containing charcoal flecks (**42007**). No other features were uncovered within this area, and it is possible that this feature represents burnt-out bioturbation rather than a posthole.

Two post-medieval drainage ditches were uncovered within Fields 43 (**43001**) and 44 (**44003**) (Figure 18). The former ran parallel to a collapsed field wall removed during the works and the latter was a functioning drainage ditch. In Field 44 there was also a shallow curving ditch (**44001**) between 0.6m and 0.9m wide. This was the truncated base of a ditch of unknown, but possibly quite recent, date.

A spring (**45001**) was revealed within Field 45 with the remains of a collapsed structure around it (Figure 26, Plate 21). The stone structure included a very rough drystone wall and an upright slate slab. The spring flowed from the base of a field boundary bank into the adjacent stream. Two parallel straight ditches (**48004** and **48005**) were uncovered within Field 48, running south-east to north-west. Both ditches were approximately 1m in width. Ditch **48004** was 0.3m deep (prior to truncation during the controlled strip) and filled with a reddish brown silty sand deposit (**48003**), while ditch **48005** was 0.36m deep and filled with a light greyish brown silty clay deposit (**48006**). The ditches ran either side of a modern footpath. The footpath is shown on the 25 inch OS maps. On these it is unenclosed but the ditches may indicate that is was formerly enclosed or at least drained by the ditches. Ditch **45004** seems to be a continuation of a ditch shown to the north on the maps that presumably extended further south at an earlier date in the 19th century.

The spring **45001** was located at SH5304742101 and has been allocated PRN 62637, the parallel ditches (**48004** and **48005**) were centred on SH5326942147 and have been allocated PRN 62638.

At the south-western end of Field 50 (Figure 26), the foundations of a wall (**50001**) (Figure 27, Plate 22) were uncovered. The wall was aligned roughly east-west and ran for approximately 6m from the edge of the excavation area until it petered out to the east. It was 1m wide, with a maximum depth of 0.5m. The foundations were well-constructed, with large stones forming the faces and smaller stones in the core, and survived to up to 5 courses high (Figure 28).

The wall **50001** was located at SH5346042226 and has been allocated PRN 62639.

Towards the north-eastern end of this field, a modern dump of slate (**50002**) was revealed at the edge of the excavation area (Figure 29). Close to this, a slightly curving ditch (**50004**) was revealed, aligned north-east to south-west, and measuring 2.6m in width with a depth of 0.2m. It was filled with two distinct fills, a brown silty sand deposit (**50003**) located around the edges of the base, and a greyish brown silty clay (**50005**) which sealed this deposit. This ditch appeared to peter out towards the stream which marked the field boundary in this area. However ditch **51002**, located within the next field (Field 51), is on the same alignment and also peters out towards the stream, as well as to the north-east, and it is likely that these are the same ditch, but that the area around the stream has been more heavily truncated. As both these ditches run towards the stream, it is likely that they represent drainage ditches to allow water to run off into the stream. No other features, except for a post-medieval stone field drain (**51003**) were uncovered within Field 51. The field drain was stone-lined (Plate 23) and ran south-east to north-west from a derelict farm building, part of which is shown on the 25 inch OS maps from 1889 onwards.

A possible variant on a plano-convex knife (SF9) made on dark grey fine flint was found in the ploughsoil in Field 51. It has two sides trimmed by steep edge retouch to a broad point, and is highly polish as from being carried in a pouch or pocket. The knife is probably of a 2nd millennium date, but cannot be related to other features found in the field. This find has been allocated PRN 62671. Its find location was not accurately recorded so it can only be approximately located to Field 51 (about SH53834242).

Within Field 55, a shallow ditch (**55001**) aligned north-west to south-east was uncovered (Figure 29). It measured 1.4m in width, with a depth of 0.18m, and was filled with a single brown silty sand deposit (**55000**). This feature was seen in trench 19 where it was recorded as being filled with stones, and was considered to be a possibly trackway. The function of this feature is uncertain, however it is likely that it represents the remains of a field boundary. If so it pre-dates the later 19th century field system as it is on a different alignment and the 25 inch maps show no boundary in this location.

8.1.6 Field Boundaries

A total of 63 field boundaries were recorded on the site (Figure 2). These took a number of different forms, the most common of which were either a stone wall (**16-9**, **21**, **26-8**, **32-3**, **36**, **52**, **56-62**, and **64-5**) or a fence (**5**, **9**, **11-4**, **25**, **34**, and **42**), but also included banks (**29**, **37**, **39**, and **49**), hedgebanks, and ditches (**40**), or a combination of these (**2-4**, **6-8**, **10**, **15**, **20**, **22-4**, **31**, **35**, **38**, **41**, **43-8**, **50-1**, **53-5**, and **63**). The majority of these boundaries were partially removed within the working corridor area of the pipeline, and were replaced or rebuilt at the end of the job. The exception to this was field boundaries **02**, **03**, **06**, and **16**, which were left untouched. Descriptions of all the field boundaries can be seen in Appendix VI.

8.2 Dolbenmaen WTW (G2293)

8.2.1 Introduction

This section presents the results of the excavation at the Dolbenmaen Water Treatment Works (Figures 5 and 30). The results of the evaluation (McNicol 2013) and a further five features (**1677**, **1678**, **1681**, **66001**, and **66004**) which were uncovered in the area during the works associated with the Dolbenmaen to Cwmystradllyn pipeline (McNicol 2015b) have been integrated into this report. For a list of all the features and deposits uncovered during the archaeological works see Appendix XV.

8.2.2 Geology

With the exception of Zone A where only the topsoil was removed, the entire site was taken down to the natural geological deposits which consisted of light reddish brown sandy clay with patches of gravel throughout (**1501**). The natural topography sloped generally downhill north to south or west to east, from approximately 96m AOD in the north-west to 89.5m AOD in the south-east. Patches of lower ploughsoil were visible across the site, ranging from 0.1m to 0.3m thick, and consisting of greyish brown sandy silt (**1507**). This was sealed by a dark greyish brown sandy silt topsoil, 0.15m to 0.6m thick (**1500**). All features uncovered were cut into the natural geology and sealed by the topsoil or ploughsoil unless stated otherwise.

8.2.3 Circular Ditches

Two circular gullies or ditches (**1652** and **1656**) and a possible third circular gully (**1642**) were uncovered towards the western end of the site; with ditch **1656** representing what had initially been assumed to be a roundhouse (**103**) during the evaluation stage (McNicol 2013). Gully **1652** (Plates 24 and 25) was located on the western edge of the site, and approximately a third of it had been truncated by a modern pipeline associated with the original WTW (Figures 31 and 32). It measured approximately 9m internally and 10m externally in diameter, with an average depth of 0.25m and a width of 0.5m. The gully was filled with a high concentration of sub-rounded stones (**1653**) which sealed a thin layer of light brown sandy silt (**1657**) (Figure 33). The sides of the gully were near vertical and it had a fairly flat base with the exception of six depressions (Figure 32). These depressions were located at random and most likely represent stone impressions. The vertical sides, narrow width and stone fill make this a circular stone-filled drain rather than a potential ring ditch for a barrow as was considered possible during the excavation.

Three features (**1646**, **1648** and **1654**) were uncovered in the middle of circular gully **1652** (Figure 32). Feature **1648** was circular in plan and measured 0.75m in diameter and 0.28m deep (Plate 26). It contained three distinct fills (Figure 34). A 0.02m thick charcoal rich black sandy silt (**1649**) containing fragments of burnt bone was located at the base of the feature. This was sealed by a 0.16m thick layer of brown sandy silt (**1650**), which in turn was sealed by a mottled black and brown sandy silt (**1651**), 0.12m thick. A large stone was set on edge against the north-western side of the feature, and this with the near vertical sides of the feature suggests that this was a posthole. The fills contained small fragments of burnt bone, mostly from **1649**, some charcoal, occasional hazelnut shells and **1649** produced a single charred wheat grain. Some of the bone fragments from **1649** were identifiable as sheep and there was no evidence of human bone. This feature had initially been suspected of containing a cremation burial, but the lack of human bone demonstrated that this was not the case.

Immediately adjacent to **1648** was pit **1646**, which measured 0.5m in diameter with a depth of 0.12m and was filled with a single deposit comprising of charcoal-rich black sandy silt (**1647**). The relationship with feature **1648** was unclear due to the shallowness of **1646**.

Directly to the south was feature **1654**, measuring 1.4m by 1.15m, and with a maximum depth of 0.1m. It had uneven sides as well as an uneven base and was filled with a single deposit comprising of a brownish grey sandy silt with occasional charcoal flecks throughout (**1655**). The fill contained numerous stones and a small concentration of stones was uncovered within the subsoil above this feature. This feature was almost central to the ring gully and was originally thought to be a possible central burial but there was nothing to confirm this interpretation.

Circular ditch **1656** was located approximately 95m to the southeast of gully **1652** and measured 9.5m and 11.5m in diameter, internally and externally respectively (Figure 35) (Plate 27). It had an average width of 1.1m with a depth of 0.35m, and had fairly steep sloping sides with a slightly concave base (Plate 28). A number of deposits were visible within the ring ditch (**1653**, **1657**, **1658**, **1659**, **1660**, and **1661**) (Figure 36), the main ones consisting of a possible burnt layer (**1661**), 0.02m thick, located at the base of the ditch on its eastern side; a deliberately dumped deposit of sub-rounded stones on its western side (**1658**), measuring a maximum of 0.35m thick (Plate 29); and a 0.35m thick brownish grey sandy silt deposit (**1659**), representing the main silting up episode of the ditch. This ring ditch had no features inside it.

The third possible curving gully (**1642**) was located approximately 21.5m to the east-south-east of circular ditch **1656**. A length of about 10m survived of this gully that was 0.26m wide and no more than 0.17m deep (Figure 37, Plates 30 and 31). It was assumed on site that this was a highly truncated version of the other ring ditches but it is very much narrower than the others and can never much more than 0.26m wide. It seems to have been a feature of quite a different character and probably different function to the others. A large circular posthole (**1644**) was visible truncating the western part of this gully (see below).

8.2.4 Western group of pits and postholes

(Figure 3 and Figure 38)

A large number of pits were uncovered during the archaeological work on site (Figures 2 and 3), the majority concentrated towards the western part of the site. Within this western area of activity there were also numerous postholes or possible postholes. Finds were rare in this western area. The fills of three of the pits (**1503**, **1514**, and **1677**) contained fragments of 20th century glass and pottery, while a further five features (**1547**, **1608**, **1648**, **1666**, and **1668**) contained fragments of burnt bone. The only other finds came from pit **1608**, which contained part of a copper thimble (SF5), and a polished stone tool (SF6), and from posthole **1584**, which held a worked stone (SF4).

A single sub-oval pit (**1539**), measuring 0.88m by 0.75m, and with a depth of 0.32m was located in an isolated area to the north-east of ring gully **1652**. It had numerous medium sized stones in its base with a largely stone-free greyish brown sandy silt above (**1540**). This contained small amounts of birch charcoal and a single charred oat grain, both of which could have been intrusive.

To the north of the main focus of activity were two features (**1678**/**1681** and **1622**/**1624**), both initially interpreted as each having two intercutting pits but on closer inspection appeared to be single features. Feature **1678** had an elongated cut, about 1m wide, with straight parallel sides, which opened out into a broader, sub-circular area (**1681**) (Figure 39, Plates 32 and 33). The feature had stones near its edges, a few set along its sides, and these seem to have formed a rough lining, some of which had collapsed inwards. There was strong heat-reddening on its fairly level base, which extended in small patches into the open end. The base of **1678** was covered with a black silt deposit (**1680**), 0.15m thick, which was sealed by a dark grey clayey silt deposit (**1679**). The burnt layer did not extend into the open end, which was filled only by the grey clayey silt (here recorded as **1682**). The feature was orientated south-south-east to north-north-west and the north-north-western end was cut by a modern rectangular pit (**1677**), filled with stones.

Part of the open end was truncated and with the northern end lost to the modern pit the original shape of this feature was difficult to determine but it is possible that there was another sub-circular wider area at the northern end and that it was roughly a dumb-bell shape. This would make it a typical shape for a corn drier, although quite small. There was a significant number of charred cereal grains from **1680**, with a smaller number from **1682**. Most of the identifiable grains were oats but there were also a few wheat grains. However there was very little identifiable charcoal present. This layer also contained fuel ash slag, some of which contained heavily burnt grain. While fuel ash slag can be produced in domestic fires it is particularly common in corn driers, especially where grain has been accidentally burnt. The burnt grain and fuel ash slag supports the interpretation of this feature as a corn drier.

To the south of **1678**/**1681** was a sub-circular feature (**1622**) with a deeper elongated hollow in its base (**1624**), which projected to the south-west, giving a roughly key-hole shape to the feature as a whole (Figure 40, Plate 34). The sub-circular part measured 1.8m by 1.3m, with a depth of 0.2m, and was filled with a grey-brown silt (**1623**) containing some large stones, the largest 0.4m long. Under this was a charcoal-rich dark greyish black sandy silt (**1625**) filling the elongated hollow, which was 2.2m long overall and 0.7m wide, with a depth of 0.2m. There were traces of heat-reddening suggesting *in situ* burning in the base of this hollow. The whole feature was aligned roughly east-north-east to west-south-west.

The burnt layer contained very large numbers of charred cereal grains, predominantly oats but with some wheat and barley. It also contained some charcoal, mainly hazel with a little birch and some charred hazelnut shells. The quantity of cereal grains strongly suggest that this was a corn drier where at least one accident occurred where the drying grain caught fire. The charcoal was probably from fuel wood.

Pit **1608**, located directly to the south of feature **1622**/**1624**, consisted of a large sub-rectangular pit measuring 1.25m by 0.85m, and with a depth of 0.55m (Figure 41, Plate 35). The basal fill of the pit consisted of a light brownish grey sandy silt and gravel with the occasional fragment of burnt bone (**1612**). No evidence of any *in situ* burning or other burnt material was visible within this deposit. The upper fill of this pit, a dark brownish grey charcoal rich sandy silt (**1611**), contained part of a copper thimble (SF5), and a polished stone tool (SF6). A possible pit (**1634**) was cut into this deposit, and was completely contained within this deposit. It was filled with a light brown sandy silt and gravel (**1610**) most likely representing a re-deposited natural deposit, which in turn was sealed by a thin deposit of brownish grey sandy silt (**1609**), which contained small fragments of dense grey iron slag and coked organic matter.

The presence of burnt bone led to this feature and several others on the site to be referred to as cremation pits. However there was only 1g of bone from fill **1611** and 4g from **1612**. These were very small fragments and the only identifiable piece was a fragment of a cattle-sized metapodium from **1612**. There was no evidence that human bone was present, so with the small quantity of bone this shows that this pit did not contain a cremation burial. None of the charcoal present was identifiable, but all the sampled fills of pit **1608** contained small quantities of charred cereal grain, all the identifiable grains being oats. The stone tool was a pebble that had been used for polishing or possibly burnishing leather. The thimble probably dated to the late 14th or early 15th century and its fragmentary condition suggests a worn and broken discarded item. The material in the pit therefore seems to have been domestic waste from fires and cooking with broken objects included.

Near pit **1608** was a group of five rectangular pits (**1596**, **1598**, **1600**, **1604** and **1632**). These were all rectangular in plan with rounded corners and near vertical sides and flat bases. They measured between 0.7m by 0.35m (**1600**) and 1.2m by 0.7m (**1632**), with an average depth of 0.2m, except **1596**, which was 0.29m deep. All the fills were similar, consisting of a single deposit of a brownish grey sandy silt, with the fill (**1599**) of pit **1598** containing occasional charcoal flecks and small fragments of dense grey iron slag and coked organic matter. A large stone was set on edge towards the north-eastern end of **1596** (Plate 36), and this could have functioned as a post-packing stone. Pit **1600** also had a large stone in its upper fill and other stones near the edge, and **1604** had medium sized stones but these were more randomly distributed.

Feature **1596** was cut into the corner of **1632**, although the features were so closely aligned that this must have been done deliberately when **1632** was still visible (Plate 37). Features **1600** and **1598** were too close together to have been open at the same time or the baulk of natural between them would have collapsed (Plate 38). This suggests that there was more than one phase of pit digging with **1596** and **1600** possibly replacing the earlier pits, but the similarity of form suggests that their function was the same.

A small circular pit (**1594**) seems to form part of this group due to its position and the fact that it also had steep sides and a flat base. Pit **1594** measured 0.6m by 0.5m and had a depth of 0.15m. It seems probable that pit **1608** also formed part of this group, as it also had vertical sides and a flat base, even though it was larger than the other pits. Together these features formed a semi-circle measuring about 4.5m by 3.8m internally and opening towards the north-east. The features are aligned on differing orientations around this semi-circle.

Pit **1598** contained two charred oat grains and **1604** a single charred hazelnut shell. Some of the other pits had small quantities of unidentifiable charcoal. This material could have originated from the later medieval activity and been introduced to the fills by worm action. While pit **1608** had quantities of medieval domestic waste this was restricted to the upper fill and the lower fill (**1612**) was similar to the fills of the other rectangular pits. It did contain a small number of charred oat grains but these are likely to have originated from the layer above and also brought down by worms. The slag fragments were also so small that they might be intrusive.

The vertical sides and flat bases of these features as well as the stones, especially in feature **1596**, are suggestive of postholes, but the rectangular plan seems unusual for posts. The semi-circular shape formed by the pits does not seem to represent a viable structure. Features **1600** and **1598** resemble children's graves but the other features do not have the right proportions for graves and their variable alignment and arrangement make them unlikely to be graves. The function of these features is therefore not understood and with the lack of finds and datable material their date is unknown except that they are probably earlier than the 15th century AD.

Pit **0203**, which was found in the evaluation trenching, was just to the north and similar to this group. It was circular with steep sides and a flat base. Just north-west of pit **1608** was a posthole (**1606**) 0.4m in diameter with a depth of 0.3m. It was filled with a single greyish brown sandy silt deposit (**1607**), which contained a quantity of charred grain, mainly oats. No other postholes were located within this area, and its relationship to the nearby pits or its function is unknown.

To the east was a group of four shallow intercutting pits, consisting of two roughly circular pits (**1614** and **1639**), a sub-rectangular pit (**1616**), aligned east-west, and a sub-oval pit (**1618**) (Plate 39). All of these pits had been heavily truncated and were a maximum of 0.18m deep, with the exception of pit **1639**, which was only 0.1m deep because it had been largely machined away. Its fill (**1619**), which was black sandy silt with angular stones, was apparently visible within the ploughsoil, so pit **1639** seems to have been cut from near the modern ground surface; its base truncating pit **1618**. The fills of pits **1614**, **1616**, and **1618** were all very similar and consisted of a compact, mottled grey and brown sandy silt (**1615**, **1617**, and **1620** respectively). This similarity meant that it was impossible to identify relationships between the pits. There were small quantities of unidentifiable charcoal in the pits and pit **1616** had a single charred hazelnut shell. Fill **1620** in pit **1618** contained some charred grain, mainly oats and some weed seeds, particularly hemp nettle, but these may have been brought down from the charcoal-rich fill (**1619**) of pit **1639**, which was not sampled as it appeared to be of recent origin.

It is possible that these pits were used with the group of pits to the west but with the lack of dating material this is impossible to prove.

To the south were three postholes (**1588**, **1590** and **1592**) possibly forming a right angled corner of a structure. Both **1588** and **1590** measured approximately 0.65m in diameter, with posthole **1588** having a depth of 0.16m, and posthole **1590** a depth of 0.24m (Figures 42 and 43). Neither of the fills of the postholes (a brownish grey sandy silt (**1589**) and a dark greyish brown sandy silt (**1591**) respectively) contained any *in situ* packing stones but some medium-sized stones in **1588** may have been disturbed packing. The size, shape and steep sides of these features suggest postholes, although **1588** in particular seems to have been heavily truncated. The fill of **1588** contained charred hazelnut shells.

Feature **1592** measured 0.6 by 0.5m and was 0.22m deep (Figure 44). It had steep sides and a concave base and its sandy silt fill was fairly rich in charcoal, mainly blocky fragments of oak, possibly from a post charred to inhibit rotting. It also contained numerous medium sized stones. While not certainly a posthole it could be one and fits well with **1588** and **1590**.

To the south were three large stone-filled pits (**1626**, **1630**, and **1637**). Pit **1626** was roughly circular in plan, measuring 2.5m by 2.2m and with a depth of 0.38m (Plate 40). A small possible posthole (**1628**) was located truncating this pit on its southern side. The posthole (**1628**), 0.22m in diameter and 0.24m deep, was filled with a single brownish grey sandy silt (**1629**). No other postholes of a similar size were uncovered within this area, and its function is unknown, but it may be quite late in date as it seemed to cut the edge of the pit.

Pits **1630** and **1637** were located adjacent to each other and were both sub-circular in plan, measuring 3.45m by 2.3m and 1.85m by 1.3m, and with depths of 0.48m and 0.1m respectively (Plate 41). All three of these pits were filled with deliberately dumped deposits of sub-rounded stones (**1627**, **1631**, and **1638** respectively).

Pit **1626** contained a small amount of charred cereal grains and some weed seeds, especially blackberry/raspberry seeds. Pit **1637** had some grain and some hazelnut shells. It is assumed that these features are quite recent and that the pits were dug to bury stones below the level of the plough. Charred plant remains could easily work their way into the loose fill around the stones. It is possible that the pits were dug for another purpose and only incidentally used to hold stones. Pit **1630** in particular was quite regular with a very flat base, seeming very neat for a hole dug merely to bury stones.

The smaller pit (**1586**) was also filled with a deliberately dumped, loose deposit of stone, and is also considered to be most likely of a post-medieval date.

Towards the southern end of the trench were two circular features (**1666** and **1668**), measuring 0.75m in diameter and with an average depth of 0.35m (Figures 45 and 46, Plate 42). Both of these were filled with a charcoal-rich dark greyish black clayey silt deposit with frequent inclusions of burnt bone and some coked organic matter (**1667** and **1669** respectively). These small steep sided features could easily have been postholes rather than pits. Feature 1666 had some fairly large stones in it but nothing positioned like post-packing stones.

Like **1608** the bone found in these features led to them initially being interpreted as cremation pits. However there was only 11g of burnt bone in feature **1666** and 4g in **1668**; some of the bone in **1666** was identified as sheep and fragments in **1668** came from medium-sized mammals. There was nothing to indicate human bones were present. Both pits contained considerable quantities of charred cereal grains, mostly oats but with a small number of wheat grains, and also numerous fragments of hazelnut shells. Roundwood charcoal from birch and hazel suggests branches used for fuel, supported by the presence of a small amount of fuel ash slag. This suggests the disposal of waste from domestic fires but there were no lenses of charcoal to indicate ash dumped directly in the pits. The charred remains were well-mixed into the fills so it is likely that the pits were filled by a general mixed deposit, perhaps originating from an occupation layer that contained burnt material.

Near these features was a substantial circular posthole (**1644**), 0.7m in diameter and 0.55m deep (Figure 47). It was filled with a brownish grey sandy silt with frequent sub-rounded stones (**1645**), including a flat stone laid in the base of the posthole. These stones are most likely the remains of the packing material for a post. This posthole truncated the western part of possible circular ditch **1642**, and contained a significant quantity of charred cereal grain, mainly oats with a small number of barley grains and also a few hazelnut shells and weed seeds. It also contained oak, birch and willow charcoal, and a few small fragments of burnt bone, making it likely that the same occupation deposit that was included in features **1666** and **1668** was also incorporated into the fill of this posthole.

Two possible postholes (**1662** and **1664**) were uncovered directly to the west of posthole **1644**, and adjacent to pit **1668**. They measured approximately 0.4m in diameter and had a depth of 0.2m and 0.28m respectively. A similar, dark greyish brown clayey silt with charcoal inclusions (**1663** and **1665**) filled both of these pits. These deposits were very similar to those found within adjacent pits **1666** and **1668**, but were lacking any burnt bone and contained less charcoal.

Features **1674** and **1672** may also have been related postholes. Feature **1674** a large posthole, sub-rectangular in shape, measuring 0.8m by 0.55m, and with a depth of 0.47m. Frequent sub-rounded stones were uncovered within its fill, a greyish black clayey silt (**1675**), and these are likely to represent packing material for a post. Feature **1672** was little more than a hollow 0.15m deep and 0.6m in diameter but its proximity to the other postholes in this area suggests that it may be related. Both **1674** and **1672** contained small numbers of charred cereal grains; wheat, barley and oats, also supporting their relationship to the other postholes in this area. Posthole **1674** formed an almost straight line with postholes **1590** and **1592** and **1668** was at right angles from this alignment from **1674**. Feature **1672** lay just south of the line between **1674** and **1668**, in a similar position to **1664**.

To the south-east of ring ditch **1656** were four substantial postholes with stone packing. Three circular postholes (**1508**, **1534**, and **1584**) were uncovered in a triangular pattern. They measured on average, 0.55m in diameter and with a depth of 0.35m. A similar sized posthole (**1510**) was located approximately 5m to the southeast of these postholes, at the edge of the excavation area. All four of the postholes were filled with a similar deposit comprising of a greyish brown sandy silt with frequent sub-rounded stones (**1509**, **1535**, **1585**, and **1511** respectively). Some of these stones were carefully set around the sides of the postholes, especially in **1508** and were the remains of the packing material for posts (Plate 43).

Posthole **1510** contained a few charred weed seeds and **1534** and **1584** each a single charred hazelnut shell, but it is notable that unlike the postholes just to the east these contained no cereal grains. The charcoal it contained was mainly oak in blocky fragments probably from a charred post. Two pieces of what were initially thought to be fragments of quern or grinding stones (SF1 and 2) from posthole **1510** proved to be unworked. A rounded cobble (SF3) collected from posthole **1534** was also unused and just a natural pebble included as a packing stone, however a fire-shattered cobble fragment (SF4) from **1584** may be part of a shaped working slab.

Other features in this southern area included two very shallow hollows (**1512** and **1526**, 0.08m and 0.13m deep respectively), that may have been the truncated bases of the pits but could have been just hollows in the natural gravels.

To the east of this southern collection of postholes and other features was a group of four postholes (**1516**, **1518**, **1520**, and **1522**) in a square, measuring approximately 3m by 3m (Figure 37, Plate 44). The postholes all measured approximately 0.7m in diameter, with a depth of between 0.35m and 0.5m, and were filled with a single greyish brown sandy silt with frequent sub-rounded stone inclusions (**1517**, **1519**, **1521**, and **1523** respectively), most likely representing packing material for posts. The layout of these postholes is suggestive of four-poster structure of a type usually interpreted as a granary.

8.2.5 Outlying pits and other features

Figure 30

Pit **1547**, located close to field boundary wall **1506** and linear gully **1556**, measured approximately 2.8m by 1.6m, and had a maximum depth of 0.75m (Figure 48). It was filled with four distinct deposits; a 0.15m thick greyish brown sandy silt (**1548**) located at the base representing the initial silting up of the pit (Figures 49 and 50, Plates 45 and 46). This layer was burnt strongly red in places. At least two *in situ* burning events were visible within a 0.15m thick layer of charcoal-rich black sandy silt (**1549**) located at the northern end of the pit. Small fragments of burnt bone were also recovered from this deposit. This was sealed by a grey stony silt deposit (**1550**), 0.4m thick, which was in turn sealed by a 0.32m thick greyish brown stony silt deposit (**1551**), both of which contained fragments of 20th century pot or glass.

At least one of the larger stones was placed against the side of the feature as if there might have been a stone lining. When fully excavated the pit had a slightly waisted plan, suggesting there may have been two chambers to the feature. The base was clearly heat-reddened in places.

The burnt layer (**1549**) contained large numbers of charred grains, many oats, but even more barley, as well as some charred weed seeds. There was only 2g of burnt bone fragments recovered from fill **1549**, but it contained considerable quantities of charcoal, oak, birch and hazel with roundwood of oak and hazel present, making it probable that this was fuel wood. The significance of the modern pot and glass in the upper layers is uncertain as the size and quantity of the pieces was not recorded. This may have been incorporated into the loose stony fills from the ploughsoil.

While quite deep and not a classic shape the quantity of grain and *in situ* burning suggest that this feature was a corn drier.

To the east of the site, and adjacent to scarp **1582**, a linear deposit of stones (**1602**) was uncovered measuring 3.1m by 0.62m and aligned east-west (Figure 51, Plates 47 and 48). These were set in a shallow trench (**1683**), up to 0.17m deep, which continued further east than the stones but was very shallow at the eastern end. A square stone 'pad' (**1583**) measuring 0.48m by 0.42m by 0.28m, and with a flat top, was located at the northern edge of this stone alignment. The stone pad seemed to have been wedged in place by small stones to the north-east. The pad was cracked into pieces, possibly by considerable heat. The fact that one of the wedging stones was also cracked and had burnt clay adhering to it supports the cracking being done by heat rather than a strike by the plough, which would have had to have considerable force to crack such a thick stone. However there was little evidence of burning on the adjacent stones in **1602**. A sherd of pottery (SF30) was recovered from the soil around the stone pad. This is of Midland Purple-type ware that was in use in the late medieval to early post-medieval period (roughly 15th to mid-17th centuries).

Directly to the south of the stone alignment, and partly covering it, was an extensive burnt deposit (**1603**) 0.1m thick and covering an area of 3.6m by 1.8m. This contained charcoal, including oak, birch and hazel, and areas of burnt clay as well as fuel ash slag. The latter assemblage was suggestive of burning at a fairly high temperature and also contained fragments with an adhering red sandy ceramic, possibly from a hearth wall or floor, which could hint at a superstructure. While the fuel ash slags can be produced in domestic fires they are particularly common in corn driers, especially where grain has been accidentally burnt. Layer **1603** produced a large number of charred hazelnut shells, some weed seeds and a significant number of charred cereal grains, all the identifiable grains being oats.

The cereal grain and fuel ash slag is suggestive of a corn drier but the form of this feature is unusual. Most of **1603** seems to be material spread from the main area of activity, but the thicker northern end of the deposit may indicate the location of the fire, as there was a consistent lens of charcoal at this end. There does not seem to have been a fire laid directly on the stones (**1602**) as there was very little charcoal recorded between the stones and they did not appear to be fire-cracked. How the stone pad **1583** could have been heat-cracked with no fire directly over it is unclear. Perhaps the burnt clay in **1603** indicates that there was some kind of superstructure that retained the heat and directed it over the stone pad.

About 3m south-east of this feature was a circular pit (**1566**) measuring 1.2m in diameter and 0.25m deep, with a homogenous fill of grey-brown sandy silt (**1567**). There was no trace of burnt material in this to connect it with feature **1602**/**1683**, or to provide any idea of date or function. This pit was located at the end of ditch **1568**, but as their fills were indistinguishable it was not possible to establish the relationship between them.

Two pits (**1545** and **1562**), measuring 1.1m by 0.65m and 0.8m by 0.64m respectively were uncovered at the southern side of the site adjacent to the river (Figures 52 and 53, Plates 49 and 50). Both pits were on average 0.2m deep and contained a single deposit each comprising a large concentration of fire-cracked stone (**1546** and **1563** respectively). Fill **1546** produced a significant quantity of oak charcoal and **1563** had oak and hazel with a smaller amount of birch. Although there were no traces of burnt mounds found near these pits the stony fills are typical of burnt mounds and it was assumed that these were the pits of burnt mounds where the mounds had been ploughed away.

To the east of the site, a sub-rectangular pit (**1560**) with steep, irregular sides and an uneven base was uncovered. It measured 2.65m by 1m and had a maximum depth of 0.35m. It was filled with three distinct fills (**1576**, **1577**, and **1578**), with the main fill (**1577**) consisting of a heated or burnt clay. There was no evidence of any *in situ* burning and the reason for the heated clay is unknown. The irregular shape suggests that this is not a deliberate anthropogenic feature and is possibly the result of the heat of surface burning entering an animal burrow.

A sub-rectangular pit (**1514**) near the north-eastern corner of the existing WTW proved to be of recent date. It measured 1.3m by 0.85m and 0.21m deep and its rather loose fill (1515) contained modern glass and wood.

Located to the east of gully **1570**, possible posthole **1574** measured approximately 0.5m in diameter, with a depth of 0.19m, and was filled with a dark greyish brown sandy silt (**1575**).

Given its isolation it is likely that this feature represents a stone impression rather than a posthole.

To the east of this were three widely spread features (**1552**, **1554** and **1558**). They measured between 0.55m and 1.2m in diameter, with an average depth of 0.2m. They were all filled with a single silted up deposit, and their function and date are unknown, although it is possible they are merely where stones have been pulled out during ploughing.

8.2.6 Ditches and field boundaries

A total of nine ditches (**502**, **504**, **1524**, **1528**, **1530**, **1556**, **1561**, **66001**, and **66004**) and five gullies (**1543**, **1568**, **1570**, **1572**, and **1580**) were uncovered on site, ranging in size from 0.4m wide and 0.1m deep (**1572**), to 1.78m wide and 0.38m deep (**66001**) (Figures 30 and 31, Plates 51-53). Post-medieval pottery was recovered from two of the ditches (**1530** and **1556**) and one of the gullies (**1572**). Six of the ditches (**502**, **504**, **1524**, **1556**, **66001**, and **66004**) previously continued into the area occupied by the WTW.

Two upstanding field boundaries (**1502** and **1505**) were partially truncated to provide access routes, and a large part (50%, approximately 115m) of a third field boundary (**1506**) was removed during the works. Field boundary **1502** was constructed from large angular cobbles, cemented in place. It is very straight and forms the boundary along the road leading to the WTW. Both field boundaries **1505** and **1506** consisted of a rough drystone wall with an earthen bank in places. Post-medieval glass and pottery sherds were recovered from field boundary **1506** but not retained.

Two scarps (**1582** and **1676**) were revealed during the excavation, one of which (**1582**) had been interpreted as a possible platform (**1002**) during the evaluation. Scarp **1582** was located within the eastern half of the site and was roughly semi-circular in shape with a diameter of approximately 44m, and a maximum depth of 0.7m. Scarp **1676** measured approximately 26m in length and was located towards the north-western corner of the site. It had a maximum depth of 0.25m. Both scarps were fairly steeply sloping to begin with before becoming more gradual. Concentrations of stones were uncovered along small sections at the base of both of these scarps, and it is likely that these are natural slopes which have been enhanced by ploughing.

All of the ditches and gullies appear to be approximately contemporary with each other due to their similar orientations and sizes, and in a number of cases they respect the presence of other ditches or gullies, such as ditches **1528** and **1530** terminating just before ditch **1561**. They also seem to relate to existing field boundaries, especially where ditches **1528** and **1530** run parallel to field wall **1505**, ditch **1561** continues the line of the northern boundary around Beudy Tai-duon (PRN 62612) and ditch **1556** seems to be running from wall **1506**.

A coherent field system seems to be represented with ditches defining the fields, later to be replaced by walls along some boundaries. Although wall **1502** is shown on the first edition 25 inch OS map dating to 1889 its straightness and the regularity of the other field boundaries to the west of the WTW shows that it is a late wall built in the 19th century. Ditch **0504** can be seen on the OS maps as a straight boundary which goes out of use by 1915 (PRN 61897). This is also probably 19th century in origin.

The other two walls upstanding at the start of the project are less regular. Wall **1506** has distinctly wandering line, typical of earlier boundaries, and is clearly shown as such on the 25 inch maps. It also has a slight curve in its line. Wall **1505** is straight with a sharp bend in the middle. It is shown in this form on the 1889 OS map, but it is likely that this form is a regularised version of the original curving boundary. The slight curve at the southern end of ditches **1528** and **1530** probably reflect the original line of the northern part of wall **1505**. The slight curves suggest the boundaries of furlongs and perhaps indicate the enclosure of a medieval field system. Similar slight curves are seen on many of the ditches. These seem to define small fields but they are perhaps better seen as drainage ditches around small groups of lands in what was originally an open field system. The presence of post-medieval pottery within some of these ditches suggests more continued in use into the 18^{th} and early 19^{th} centuries than are shown on the OS maps but it is probable that the origin of the field system is very much earlier.

9 SUMMARY OF SPECIALIST REPORTS

The full reports by the relevant specialists are given in the appendices, and these are summarised here.

9.1 G2231 Dolbenmaen to Cwmystradllyn Pipeline

9.1.1 Charcoal and Charred Plant Remains

The soil samples were processed by flotation and wet sieving, and then the charred plant remains were assessed by Mhairi Hastie and the charcoal by Mike Cressey, both of CFA Archaeology Ltd (Appendices VIII and IX). A total of 26 samples were submitted for assessment.

The plant macrofossil material was generally in a poor condition and much abraded. The bulk of the carbonised plant remains were recovered from the features uncovered within Field 1, with wheat (hulled, emmer/ spelt) being the most common species identified, along with smaller amounts of barley and occasional grains of oat. Neither the barley nor the oat grains were sufficiently well-preserved to allow identification to species level. This assemblage, dominated by hulled wheat and barley, would be consistent with a prehistoric date, and their presence, albeit in small amounts would also suggest that some food processing was being carried out on site.

Weed seeds were recovered from the samples taken from ditch **01001** and postholes **01017** and **01040**. They included seeds of knotgrass, ribwort plantain, and grasses, which are characteristic of waste places and grassland. The seeds could have been either growing on or near to the site, or brought to the site along with the cereal grains.

Fragments of burnt peat were also recovered from the fill of ditch **01001**. The recovery of burnt peat along with a small assemblage of cereal grain from the same feature, suggests that the carbonised plant remains are accumulated remnants of a domestic hearth. A further concentration of burnt peat was recovered from the fill of ditch **42001**. The peat was recovered along with a small amount of heather charcoal, suggesting that the material is the remnants of peaty turfs. The origin of this material is unknown, although it may be an accumulation of domestic debris that has been spread on the fields.

Charcoal was present in a number of samples, with large concentrations recovered from pits **01069** and **01103**, and ditch **01001** in Field 1; three pits in Field 9 (**09005**, **09019**, and **09023**); pits **27002** and **27003** in Field 27; pit **39019** and burnt layer **39015** within Field 39; as well as from possible posthole **42006** in Field 42. The charcoal consisted of a mixture of blocky fragments of oak (from pits **01069** and **01103**, as well as from features within Field 9), a mixture of small round wood fragments of oak and non-oak species (from ditch **01001** and features within Field 39), and fragmentary pieces below the level of identification (from features within Fields 27 and 42).

Hazelnut shell was also uncovered from the fills of pits **01053**, **01013**, **09005**, **09019**, **27002**, **39019**, and posthole **42006**. The small amount, and fragmentary nature of the hazelnut shell, along with the lack of cereal grains within these features, suggests that the hazelnuts were collected along with the fire wood rather than harvested.

9.1.2 Auger Survey, Coring and Pollen Analysis

After a probe survey of the whole pipeline route 11 transects of auger holes were made across areas with soft sediment depths of over 0.4m (Figure 54). The deepest areas were also selected for core sampling. The data from the auger survey and cores were assessed by James Rackham of the Environmental Archaeology Consultancy (Appendix X), who recommended pollen analysis, some analysis of macrofossils and further radiocarbon dates.

A palaeosol was recognised beneath the peats in several of the auger transects (T3, T6, T7, T8 and T9) but was probably present beneath the peats in the other transects although not visually recognised in the field. Peat depth varied along the route from just a few centimetres to 1.65m in Transect 8.

In most areas the peat deposits overlay boulder clay but Transect 11 was specifically located to investigate the floodplain of the Afon Dwyfor. No significant organic deposits were located in the six auger holes along this transect so the floodplain was not cored. The other transect where no core sample was taken was T4 where the maximum depth of peat was 0.15m.

The deepest peat was cored at eight of locations, and after radiocarbon dating seven were selected for more detailed post-excavation analysis. Pollen analysis was under taken on the seven selected cores by Dr C.T. Langdon and Dr R.G. Scaife of Southampton University. All seven pollen sequences produced well-preserved and abundant pollen and spores, enabling the past vegetation and environment of the area to be interpreted from the early Holocene through to recent times. This provides a background for the archaeological activity found along the pipeline route and also that excavated at the Dolbenmaen Water Treatment Works.

The seven profiles examined span the whole of the Holocene period and possibly back into the Late Devensian stadial (i.e. pre *c*.10,000BP). Thus, a complete picture of the development of the Holocene vegetation and environments is possible.

During the early Mesolithic period woodland started to colonise the area left barren after the end of the last ice age. Birch arrived first followed by pine, oak, elm and hazel. This developed into dense, stable deciduous woodland by the late Mesolithic period. Oak was dominant in the woodland but there was also hazel and elm with some lime, ash and pine. Lime trees are unexpected as they would have been at the very edge of their ecological range, but they seem to have been growing close to some of the sampling sites. Alder arrived to produce dense alder carr woodland in the wet valley bottoms and lower slopes. This alder carr remained through into the historical period and would have been a prominent feature of the landscape. The influence of Mesolithic people on the woodlands will have been small and it would require much more detailed work to detect their presence in the pollen record.

A decline in elm occurred in the early Neolithic period. This is part of a decline found across Britain in the early Neolithic and often associated with the first appearance of agriculture, as it is in the Dwyfor valley. The decline is now largely thought to have been due to the spread of elm disease, but it does seem to be linked with early farming. This represents the first time human impact on the woodland can be seen in the pollen cores with hints of small scale woodland clearance for both arable and pastoral uses.

The Neolithic horizons were often very close to the surface, and this was initially assumed to be due to peat cutting, but detailed analysis showed that the sequences were compacted rather than truncated. Indications of woodland clearance were detected in the early Neolithic period at Ynys Pandy (Transect 5) (PRN 67652) and by the middle Neolithic at Tyddyn Madyn, and probably by the late Neolithic at Efail Uchaf. These clearances were not permanent but may have regenerated with birch, causing a change in the overall composition of the woodland.

It is notable that not all the sample sites dating back to the Neolithic show human activity. The pollen core at Transect 5 (Figure 54) has a clear elm decline and evidence for farming activity but that at Transect 8 only *c.*500m away has no Neolithic elm decline and no evidence of human activity. This demonstrates the small scale of Neolithic clearance in the valley and shows that pollen sites need to be very close to the location of farming activity to register it.

From the Neolithic period onwards there is evidence of continued woodland clearance, but this is small scale and temporary and the woodland remains the dominant feature of the landscape, with oak and hazel growing on the drier slopes and dense alder carr in the wetter valley bottoms. There is some evidence for openings in the woodland and establishment of pasture land with some cereal pollen grains suggesting some agricultural activity in the late Bronze Age. However both pasture and arable lands might have been more extensive further up the hill slopes away from the sampling sites in the wet valley bottom.

The pollen core at Transect 10, in the upper part of the valley not far from the Cwmystradllyn WTW (Figure 54), differs from the other profiles in suggesting an open environment by the late Iron Age, with woodland having been cleared and acid heathland and Sphagnum bog established. This might support the suggestion that while the main Dwyfor valley was heavily forested there may have been more clearance on higher slopes and Cwmsytradllyn may have been a more open landscape by the Iron Age. The number of hut circles and roundhouse settlements on the slopes around Llyn Cwmystradllyn do suggest a densely occupied landscape in the Iron Age. However there are also considerable numbers of Iron Age settlements around Dolbenmaen, and perhaps it was only the bottom of the river valley that was densely wooded.

From the Iron Age onwards evidence for both pastoral and arable activity increased, although woodland remained important, at least in the valley bottom into historic times. A mixed economy of arable and pastoral farming is suggested by the pollen data. By the middle of 1st millennium BC the landscape becomes more open and is now well populated.

In places woodland clearance for agriculture on acid soils led to soil depletion and the development of heathlands, as seen today. The opening up of the landscape also led to reduction in the alder carr woodland, which was replaced by grass-sedge fens and the development or expansion of *Sphagnum* bog. As the trees were removed they could not absorb the rainfall as they used to so there was increased run-off and the valley floor became wetter.

This slowly led to the open landscape of today with acid heathlands on the hills. Owing to the humification and compression of the upper peats it is difficult to identify changes within the post-Roman periods. In the uplands at Transect 10 there appears to have been an expansion of birch and hazel scrub in the early medieval period with fewer pastoral indicators suggesting abandonment of some areas of pasture. Elsewhere woodland seems to have been reduced and pasture expanded from the Roman to late medieval periods. In the post-medieval period there was a great expansion in both pastoral and arable activity. In the surface levels of the pollen cores is some pollen from spruce and pine planted in recent centuries for timber.

This study has provided a valuable contrast to other pollen data from North Wales, which is usually concentrated on upland peat and lacustrine sites. It provides an insight into how the vegetation of the valley changed and shows the immediate environment in which human activity took place.

The pollen evidence shows that the late Neolithic burnt mound and Iron Age settlement were used in a largely wooded environment with only small clearings for agriculture. By the medieval settlement was established on the Dolbenmaen WTW site the landscape was more open with ridge and furrow cultivation along much of the valley floor.

9.1.3 Stone

Eight flint flakes recovered from the topsoil or subsoil from across the site were assessed by George Smith (Appendix VII). None of the flakes came from features. There were two retouched objects: SF09, possibly a variant on a plano-convex knife from Field 51, and SF10, a small end scraper from Field 1. All of the flints, where identifiable, were made from pebble flint which could be sourced locally. There was an absence of imported material or of larger flakes, or finer techniques, which are typical of Late Neolithic activity. None of the flakes were Mesolithic in character, and the majority could belong to Early Neolithic activity. The exception to this is SF09 (from the topsoil within Field 51), which may be of a 2nd millennium date, although not of an accepted diagnostic type.

9.1.4 Other Finds

A small number of finds were recovered during the processing of the samples. These included fragments of modern pottery and glass from the fill of pit **01053**, a flake of burnt flint and fragments of burnt bone from the fills of ditch **01001**. The glass and pottery fragments may be later intrusions into the fill of the pit **01053**, most likely by ploughing or animal disturbance. The burnt bone from ditch **01001** is likely to be animal bone, and is consistent with the suggestion that food processing was being carried out in this area. A tiny eroded sherd of Samian ware (SF3) was found in the ploughsoil in trial trench 01, which cut across the ditch **01001**.

9.1.5 Dating

The only roughly datable finds recovered from the pipeline were the flint flakes recovered from the topsoil and ploughsoil, along with the post-medieval pottery, glass, and iron horseshoes. Due to the scarcity of datable finds the dating of significant sites had to rely on radiocarbon dates. Two sites, the ditch and postholes in field 1 and the burnt mound in field 39, were considered of sufficient importance to justify dating by radiocarbon assay. Three features from field 1 and two features from field 39 were dated with two samples dated from each feature. The pairs of dates allow some estimation of mixing and contamination in deposits. Only short lived species were used for dating. See appendix XII for the full report and appendix XIII for the dating certificates.

Table of dates from burnt mound in field 39

Lab No	Context No	Context Description	Material/species	Radiocarbon Age (BP)	Calibrated date (95% confidence)[1]
SUERC-68357	39023	Basal fill of pit [39019]	charcoal: *Betula* sp.	4136 ± 34	2880–2570 cal BC
SUERC-68358	39023	Basal fill of pit [39019]	charcoal: *Corylus* sp.	4116 ± 34	2880–2570 cal BC
SUERC-68362	39015	Burnt spread	charcoal: *Corylus* sp.	4181 ± 34	2890–2630 cal BC
SUERC-68363	39015	Burnt spread	charcoal: *Corylus* sp.	4238 ± 34	2910–2710 cal BC

Dates were obtained on the burnt mound from the basal fill of the pit under the mound and from the overlying burnt mound spread itself. Single fragments of birch and hazel charcoal probably originating from fuel wood were used for dating. Bayesian modelling of the dates suggested that the burnt mound activity began in *3145–2690 cal BC* (*95% probability*), and probably in *2935–2765 cal BC* (*68% probability*). The activity ended in *2870–2400 cal BC* (*95% probability*). The overall period of burnt mound use could have been up to *670 years* (*95% probability*), and probably *1–250 years* (*68% probability*) (see Hamilton Appendix XII for details of the model). This indicates that the mound was late Neolithic in date and could have been used over a substantial duration of time, although more dates would be necessary to give a confident idea of the duration of the activity.

Table of dates from ditch and related features in field 1

Lab No	Context No	Context Description	Material/species	Radiocarbon Age (BP)	Calibrated date (95% confidence)[2]
SUERC-68348	01031	Fill of posthole [01017]	charred grain: *Triticum* cf. *dicoccum* (emmer wheat)	1921 ± 34	cal AD 1–140
SUERC-68352	01031	Fill of posthole [01017]	charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)	2019 ± 34	110 cal BC–cal AD 60
SUERC-68353	01041	Fill of pit [01040]	charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)	1963 ± 34	50 cal BC–cal AD 130
SUERC-68354	01041	Fill of pit [01040]	charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)	2003 ± 34	90 cal BC–cal AD 70
SUERC-68355	01066	Basal fill of enclosure ditch [01001]	charcoal: *Quercus* sp.; roundwood	2230 ± 34	400–190 cal BC
SUERC-68356	01066	Basal fill of enclosure ditch [01001]	charcoal: *Quercus* sp.; roundwood	2209 ± 34	390–170 cal BC

Dates were obtained for two postholes enclosed by ditch **01001** and from the basal fill of the ditch. The oak roundwood in the basal fill of the enclosure ditch proved to be considerably

[1] The dates are calibrated using OxCal v4.2 and rounded outward to 10 years.

[2] The dates are calibrated using OxCal v4.2 and rounded outward to 10 years.

earlier than the material recovered from the postholes. This suggests that either the postholes and ditch are not contemporary, or else the oak roundwood is residual. The Bayesian model therefore assumes that the basal ditch dates provide a *terminus post quem* for the filling of the ditch. With this assumption there is good agreement between the dates and the model, which estimates that the activity associated with the postholes began in *200 cal BC–cal AD 60* (*95% probability*), and probably in *60 cal BC–cal AD 40* (*68% probability*). The activity in this area ended in *20 cal BC–cal AD 255* (*95% probability*), and probably in *cal AD 20–120* (*68% probability*).

It is possible that the ditch was significantly earlier than the postholes and in this case the latest date from the dated deposit suggests the ditch was open and beginning to fill in by 380–170 cal BC (95% confidence; SUERC-68356).

9.2 G2293 Dolbenmaen WTW

9.2.1 Copper Thimble

The copper thimble was cleaned and stabilised by Phil Parkes of Cardiff Conservation Services. It has been left in a stable condition for long term storage.

The thimble was examined by Jörn Schuster of ARCHAEOLOGICALsmallFINDS, and its dimensions and weight were recorded (Appendix XVII). It was subsequently compared with other pertinent collections of thimbles. On the basis of this it was dated to around the late 14th or early 15th century, although a manufacturing location was not identified. Its fragmentary condition suggests it was discarded in a waste deposit, that it may then have been redeposited into the upper part of pit **1608**.

9.2.2 Late medieval pot sherd

The only significant pot sherd recovered from the site came from the soil around the stone pad (**1583**), part of the outlying feature **1602**/**1683**, that may have been a type of corn drier. The sherd, which is in two parts, was inspected by Julie Edwards, medieval ceramics specialist at West Cheshire and Chester Council. The sherd is described as from the body of a closed vessel such as a jar or jug, with a purplish brown fabric and patches of brown or purple-brown glaze both internally and externally. The sherd falls into a group of wares known as Midland Purple-type ware, which were in use in the late medieval to early post-medieval period (roughly 15th to mid-17th centuries).

9.2.3 Charcoal and Charred Plant Remains

The soil samples were processed by flotation and wet sieving by CFA Archaeology Ltd, and Helen Muckle. The charred plant remains were assessed by Mhairi Hastie (Appendix XVIII) and the charcoal was assessed by Mike Cressey (Appendix XIX), both of CFA Archaeology Ltd. A total of 60 samples were submitted for assessment. The charred plant assemblage was recommended for further work and Mhairi Hastie produced a more detailed report on this material (Appendix XX).

Charcoal was present in all the samples in varying quantities. Only four species were represented; oak, hazel; birch and willow, with oak being the most abundant, but all these species would have been common in the area. Woodlands were most likely fairly close to the site and were quite varied with no need to resort to poor quality shrubby species for fire wood, as might be expected if woods were distant or impoverished.

Several high concentrations of plant remains were recorded, particularly from the fills of two corn-drying kilns (**1547** and **1624**). Other concentrations were found in several of the postholes at the southern part of the site and in a spread of dumped material (**1603**). The majority of the assemblages consisted of charred grain mainly oat (*Avena* sp.) and barley (*Hordeum* var *vulgare*), the latter mainly likely to be the hulled variety (*Hordeum* var *vulgare*).

The general lack of cereal chaff and weed seeds in the assemblages from the postholes indicates relatively clean grain probably from food debris has worked its way into the postholes, possibly by sweeping the floor. This suggests that occupation activities, particularly food preparation, were carried out inside the proposed building, which is supported by the presence of burnt bone fragments in the same features.

Of particular note is the recovery of oat grains from a corn-drier (**1547**) dated to the early medieval period (4^{th}-5^{th} centuries AD). The assemblage was dominated by barley grains, suggesting that this was the principal crop being cultivated, but 15% of the cereal grains present were oats, and this species seems to have been growing in importance at this period before becoming the dominant grain grown in the high medieval period.

Several hundred grains of rye (*Secale cereale*) were found, together with oat and hulled barley, in the fill of corn-drier **1624**, but in no other feature. Rye is tolerant of drought, temperature extremes and poor light soils and it is often grown on sandy soils where other crops would be less successful (Moffet 1987), so it may represent a short-term use of the poorer soils in the area.

Traces of emmer or spelt wheat were found, which are typical of prehistoric agriculture. Given the occasional Iron Age radiocarbon dates obtained from the site these may be residual from earlier activity or could represent weeds in the medieval crops. Small numbers of probable bread/club wheat grains were found in features dating to the medieval period.

Fragments of hazelnut shell (*Corylus avellana*) were noted in the fills of many different features across the site, including in dated medieval contexts, suggesting that these nuts were collected for food in this period. A small number of vetch seeds (*Vicia*/*Lathyrus* sp.) were recovered from the fill of a posthole **1666**. This plant might have been cultivated for animal fodder but it is also a common weed of arable fields and might have been introduced to the site with the cereals. There were only low numbers of weed seeds except for in the two corn-driers, **1547** and **1624**. Most of the weed seeds were from species commonly associated with arable land or grassy places, but there were also occasional seeds from more damp-loving species. The latter were likely brought to the site along with peaty turfs, evidenced by the recovery of small amounts of peat and charred rhizome (underground stems) fragments in a number of features from the site.

9.2.4 Burnt Bone

Small quantities of burnt bone (maximum 8g, average <1g) was recovered from 19 contexts and these were assessed by Jennifer Thoms of CFA Archaeology (Appendix XXI) and Jacqueline McKinley of Wessex Archaeology (Appendix XXII).

The bone fragments were all very fragmented, worn, and chalky in appearance, indicative of erosion/ degradation in the acidic sandy silt soils prevalent across the site, with a consequent loss of surface morphology. All the fragments were burnt, most were oxidised (white or pale grey in colour) indicating they had burnt at high temperatures in a high oxygen environment. The fact that no unburnt fragments were retrieved indicates that the soil conditions were unsuited for the preservation of bone, therefore the assemblage has been affected by preservation bias in that only burnt bone survived.

In many cases the surviving bone was of such a small size (<50mm) and poor condition that no statement on its possible original could be given. Broadly identifiable bone fragments were observed in six contexts. Fragments of sheep bone were identified in contexts **1609**, **1649**, and **1667** (radius and metapodia-sized bone), cattle-sized metapodia in context **1612**, and medium-sized mammal bone in contexts **1603** and **1669**. The rest of the bone from these contexts is of a size commensurate with these identifications, and no human bone could be identified within the overall assemblage.

9.2.5 Stone

Five stone finds were assessed by George Smith (Appendix XXIII). Three of them (SF 1, 2, and 3) were identified as being either natural cobbles or formed naturally. One (SF 4) may be a fragment of a shaped working slab with peck marks, although if so it is undateable.

The fifth stone was identified as an utilised pebble polishing tool (SF 6) of a very fine-grained stone, possibly chert. It is smoothed from use on both flattish faces and worn to a facet on one narrow edge. Evidence of light hammering is visible on both ends. The edge faceting suggests it was used for leather burnishing, and the presence of the copper thimble within the same feature would appear to support this.

9.2.6 Slag

The slag was examined visually with a low-powered binocular microscope where required by Dr Tim Young of GeoArch (Appendix XXIV). Small fragments of indeterminate iron slag were noted from deposits **1599** and **1609** (the fills of pits **1598** and **1608** respectively). These were not identifiable, however, their textures are compatible with identification as smithing slags and may date from the Iron Age to the modern period.

Fuel ash slag was noted from contexts **1603**, **1667** (fill of posthole 1666), and **1680**, with the largest amount coming from contexts **1603** and **1680**. The latter is the charcoal-rich deposit at the base of corn drier **1678**. Layer **1603** was formed of burnt waste from feature **1602**/**1683**. Fragments of slag with an adhering red sandy ceramic, possibly from a hearth wall or floor were noted within the collection from deposit **1603**. The fuel ash slag is very similar to slags from corn driers, as well as to slags from other long-burning hearths.

The submitted material also included particles of burnt and/or cooked organic matter from contexts **1513**, **1599**, **1603**, **1609**, **1668**, **1669**, and **1680**. The original nature of the organic material was not determinable.

9.2.7 Other Finds

A small number of finds were recovered during the processing of the samples. These included two small fragments of modern pottery, a fragment of modern glass, and two very small fragments of possible iron objects. Both the glass and pottery fragments are likely to be later intrusions into the fills of the features, most likely by ploughing or animal disturbance. The iron fragments may also be later intrusions, however they are too small to be identifiable.

9.2.8 Dating

Dateable finds were few with the only two found (the thimble and pot sherd) suggesting activity in the 15th century AD. It was initially expected that prehistoric activity would be represented on site and it certainly seemed likely that activity of various periods might be represented. A full programme of radiocarbon dating was therefore necessary.

Table of dates from Dolbenmaen WTW (See Figure 55 for location of dated features)

Lab No	**Context No**	**Context Description**	**Material/species**	**Radiocarbon Age (BP)**	**Calibrated date (95% confidence)**[3]
SUERC-68324	1521	Fill of posthole [1520]	charred grain: *Avena* sp. (oat)	1616 ± 34	cal AD 380–540
SUERC-68325	1521	Fill of posthole [1520]	charred grain: *Hordeum var vulgare* (hulled barley)	1637 ± 34	cal AD 330–540
SUERC-68326	1585	Fill of posthole [1584]	charred hazelnut shell	3276 ± 34	1630–1450 cal BC
SUERC-68327	1603	Burnt spread associated with possible corn drier 1602/1683	charred grain: *Avena* sp. (oat)	592 ± 64	cal AD 1290–1420
SUERC-68328	1603	Burnt spread associated with possible corn drier 1602/1683	charred grain: *Avena* sp. (oat)	461 ± 34	cal AD 1410–1470
SUERC-68332	1589	Fill of pit [1588]	charred hazelnut shell	677 ± 34	cal AD 1270–1390
SUERC-68333	1649	Basal fill of pit [1648]	charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)	2537 ± 34	800–540 cal BC
SUERC-68334	1649	Basal fill of pit [1648]	charred hazelnut shell	1395 ± 34	cal AD 600–670
SUERC-68335	1645	Fill of posthole [1644]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	2296 ± 34	410–230 cal BC
SUERC-68336	1645	Fill of posthole [1644]	charred grain: *Avena* sp. (oat)	658 ± 34	cal AD 1270–1400
SUERC-68337	1661	Basal fill of ring ditch [1656]	charred hazelnut shell	8971 ± 34	8280–7990 cal BC
SUERC-68338	1661	Basal fill of ring ditch [1656]	charcoal: *Corylus* sp.	2374 ± 34	540–390 cal BC
SUERC-68342	1667	Burnt fill of pit [1666]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	758 ± 34	cal AD 1210–1280
SUERC-68343	1667	Burnt fill of pit [1666]	charred grain: *Avena* sp. (oat)	708 ± 34	cal AD 1260–1390

[3] The dates are calibrated using OxCal v4.2 and rounded outward to 10 years.

Lab No	Context No	Context Description	Material/species	Radiocarbon Age (BP)	Calibrated date (95% confidence)[3]
SUERC-68344	1669	Burnt fill of pit [1668]	charred grain: *Hordeum var vulgare* (hulled barley)	737 ± 34	cal AD 1220–1300
SUERC-68345	1669	Burnt fill of pit [1668]	charred grain: *Avena* sp. (oat)	677 ± 34	cal AD 1270–1390
SUERC-68346	1679	Fill of corn drier [1678]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	764 ± 34	cal AD 1210–1290
SUERC-68347	1679	Fill of corn drier [1678]	charred grain: *Avena* sp. (oat)	909 ± 34	cal AD 1020–1220
SUERC-70635	1563	Fill of pit [1562]	charcoal: *Corylus avellana*	5083 ±33	3970–3790 cal BC
SUERC-70636	1563	Fill of pit [1562]	charcoal: *Corylus avellana*	5042 ±33	3960–3710 cal BC
SUERC-70637	1549	Fill of corn drier [1547]	charred grain: *Avena* sp. (oat)	1544 ±33	cal AD 420–600
SUERC-70638	1549	Fill of corn drier [1547]	charred grain: *Hordeum var vulgare* (hulled barley)	1588 ±33	cal AD 390–560

Twenty three samples were submitted but one sample was failed during pretreatment, leaving 22 dates obtained on 12 features. All but two features have pairs of dates, however the measurements from five of the ten pairs of dates are not statistically consistent, indicating considerable mixing of material in some features on the site.

The earlier dates are isolated and unsupported by other dates from the same or neighbouring features. A Middle Iron Age and a medieval date (SUERC-68335 and -68336) were obtained from posthole **1644**, and the similarity of the medieval date to statistically consistent paired dates from nearby pits and postholes suggests that the feature is probably also medieval in date and that the Iron Age material is residual.

A single date (SUERC-68326) on a hazelnut shell from posthole **1584** suggests a Bronze Age date, but the presence of residual material in other features brings this into question, especially as hazelnut shells are especially robust.

Early Iron Age and early medieval dates (SUERC-68333 and -68334) from pit **1648**, inside the circular gully **1652** are hard to explain. The dates are not similar to the other Iron Age and early medieval dates from the site and it is impossible to tell which might provide the most reliable date for the feature, or whether they are both residual.

The main ring ditch **1656** was assumed to be the ditch round a Bronze Age barrow but the two dates from its fill (SUERC-68337 and -68338) were not useful in dating it. One date on a hazelnut shell is Mesolithic, while the other, on hazel charcoal, is Early Iron Age. The nutshell is likely to be residual, but with the lack of other Early Iron Age dates from the site it seems possible that the Iron Age date is residual also.

The medieval dates being more consistent and coherent can be taken as indicating the date of the main phase of activity on the site. When the medieval dates are modelled they suggest that the activity began probably in *cal AD 1170–1260* (*68% probability*) and ended probably in *cal AD 1285–1330* (*68% probability*). The overall span of medieval activity was probably *35–155 years* (*68% probability)*.

This model includes the medieval dates from the western part of the site but excludes the dates on the possible corn drier **1602**/**1683** further east. The latter has two dates (SUERC-68327 and -68328) only at 3σ, possibly suggesting a long period of use. The later date (SUERC-68328) provides the best single date estimate for the activity (cal AD 1410–1470; 95% confidence), placing the use of this feature somewhat later than the main group of features to the west. Its 15th century date is supported by the presence of a sherd of Midland purple ware in the feature. However the presence of the thimble in pit **1608** also hints at 15th century activity in the main area, and it may be that the dates obtained were too few to represent the full duration of activity on the site.

Of particular interest are five results (SUERC-68324, -68325, -68334, -70637, and -70638), from three features, dating to the mid-1st millennium cal AD, as there are so few early medieval settlements known in Wales. SUERC-68334 is from pit **1648** which also produced an early Iron Age date, so the significance of this date is uncertain. It is also statistically significantly different to the other 4 early medieval dates, which are all consistent and could be the same actual age. Two pairs of these dates are from posthole **1520**, part of the four-poster structure and two are from an outlying corn drier (**1547**). These suggest activity dating sometime in the period cal AD 330–540 to cal AD 420–600.

Also of considerable significance are two results (SUERC-70635 and -70636) pit **1562**, an isolated pit filled with burnt stones. The more recent of the two consistent dates (SUERC-70636) provides the best estimate for the date of the feature (3960–3710 cal BC; 95% confidence), making it very early in the Neolithic period for north-west Wales.

10 INTERPRETATION

10.1 Pipeline Field 1

The curvilinear ditch (**01001**) uncovered within Field 1 (Figures 7-10) most likely represents an enclosure ditch which may have enclosed a small settlement. Its location, on fairly high, flat ground, within close proximity to a river would make an ideal location for a settlement. The four postholes (**01017**, **01032**, **01040**, and **01042**) enclosed by this ditch may form part of a structure, although their close proximity to the edge of the excavation area means that the form of this structure is unknown. These postholes, along with the presence of a high concentration of cereal grain within both the postholes and the ditch, are suggestive settlement activity within the enclosure.

The V-shaped profile of the ditch is typical of the Iron Age and the radiocarbon dates confirm an Iron Age date. The dates suggest that activity relating to the postholes began probably in *60 cal BC–cal AD 40* (*68% probability*) and ended probably in *cal AD 20–120* (*68% probability*).There is a significant difference between the dates from the basal fill of the ditch and from the postholes enclosed by the ditch, with the best estimate for the primary deposition in the ditch being 380–170 cal BC (95% confidence; SUERC-68356). This could indicate different phases of activity. However charcoal was rare in the basal deposit and mostly below the level of identification with only a few fragments of oak roundwood identifiable. The basal fill seems to have been an erosion deposit so and it is probable that the charcoal came from the ground surface and eroded into the ditch. The dated material therefore could pre-date the ditch by a considerable period. However it does hint at earlier Iron Age activity and may still indicate that the settlement was long lived.

Archaeological evidence suggests that the ditch did pre-date the postholes inside it. Although unenclosed settlements may be later enclosed, it is also common for settlements to continue in use once the ditch has been abandoned and filled in, and it appears that this may have occurred in this case. It would be expected that the ditch would be accompanied by a bank on its inner edge. The positioning of the postholes gives no room for a bank, suggesting that they were inserted after the bank had been pushed or eroded into the ditch.

The sections of the ditch are quite variable (Figures 11-14) and are not conclusive about the presence of a bank though all but one have significantly more material eroding in from the southern side. The exception is where the ditch has gullies to the north (1073 and 1070) and material from digging the gullies may have been thrown into the ditch. If so the gullies were dug fairly soon after the ditch and before it started to fill from erosion from other sources. The other sections are consistent with a bank on the inside of the ditch. One section (Figure 13) has a series of deposits sloping down its southern side that may have come from a successively eroding bank. These include fairly large stones that might have formed a revetment to a bank. The quantity of stones part way up the ditch fill in most of the sections suggests that there were quantities of stone in the area that were dumped into the partly filled ditch probably to clear the area for agriculture after the settlement had been completely abandoned. These stones may have come from a revetment to the bank or walls or wall foundations of roundhouses.

It is possible therefore that the main settlement was considerably earlier than the very late Iron Age dates on the postholes and that the ditch, with the proposed bank, had gone out of use and been partly levelled by the time of the later phase of activity on the site, which extended into the Roman period. The tiny eroded sherd of Samian ware (SF3) found in the ploughsoil in trial trench 01, which cut across the ditch and internal area, supports the use of the site into the Roman period, and suggests that the settlement was rich enough to purchase some Roman artefacts.

As such a small area of the probable settlement was revealed and dated it is impossible to be more than tentative in this interpretation. The size of the ditch does suggest a fairly substantial settlement but how large this was is unknown. As the geophysical survey carried out along the pipe route was restricted to the easement this did not detect any more of the enclosure than was excavated. However there does appear to have been an enclosed Iron Age settlement here used into the very end of the Iron Age, even it became unenclosed in later phases.

10.2 Pipeline Field 9

The remains of a stone wall (**09032**) and a cobbled road (**09026**) uncovered within Field 9 have been dated to the post-medieval period due to the presence of post-medieval pottery and iron horseshoes within each of them respectively. Both the cobbled road and the stone wall run roughly parallel with the main A487 road, although the wall appears to turn towards it at one end, while the cobbled road appears to curve slightly away from it at both ends. Directly to the northwest of these features, a local trackway runs from the A487 to the west-south-west and past the remnants of the Beudy Cil Haul manganese mine (PRN 21533) which dates to the post-medieval period. Given the close proximity of this mine then it is likely that the cobbled road and the stone wall are contemporary and related to the activity carried out here.

A large amount of other post-medieval activity was also noted within Field 9, the majority of it consisting of modern pits, furrows, drainage, and a field boundary ditch. Due to this large amount of post-medieval activity and the lack of any other dating evidence, it is likely that the remaining undated features are also result of the activity dating to this period, and are most likely also associated with either field clearance, or activity associated with the mine.

10.3 Pipeline Field 39

The stone platform (**39001**) uncovered at the north-western end of Field 39 was located adjacent to a stream and within/on the edge of a marshy area. The exposed section appeared to be part of a linear feature running north-east to south-west, rather than being an isolated platform and may have been part of a causeway across this rather boggy area. No dating was recovered from this feature and its date is uncertain, although it may be associated with the post-medieval houses located nearby. No trackway is shown here on the 25 inch OS maps so it presumably pre-dates the late 19th century.

The stone concentration (**39027**) partially revealed within Field 39 was located at the bottom of a slope and close to the convergence of two stone drains (**39004** and **39021**). This area is therefore likely to have become regularly waterlogged, and it is probable that the stones were deliberately dumped here most likely to produce a more stable/drier area. Given that the drains are of a post-medieval date, then it is likely that this stone concentration also dates to this period.

The burnt spread (**39015**) in Field 39 was typical of a burnt mound. It contained a high concentration of burnt stone, and represents the remnants of a ploughed out burnt mound. Feature **39017** was a pit that probably acted as a trough to hold water. Feature **39019** appeared to be more of an irregular hollow than a trough but insufficient was excavated to understand its form. No lining was revealed within either of these features, although the clayey nature of the natural geology within this area would have allowed water to be retained without a lining. No evidence of *in situ* burning was visible in the excavated area so the hearths which probably accompanied the pits were not located. There may have been other pits and fire sites under the parts of the mound that were not removed.

Burnt mounds are commonly found close to a water course. In this case the site is 350m south of the river, not convenient for obtaining water, but as it is on the flood plain the water table would have been high and the troughs would probably have filled easily from ground water. The function of burnt mounds is still uncertain, with ideas ranging from a sauna, to use in salt production, fulling, or cooking. The lack of animal bone recovered from the majority of these features has been used to argue against cooking as not the primary function of a burnt mound, but bones do not survive in the wet, acid soils that cover most burnt mounds and occasionally when conditions are favourable bones are found (Kenney 2012).

The radiocarbon dates when modelled suggest the activity probably started in *2935–2765 cal BC* (*68% probability*) and ended in *2870–2400 cal BC* (*95% probability*), having probably been in use for *1–250 years* (*68% probability*). This makes the mound late Neolithic in date rather than the Bronze Age date usually assumed for burnt mounds, but mounds of a late Neolithic date are being found more frequently in north-west Wales as more dates are being obtained on these features.

Several mounds found along a pipeline route near Criccieth and Pentrefelin had Neolithic dates. The earliest was probably in use in 2800–2670 cal BC (*68% probability*), making it roughly contemporary with the Field 39 mound, while others were in use during what can be referred to as the Beaker period, covering the period roughly from 2500 to 200 BC. A large burnt mound near Pentrefelin used over a long period started being used in *2715–2510 cal BC* (*68% probability*) (Kenney *et al* 2014, 65-66). Burnt mound activity in North West Wales in general seems to start around 2500 cal BC (Kenney 2012), with some earlier dates, including one mound from Parc Bryn Cegin, Llandygai with dates of 3490-3120 cal BC (KIA-30449) and 3340-3020 cal BC (KIA-30450) (Kenney 2008).

10.4 Other features on the pipeline route

The remains of a wall (**50001**) were uncovered at the southwestern end of Field 50. The foundations were well-constructed, and could have supported a substantial wall. No wall is shown on the 25 inch OS maps in this location so it presumably pre-dates the 19^{th} century consolidation and rationalisation of the fields. Alternatively the quality of the wall may suggest that it was the wall of a small building otherwise completely removed.

The ditches uncovered throughout the pipe route all relate to either current or relict field boundaries, or form part of a drainage system within the fields. The majority of isolated features were, upon excavation, seen to be off a natural nature with the remaining features being mostly of a post-medieval nature. The isolated nature of these features suggests only small scale, one off activity in these areas.

10.5 Palaeoenvironmental evidence

Pollen analysis is most often carried out on uplands where suitable marshy deposits are available. It is relatively rare that it is carried out in a lowland environment close to sites occupied in antiquity, as has been possible in this project. The pollen study has provided a view of the changing environment along the valley for the whole of the Holocene, with sample sites in many cases not far from archaeological sites.

The pollen evidence shows that during the early Mesolithic period woodland started to colonise the area, developing into dense, stable deciduous woodland by the late Mesolithic period, with alder carr in the valley bottom. No trace of the influence of Mesolithic people on the woodlands was detected in the pollen cores studied but this does not rule out small scale impact especially on the upper edges of the woodland. It is possible that much more detailed work might detect their presence in the pollen record.

Evidence of woodland clearances was detected in the early, middle and late Neolithic periods at different sites along the valley, suggesting small scale, short-term clearance. A decline in elm pollen may be related to Neolithic farming but this is not seen in all the cores showing how localised traces of clearance might be. The variation in presence and timing of the elm decline in cores that are physically close together emphasises that a decline in elm in one core may not indicate a region-wide event, and shows that pollen sites need to be very close to the location of farming activity to register it.

From the Neolithic period onwards there is evidence of continued woodland clearance, but this is small scale and temporary and the woodland remains the dominant feature of the landscape, with oak and hazel growing on the drier slopes and dense alder carr in the wetter valley bottoms. There is some evidence for openings in the woodland and establishment of pasture land with some cereal pollen grains suggesting some agricultural activity in the late Bronze Age. However both pasture and arable lands might have been more extensive further up the hill slopes.

By the late Iron Age the upper part of the valley may have had an open environment, with woodland having been cleared and acid heathland and Sphagnum bog established. It seems probable that there was also more clearance on higher slopes of the main Dwyfor valley, with possibly only the bottom of the river valley being densely wooded.

From the Iron Age onwards evidence for both pastoral and arable activity increased, although woodland remained important, at least in the valley bottom into historic times. By the middle of 1st millennium BC the landscape had become more open and well populated.

In the medieval period the landscape was largely open with ridge and furrow cultivation along much of the valley floor. In places woodland clearance for agriculture on acid soils led to soil depletion and the development of heathlands. The opening up of the landscape also led to reduction in the alder carr woodland, which was replaced by fens and *Sphagnum* bog, as increased run-off made the valley floor wetter.

In the post-medieval period there was a great expansion in both pastoral and arable activity and there is evidence of exotic timber planted in recent centuries.

10.6 Dolbenmaen Water Treatment Works

10.6.1 Early Neolithic Earth Ovens

There is evidence of prehistoric activity around the Dolbenmaen WTW with the presence of two pits located near the river. Pits **1545** and **1562** contained heat-fractured stones typical of burnt mound material, and it was assumed that these were pits relating to burnt mounds that had otherwise been entirely ploughed away. However pit **1562** was dated and proved to be very early Neolithic in date (3970–3790 cal BC (SUERC-70635) and 3960–3710 cal BC (SUERC-70636) 95% confidence). Without further dating it is not possible to prove that feature **1545** is of the same date as **1562**, although its similar form, burnt-stone fill and similar location in relation to the river suggest that both these features are probably the same date and performed the same function.

Although the earliest burnt mound known in the region dates to the mid Neolithic the very early date suggests that these were not the remains of burnt mound activity. Small, isolated pits filled with burnt stone have been interpreted elsewhere (Kenney 2008) as earth ovens. Two, possibly three, dated at Parc Bryn Cegin, Llandygai near Bangor were also early Neolithic in date and it is assumed that these were the remains of very transitory occupation. Any structures that might have been associated with these must have been very slight and not traces now remains.

The early date on pit **1562** is very significant. Dates on typically Neolithic features and artefacts in north-west Wales are rarely earlier than about 3800-3600 cal BC. Neither of these pits contained charred cereal grains or any artefacts. Identifying them as culturally Neolithic is therefore difficult. This single dated pit may represent activity taking place right at the cusp of the transition from hunter-gathering to farming but it provides no evidence to show which culture it belongs to; if such a crude division can be made for individual sites and features at this period.

The dates on pit **1562** are quite similar to the earliest earth oven at Parc Bryn Cegin with dates of 3900-3640 cal BC (NZA-26837) and 3940-3650 cal BC (NZA-26838). This feature (pit 6033) was also a small, shallow sub-circular pit but it was lined by a thin layer of plastic white clay. Like **1562** it was filled by burnt, fire-cracked stones and charcoal. Two other earth ovens from this site had early Neolithic dates, though, not as early. These were also small sub-circular pits but they had some evidence for a sealing deposit that would have sealed in the hot stones and turned the pit into an oven (Kenney 2008).

The only artefact from the early Parc Bryn Cegin ovens was a flint blade with evidence of use. Like **1562** and **1545** these ovens had very few charred plant remains other than charcoal, suggesting that the processing of grain and hazelnuts was not carried out in or near the pits.

It is suggested that as earth ovens these pits were filled with hot stones, possibly heated on a fire in the pit, then food would be placed on the stones after the fire had burnt out and the oven would be sealed with clay, earth or turves. Most recent anthropological parallels are large, catering for communal feasts, but similar technology would function for smaller quantities of food. Similar technology is still used for cooking in Polynesia and Australia (Hurl 1990, Wright 2000), and Hurl (1990) states that smaller versions with an area of only 1m^2 were in daily use in Papua New Guinea. There are also ethnographic records from Canada of similar ovens, which were described as being 2-4m in diameter and used exclusively for cooking starchy roots (Campling 1991).

If these were small ovens for everyday cooking this would be unlikely to take place far from contemporary settlement and these might be the only surviving evidence for ephemeral settlements with very slight structures, the traces of which would not survive. The scarcity of artefacts also argues that if these were settlement sites they were very short-lived and few activities took place there. These small, rather insignificant features may, therefore, be the only traces of a type of Early Neolithic settlement pattern very different to that possibly represented by the large timber buildings now being found more frequently in north-west Wales.

10.6.2 Medieval settlement

The medieval radiocarbon dates from several features within the western part of the Dolbenmaen site led to a reassessment of the site as an area of medieval activity. As well as the specifically dated features the presence of charred oat grains can be used as rough dating evidence. Oats only becomes common in the medieval period and significant numbers of charred oat grains in a feature can be used to indicate a medieval or later date (Figure 55) (Hastie appendix XX).

Several features contained charcoal-rich deposits with burnt bone and charred cereal grain that appear to have been domestic waste from fires and cooking. In postholes **1666** and **1668** this material is well mixed into the fills of the features and probably represents occupation debris dumped into the posthole after the posts have been removed. The lack of intact post packing supports the suggestion that the posts were removed. In pit **1608** this layer of waste was present in the top of the largely infilled pit so it probably represents an occupation deposit spread over the area but only surviving where it collected in hollows left where earlier pits had been mostly filled in. The presence of the broken thimble in one of these pits supports the domestic waste interpretation, but cannot be used to date pit **1608**, only the general occupation activity and it suggests multiple phases of activity in this area.

If the similarity in form of pit **1608** can be used to argue that it was part of the group of rectangular pits (**1596**, **1598**, **1600**, and **1604**) it may give a rough date to this whole group. The thimble dates to around the late 14th or early 15th century, so the later occupation deposit in the top of pit **1608** may be later medieval in date and the digging of the pits pre-dates this, though it is impossible to say by how long.

The features that produced medieval radiocarbon dates in this area imply occupation probably between about *cal AD 1170–1260* and *cal AD 1285–1330* (*68% probability*). There would appear to be a main phase of activity in the 12th or 13th centuries and some continued presence into the late 14th or early 15th century. The latter occupation seems to have included leather working as the thimble, which could have been used in sowing leather, was found with a polishing stone, probably used to burnish leather. Both phases produced waste suggestive of cooking fires, so some kind of dwelling was probably present.

Several features can be identified as postholes and seem to have formed part of a structure Figure 55). Feature **1674** appears to be a convincing posthole and features **1666** and **1668** have been interpreted as postholes due to their steep sides and regular shape even though they did not contain packing stones. Other features in the same area, while not certainly postholes, are probably best interpreted as such. Features **1674**, **1590**, **1588** and **1668** formed a fairly accurate rectangle measuring 12.3m by 5.3m. This was aligned north-west to south-east and the south-eastern end was additionally defined by features **1664** and **1672** lying just south of the line between the main postholes. Posthole **1666** fell in the north-eastern side of this rectangle, close to **1668**, and **1592** might be seen as extending the south-western side another 5.5m to the north-west. Although a temptingly regular shape this layout of postholes does not necessarily indicate a single building. There are no intermediary postholes along the walls except for the south-eastern end and no obvious supports for the roof. For this to be interpreted as a substantial building it must be assumed that some structural features have been lost to ploughing or other erosion, or that it was partly cob-walled.

An alternative might be that **1588**, **1590** and **1592** formed a four-post structure with a posthole cut away by pit **1618** and the other postholes to the south-east formed a separate small structure.

The group of rectangular pits (**1596**, **1598**, **1600**, and **1604**) could also be part of the first phase of the medieval settlement. Their function is unknown, although it is not entirely impossible that they were postholes and represent a small structure.

Although pits **1626**, **1630**, and **1637** were located within the area of the medieval activity their stony fills suggest deliberate disposal of stones, possibly as part of a field clearance. It is therefore likely that they are post medieval in date and unrelated to the settlement.

Most of the pits and postholes in the western part of the WTW site are therefore interpreted as the remains of a small medieval settlement with possibly a dwelling and various types of activity associated with it. Part of the support for a settlement here also comes from the presence of corn driers, some of which appear associated with the possible settlement (see below).

The settlement appears to be part of a wider landscape. If the ring gullies to the west of the settlement area are in fact gullies around haystacks as argued below, though not proved, then this provides an immediate context for the settlement. To the east are the ditches of the field system. The way that the ditches relate to each other suggests that most are part of a coherent field system, including two walls that were still in use when the project started. As discussed above the curves of the boundaries and the small size of the fields are suggestive of medieval fields. It seems probable that although the field system was probably in use over a long period it originated in the medieval period. Many fields in use today in north-west Wales hold traces of medieval or even Iron Age origins (Kenney 2015), so the use of some boundaries through into the modern period does not in any way rule out an early origin.

The settlement seems to have been located on the western edge of the recorded field system but the fields probably continued to the west of the settlement as well. The 1839 tithe map shows a narrow field called “Llaen Bryn Rhosedd” immediately west of the main excavated area. The boundaries of this would have extended through zone A of the WTW works but this area was only topsoil stripped so the boundaries were not recognised. This narrow field would have been a group of “lands” enclosed possibly in the 16^{th} century, “lands” being narrow strips forming part of a medieval open field system. “Llain” is the Welsh term for a quillet or group of “lands”, and implies medieval arable agriculture (Thomas 1980, 345).

10.6.3 Corn driers

Two features just north of the proposed settlement area are interpreted as corn driers and the quantity of charred grain in some of the other medieval features indicates that a major activity of this settlement was dry and processing corn.

There was some confusion with feature **1678**/**1681**, to the north of the settlement activity, as it was initially interpreted as two pits, but the photographs show a more linear form and the stone lining to **1678**. Although badly truncated and disturbed it is likely that it was originally a ‘dumb-bell’ shaped feature and is the remains of a corn drier. The open end (**1681**) would be access to the flue (**1678**). A fire would have been lit in the southern end of the flue, causing the reddening on the base of the feature and the charcoal deposit. The lost northern end would have opened into another wider area over which the grain would have been suspended to dry.

Feature **1678**/**1681** was dated by two radiocarbon dates, one on a grain of wheat and one on a grain of oats (cal AD 1210–1290 (SUERC-68346) and cal AD 1020–1220 (SUERC-68347)). These dates are not statistically consistent and probably indicate a long period of use of the corn drier. Unlike some of the other corn driers (discussed below) it did not produce hundreds or thousands of charred grains, possibly because there was never an accident when the grain caught fire. Alternatively the relatively low numbers may be due to the chamber for grain drying not having been excavated and this is where accidentally burnt grain might be expected to have collected. However it did produce significant numbers of oats, and a small number of wheat grains. Perhaps the date on the oat grain represents the main period of use of the corn drier and the wheat was from a later, short-lived reuse. The dates for the use of this feature fit well with the main phase of medieval settlement on the site.

The large number of charred cereal grains (over 11,000) from feature **1622**/**1624**, with its key-hole shape, strongly suggests that this was also a corn drier. In this case the fire was lit in the elongated hollow (**1624**) and the grain was suspended over the pit (**1622**). The extent of the burnt deposit in **1624** shows that the fire would have been directly under the grain at times. The closeness of the fire to the grain no doubt resulted in the accidental burning of the grain, resulting in the thousands of charred grain surviving. Of the identifiable grains 46% were oat 4% hulled barley, 1% wheat and 5% rye.

Another feature out in the fields is the small stone-filled gully (**1602/1683**). The associated burnt layer **1603** contained a high concentration of fuel ash slag as well as some charred grain, which may indicate that this feature was also a corn drier. However the form of this feature does not correspond to the needs of a corn drier where a fire and a pit to suspend the grain over are the basic requirements. The stone layer and stone pad (**1583**) also do not have an obvious function in a corn drier. The heat-cracked stone pad suggests high temperatures but only in a limited area and it is possible that this was some other kind of kiln or furnace with the grain and straw being introduced as fuel. However more extensive burning might be expected in this case. The function of this feature can therefore not be demonstrated.

Layer **1603** did produce dates of cal AD 1290–1420 (SUERC-68327) and cal AD 1410–1470 (SUERC-68328), both on oat grains. The later date might be taken as the best estimate for the date of the activity and this is supported by the discovery of a pot sherd dating from the

15th century from the soil around the stone pad (1583). This feature therefore seems to have been associated with the later phase of the settlement as represented by the thimble in pit **1608**.

Drying grain helps to preserve it for storage and enables easier milling. Corn driers might also be used as part of the malting process to encourage the germination of the grain (Hastie appendix XX). However there is no evidence for malting on the present site and it seems to be rarely found from corn driers in north-west Wales. Whilst the drying of corn will have been undertaken throughout prehistory, specific structures were constructed for this purpose from Roman times onwards (O'Sullivan and Downey 2005, Scott 1951). Corn driers are often keyhole or dumb-bell shaped, with a pit over which the grain was suspended and a place to light the fire with ideally a flue between the two to reduce the risk of the grain catching fire (O'Sullivan and Downey 2005).

Many corn driers in north-west Wales are radiocarbon dated to the 12th or 13th centuries AD. A partially stone-lined corn drier at Cefn Du, Anglesey was dated to cal AD 1000-1280 (Wk-9275) (Cuttler *et al* 2012, 25). A corn drier at Graeanog, Clynnog was dated between 880-1160 cal AD (CAR-934) and 1040-1280 cal AD (CAR-932) (Kelly 1998, 132), and one at Parc Bryn Cegin, Llandygai to between cal AD 1040-1260 (Wk-20035) and cal AD 1020-1220 (Wk-20036) (Kenney 2008, 132). A corn drier at Llanbeblig, Caernarfon was dated to cal AD 1050–1260 (SUERC-42596) and cal AD 1220–1280 (SUERC-41961) (Kenney and Parry 2013, 39). A well-preserved and well-built example of a dumb-bell shaped corn drier was excavated near Glan Morfa, Llanystumdwy (PRN 34081). This had a stone-lined flue and modelling of dates from it gave a best estimate for the date of the feature of probably *cal AD 1185–1255* (*68% probability*) (Kenney *et al* 2014, 18-19). There appears to have been an increase in the use of corn driers in this period. This is probably related to the increase in the cultivation of oats, which are generally picked under-ripe and then require drying (McKenna 2013).

The proportion of oats in the corn driers at Dolbenmaen WTW shows that this species was the main crop. Oats are well suited to a humid, wet climate and will tolerate poorer soils, and would be suitable to grow on the free-draining acid loamy soils in the area surrounding the site. Oat straw is more palatable and nutritious than that from other cereals, so an additional advantage of growing oats would be a source of winter fodder instead of hay (Hastie appendix XX). Rye can tolerate acidity, sandy and low soil fertility and may have been and autumn sown crop. Rye was found only in feature **1622**/**1624**, which also produced seeds of corn marigold (*Chrystanthemum segetum*) and nipplewort (*Lapsana communis*). Both species are also associated with lighter loams but corn marigold is usually associated with spring grown crops. It is possible therefore that both autumn and spring sowing was practiced to spread the work of sowing more evenly across the year (Hastie appendix XX).

Of particular interest is another probable corn drier to the east of the settlement area. The quantity of charred grains in the base of this pit (**1547)** suggests that this was also a corn drier. This was probably a simple pit corn drier with the fire directly under the grain and a hollow to allow access to feed the fire. This direct heat may have led more often to accidents where the drying grain was burnt. The particular interest of this feature comes from its early date. Both oats and barley grains were dated and showed the feature to be early medieval in date (cal AD 420–600 (SUERC-70637) and cal AD 390–560 (SUERC-70638)). This shows that oats and hulled barley, at least some of which was the two-row variety, were being grown at this date and being dried in much the same way as later in the medieval period. Barley was the main crop being dried when an accident occurred to char much of the grain, but 15% of cereal grains present were oats so this was also being grown as a crop, potentially together with the barley, as spring cereals (Hastie appendix XX).

In Ireland the early medieval period saw the peak in the use of corn driers (McCormick *et al* 2001, 33) but in north-west Wales, as discussed above, most dated examples fall into the 12th or 13th centuries AD. Feature 1547 is the first corn drier to be dated to the early medieval period.

The other feature on the site that may be related to corn driers is feature **1602**/**1683**. The dump of waste (1603) associated with this contained a mixture of cereal grains, nutshell, weed seeds, large amounts of charcoal, fuel ash slag and low amounts of carbonised peat. The cereal grain and weed seed assemblages are similar in composition to those recovered from the corn driers and fuel ash slag is typical of corn driers, although it can be formed in other conditions. However the quantity of grain per litre of soil recovered from deposit **1603** is much lower than the other corn driers. The position of this feature in the corner of a field is typical of corn driers but its form is difficult to explain in relation to the function of a corn drier. This feature was dated by radiocarbon dates and pottery to the 15th century AD and was probably associated with a possible later phase of activity in the medieval settlement. Future excavations might find better preserved examples of such features that may help to confirm the function of **1602**/**1683** and whether it can be considered as an atypical structure for drying corn.

10.6.4 Possible early medieval settlement

The four-post structure (**1516**, **1518**, **1520**, **1522**) is almost certainly a granary and would fit well with a small settlement using and drying cereal grains. However the dates from this structure suggest an early medieval date, much earlier than the rest of the activity (cal AD 380–540 (SUERC-68324) and cal AD 330–540 (SUERC-68325) from the fill of posthole **1520**). Postholes **1508**, **1534**, **1584** could also be part of a granary, the fourth posthole of which has been destroyed or possibly missed by the excavation, but the single date from this group (1630–1450 cal BC (SUERC-68326) from the fill of posthole **1584**) indicates a Bronze Age date. The date might possibly be dismissed as a residual hazelnut shell that has become incorporated in the fill of a later posthole, although the absence of charred cereal grains from the fills of these postholes does support a pre-medieval date. Posthole **1510** was very similar to the nearby group of three and could represent another granary most of which had already been destroyed by the original WTW.

These granaries are typically found on Iron Age sites, with similar examples found at Moel y Gerddi, near Harlech (Kelly 1988, 111), and at Llandygai, near Bangor (Lynch and Musson 2004, 94-95). Although the group of three postholes and the single posthole (**1510**) have not been satisfactorily dated the two statistically consistent dates on charred cereal grains from the four-poster would seem to give a reliable date for the feature and are hard to argue away. This feature at least is not Iron Age or associated with the later medieval activity.

A granary is unlikely to be far removed from settlement and it is possible that an early medieval settlement existed just to the south of the four-poster but that it was destroyed when the water treatment works was built. However a trace of a contemporary house may be present in the excavated area. The curving gully (**1642**) is quite unlike the other two circular gullies on the site and is possibly the drip gully or wall trench for a circular building. The lack of structural postholes within this area perhaps argues against this. However, if it was a drip gully for a clay-walled roundhouse, the wall of which had been ploughed away as they often are, then the lack of postholes would be less significant as clay-walled roundhouses often support the roof entirely on the walls. There is no date from the gully but the presence of a single oat grain from its fill could hint that it is contemporary with the four-poster.

Further evidence of early medieval activity comes in the form of corn drier **1547**, described above. Although this is 84m from the four-poster statistical tests on the dates show that the corn drier and four-poster could be contemporary and the drier might have been used to dry the grain stored in the granary. It would be normal to have the corn drier some distance from the settlement where any accidents would not lead to a risk of fire spreading.

Although this proposed settlement is based on four radiocarbon dates and contains no certain domestic structures the scarcity of early medieval settlements in north-west Wales makes this a site of considerable significance. It is hard to associate this site with the knoll of Pen yr Bryn Orsedd, at the foot of which it lies. If the knoll was used as an assembly place, as is argued below, it would have been in use several centuries after the date on the four-poster and corn drier, which are so early as to be possibly very late Roman. However the juxtaposition seems too close to be purely coincidental and may indicate the early growth of Dolbenmaen as an important place in the early medieval period.

10.6.5 Circular Ditches

The three possible ring ditches appeared on excavation to be the most significant features on the site and it was assumed that they were the ditches around Bronze Age earthen barrows, subsequently ploughed away. However further analysis has failed to provide any evidence of a prehistoric date and funerary use. Features that were originally thought to contain cremation burials were proved not to. One of these (**1648**) inside ring ditch **1652** might best be interpreted as a substantial posthole, but it is not centrally placed and it difficult to relate directly to the ring ditch. The dates on this feature are not useful. The two dates, both from the charcoal-rich layer in the base of the feature are very different (800–540 cal BC (SUERC-68333) and cal AD 600–670 (SUERC-68334)) and can only indicate mixing of the deposit with earlier material. It is uncertain which of these dates might relate to the use of the pit or whether both are on residual material. Neither are Bronze Age and so do not support the interpretation of the ring ditch as a barrow ditch.

Feature **1654** which was close to the centre of ring ditch **1652** could be the remains of a central burial but there is no evidence to suggest this function and as it was only 0.1m deep this seems unlikely even if it had been considerably truncated.

The form of feature **1652**, a deep, narrow gully with near vertical sides, and its stony fill make this feature very unlikely to be a barrow ditch. It closely resembles a stone-filled field drain except these are normally straight and not circular. There is little doubt that this was a circular drain, probably covered with soil when in use that drained a circular area to keep it dry. Such a dry circular area would be suitable for storing agricultural produce. The circular shape suggests that it surrounded a circular structure, such as a hay stack, which was often built around a central pole. Before threshing grain was also stored in corn ricks the stacks stacked in a conical heap with the straws outwards and the grain inwards (McCormick *et al*

2011, 30). These corn ricks were usually thatched to keep them dry and would also have benefitted from having a drain around them. As feature **1654** was central to the circle it is possible that this held the pole. This feature was shallow and irregular and could not be described as a posthole; however it may have been the location of several successive posts, none very firmly embedded in the ground. Feature **1648** was a much more convincing posthole and may have held a post for a hay stack located off centre to the drain. This may have been erected when the drain had been thoroughly grown over and its precise location lost, explaining why the post was not centrally positioned. The fill of **1648**, which contained charcoal, charred cereal grains and burnt bone suggests that that there was domestic occupation nearby, however the dates from this material suggests that it could have originated from much earlier occupation mixed into the soil surface.

The complete circular ditch (**1656**) is more consistent with an interpretation as a round barrow ditch. The ditch was wider than that of **1652**, at 1.1m wide, and was not filled with stones, except for a short section on the western side. The diameter of this feature, at 9.5m internal diameter, is well within the average size for barrow ditches, and the lack of an entranceway or causeway rules out its interpretation as a roundhouse gully. However the proximity of **1652** and the lack of any burial evidence raises questions about this interpretation. It is probable that this feature existed as an open ditch and the stones **1658** may to have been dumped to create a causeway into it, which would be unlikely for a barrow ditch. Assuming the earliest radiocarbon date from this feature is residual the dates could be interpreted as support that this was a gully for an Iron Age roundhouse, but it is far from typical, and there are no postholes to support a roof. A clay-walled roundhouse would not need postholes but then the surrounding drainage ditch would have needed an outflow to carry the water away. It is possible that both dated samples are residual and that this ditch also surrounded a feature such as a hay stack and that the stones provided a causeway to assist access inside.

Gully **1642** is far too slight to be a ring ditch for a round barrow, but might have been part of a circular gully 10m in diameter. The profile of the gully is much more suited to being a wall gully for a roundhouse. As discussed above it is suggested that this might be related to the early medieval activity on the site.

If the two larger ring gullies were haystack or corn rick gullies they would fit well with the medieval settlement, with hay or unthreshed corn being stored conveniently close to the possible house but far enough from the corn driers to avoid any accidents.

10.6.6 Pen Bryn yr Orsedd

Immediately north of the excavated area is a mound apparently formed of a natural rock outcrop and glacial deposits around it. This is not named on the 1st Edition OS map, which shows few placenames, but on the 2nd edition it is named as Pen Bryn yr Orsedd. The 1839 tithe map names the field covering this area as “Bryn Rhosedd”, raising the possibility of quite a different original name.

Pen Bryn yr Orsedd translates as ’the Seat on top of the Hill’, but the word “*gorsedd*” has connotations of a judicial court or assembly place. Bryn Rhosedd may be a corruption of Bryn Rhosydd, i.e. hill of the heaths or moors. However “yr orsedd” in a name often contracts to “rhosedd” and Rhian Parry of the Welsh Place-Name Society thinks that this is more likely than the “hill of the heaths” alternative. The original form of the name is of importance as it may indicate an early medieval assembly place.

The term “*gorsedd*”, which literally means ‘over-seat’, links the concept of a mound, barrow or vantage point with terms in the Welsh Laws for ‘court’ or ‘session’, and probably had some connection with the seating plan of a judicial court (Charles-Edwards 2004, 97, 98, 103). The judicial section of the royal court when sitting as a judicial court could be referred to as a “*gorsedd*”, but the term was also occasionally used for the whole judicial court (Charles-Edwards 2004, 99-101). The term “*gorsedd*” might therefore suggest the location of a judicial court, but its use in the Mabinogion in reference to Gorsedd Arberth is perhaps more suggestive of an outdoor assembly place on a mound (this site is discussed by Charles-Edwards (2004, 98), but he does not explicitly come to this conclusion).

The place name ‘Dol Pen Maen’ is mentioned in the medieval story of ‘Math and Mathonwy’ in the Mabinogion as a point where hostages were exchanged between two high-status families (Evans and Evans 2001, 57). Dolbenmaen (Dol Pen Maen) translates as ‘The Meadow with the Rock at the Head’, and the rock in this instance may be Pen Bryn yr Orsedd (Smith 2012). The choice of this location to exchange hostages suggests a pre-existing location of some significance and certainly one that both parties could recognise. Obviously the Mabinogion is a work of fiction but often refers to real places and the mention of Dolbenmaen indicates that it was a place that was considered believable as somewhere an exchange of hostages would take place.

The use of a hill or mound for a meeting place would be normal for the early medieval period. In Anglo-Saxon England assembly places or moot-sites where the hundred met were often marked by mounds, either natural or prehistoric burial mounds, and these were often close to major routeways, mostly Roman roads still in use in the period (Pantos 2004).

The probable line of the Roman road lies only *c*.60m north of Pen Bryn yr Orsedd, making it a typical choice for a meeting place. In the Mabinogion the Gorsedd Arberth clearly situated near the *llys* (royal court) of Arberth (Jones and Jones 1949, 43, 50) and it seems likely that proximity to a *llys* was necessary for a “gorsedd”. At Dolbenmaen Pen Bryn yr Orsedd is 750m west of the motte, presumably the site of the *llys*, so the association between the two is not close, but they are on the same side of the river and both close to the Roman Road. Perhaps this knoll was the closest suitable location.

As a prominent knoll near the Roman road with placename and literary connections the hints of Pen Bryn yr Orsedd being an assembly place of some sort are suggestive if not definitive. Unfortunately the project did not investigate the knoll itself as archaeological investigation of such sites would be valuable, even if the number of features and finds to be expected might be limited. The excavation did however extend to the southern foot of the knoll, but it is hard to relate the features found here to the use of the knoll as an assembly place.

The four-post granary and the earliest corn drier date to 4th to 6th centuries AD. This places them in the very early post-Roman period if not actually during the Roman occupation. The Roman road would certainly be an active routeway at this period, but the political reorganisation necessary to convert the country from Roman control to that of medieval warlords would barely have started and the use of the knoll as a *gorsedd*, whatever that entailed, seems unlikely to have occurred so early. It is not known when the motte was constructed at Dolbenmaen but it was presumably in the later 11th century. Dolbenmaen probably became the Maerdref, administrative centre, of the commote of Eifionydd and the *llys*, the royal court, would have been located in or near the motte. Dolbenmaen probably ceased to be a royal residence when Criccieth castle was built by Llywelyn Fawr in the early 13th century and the castle took over the functions of the *llys* at Dolbenmaen. The township however continued with the demesne lands, concentrated on the alluvial flat lands north of the river, i.e. including the area of the site, probably becoming a manor.

If Pen Bryn yr Orsedd was an assembly place it would have ceased to be used when the motte was built and the medieval settlement to the south of it would have been in use from the time of the *llys*. It is therefore impossible to relate any of the archaeological features found to the possible use of the area as a meeting place.

PRN Allocation

PRNs have been allocated to elements of this site according to their proven or interpreted date. This allocation follows the interpretations given above. Features of the same period grouped together have been given a single PRN but those that are widely separated are given different PRNs.

PRN	Features	Grid reference
62640	Early Neolithic oven (1562)	SH5008843006
62641	Probable early Neolithic oven (1545)	SH4992742938
62642	Possible early medieval settlement	SH4988043016 C
62643	Early medieval corn drier (1547)	SH4996743013
62644	Medieval settlement	SH4986043022 C
62645	Field system, possibly medieval in origin	SH5001043006 C
62646	Ring ditch (1656)	SH4983943026
62647	Ring gully (1652)	SH4980843044
62648	Possible corn drier (1683/1602)	SH4998643030

11 CONCLUSIONS

The combined pipeline and water treatment works projects have revealed previously unknown sites of considerable significance. Although small and seemingly insignificant the two earth ovens, one certainly and the other probably of early Neolithic date, are some of the most intriguing evidence found on the project. They indicate temporary, mobile occupation at the start of this period often presumed to be typified by sedentary settlements. They demonstrate the importance of dating possibly prehistoric features lacking artefacts as only the radiocarbon dates could show their actual date and importance.

While burnt mounds are common site types the excavation of one in this area helps to fill in their known distribution and date range. This one consolidates the evidence for late Neolithic burnt mounds, extending the known use of these sites significantly earlier than used to be assumed.

Iron Age settlements are also common in this area but mainly preserved on the uplands. The discovery of a new lowland enclosed settlement is significant, especially as this appears to be a settlement of some status due to the large size and defensive nature of its enclosing ditch.

While it appears likely that the features interpreted during fieldwork as Bronze Age barrows and burials are actually part of a medieval settlement this does not detract from the significance of the work because the medieval features fit into a probably contemporary field system, and the excavation represents the discovery of a large part of a medieval landscape. Due to the difficulty of finding sites defined only by a few postholes and pits excavation of the lower status medieval farmsteads is rare and often restricted to the uplands where they are visible as rectangular house platforms. This site seems to have been used over a significant period of time even if never developed beyond a small house with associated features such as corn driers.

Of even greater importance is the evidence from radiocarbon dates that this small farmstead was preceded by early medieval. The focus for this activity was probably under the existing water treatment works as the main feature, a four-poster granary, was close to the southern limit of the excavation area. The loss of an early mediaeval house site under the water treatment works is frustrating as houses of this date are extremely rare and each excavated example is of national importance. However the fine granary indicates its presence and the dating of one of the corn driers to the same period supports the former existence of a farmstead nearby.

The pollen study carried out as part of this project provides some of the most important information. Pollen analysis is most often carried out on uplands where suitable marshy deposits are available, but this work has enabled the changing environment of the valley to be studied. It has provided a vegetational history for the whole of the Holocene, with sample sites in many cases not far from archaeological sites, and therefore closely related to them. The detailed resolution of the study has enabled variations within the valley to be detected, in particular providing locational information for Neolithic clearances. It demonstrates what can be achieved by the use of pollen analysis in commercial projects where suitable valley bottom deposits survive.

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Dave McNicol ran the field project and wrote the bulk of the text, Jane Kenney combined the two reports and added new interpretation. Spencer Smith provided the background summary.

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14 Appendix I: Project Design

Dolbenmaen WTW to Cwmystradllyn WTW Transfer Pipeline Project Design For Archaeological Evaluation: Archaeological Trial Trenching (G2231)

Prepared For Black & Veatch Ltd February 2013

Introduction

Gwynedd Archaeological Trust (GAT) has been asked by *Black & Veatch Ltd* to provide a project design for carrying out a programme of archaeological trial trenching in response to the results of a geophysical survey (Stratascan forthcoming) and analysis of airborne Lidar (Light detection and ranging) data within the working corridor along the route of the transfer pipeline between Dolbenmaen Water Treatment Works (WTW) (NGR SH 4986 4926) and Cwmystradllyn Water Treatment Works (WTW) (NGR SH 5471 4286) *see Figure 1*.

As stated para. 3.1.2 of the Written Scheme of Investigation (WSI) (December 2013):

Based on the results of the geophysical survey, specific anomalies may be targeted for additional information on archaeological content and context. This will be undertaken using targeted trenching. The extent and location of the targeted areas will be defined in a further archaeological works design (FAWD) that will be approved by SNPA and GAPS.

It is therefore proposed that a total of 18 trenches are excavated to investigate anomalies which appear to be archaeological in origin and may cause disruption to the project timetable if not investigated prior to the controlled strip.

A detailed brief has not been prepared for this stage by Gwynedd Archaeological Planning Service (GAPS) or the Snowdonia National Park Authority (SNPA): However GAPS and SNPA have verbally confirmed, following scrutiny of the provisional geophysical results and Lidar data, that a series of archaeological trial trenches should be excavated to assess identified features.

The current design conforms to the guidelines specified in the *IFA Standard and Guidance for Archaeological Evaluation* (Institute for Archaeologists, 1994, rev. 2001 & 2008).

The content of this design and all subsequent designs and reports must be approved by both GAPS and SNPA.

Background

Scheme Background

The transfer pipeline route is located between Dolbenmaen water treatment works (**NGR SH49864926**) and Cwmystradllyn water treatment works (**NGR SH54714286**), as indicated on *Black and Veatch* Drawing No. 174357-20-9100 (reproduced as Figure 1). The route measures *c*.5km in length and the proposed easement will be 21.8m in width, the easement route will be surrounded by a stockproof fence.

The scheme route starts at the Dolbenmaen water treatment works (WTW) and runs eastwards for 300.0m across an open field before turning south for 80m crossing Afon Dwyfor and then running southwestwards for 560.0m to then run parallel to the south side of the A487(T) road for 190.0m to then cross the A487(T) road, following the route of a local road for 550.0m and then crossing a series of irregular fields to the east for a distance of 720.0m and then southeast for 780.0m, before continuing northeast for 1.87km to terminate at the Cwmystradllyn WTW (Figure 1).

Based on current information the easement route will be separated into an intrusive zone and a non-intrusive zone: intrusive works are limited to a 13.8m wide portion of the easement, which will be segregated from the non-intrusive zone by an internal fence. The intrusive works zone will be stripped of topsoil to a mean depth of 100mm and the material stockpiled in the non-intrusive zone; a 5.0m wide haul road built from geotextile membrane and crushed stone will then be laid within the intrusive zone. This haul road will be used to transport pipe along the route, which will then be stockpiled prior to burial in the non-intrusive zone. The 4.8m wide pipe trench for the treated water and raw water mains will then be excavated in the intrusive zone parallel to the haul road and the excavated material stockpiled alongside. On completion, the pipe trench will be buried, the haul road removed and the topsoil reinstated.

In addition to the transfer main, there will also be the following programmed works:

- a 50mm branch pipeline that will run from Dolbenmaen WTW to Dolbenmaen village that crosses the A487(T) c.500m from the scheme start point and then continues along the local road into Dolbenmaen village, where it terminates (as detailed on *Black and Veatch* Drawing Nos. **174357-20-0404 Rev C** and **174357-20-0405 Rev C**).

- 5No pipeline cross connections that will connect the transfer main to existing smaller diameter branch pipes, replacing the existing set up for the 18” main. These cross connections will be of small diameter (50 to 200 mm) and of short length, as indicated on *Black and Veatch* Drawing Nos. **174357-20-9100 Rev B**.
- Reconnections to all properties or cattle troughs that are currently supplied directly off the treated water main. The locations and quantities of these are not recorded by Dŵr Cymru but it is expected that these will be very small diameter connections and the works will be normally carried out within the notified construction easements.

Three temporary compounds will also be constructed along the route as shown in Figure 1.

Archaeological Background

GAT completed an archaeological assessment report in advance of the proposed works (Smith 2013) which summarised that the route lies within a varied archaeological landscape and passes close to a number of sites of known archaeological significance dating from the prehistoric to the post-medieval.

The sites identified within the landscape include a number of hut circles/ structures dating from the prehistoric to the Romano-British period (PRN 145,

150, 160, 164, 165, 166, 170, 172, 188, and NPRN 145), two probable Bronze Age standing stones (Beudy Cil-Haul (PRN 192) and Meini Hirion (PRN 2359 and 2360)), and a burnt mound (Glan-Dwyfach (PRN 154)). Recent discoveries during the archaeological mitigation for the Dolbenmaen WTW have confirmed the existence of prehistoric ritual activity at this location (GAT forthcoming).

The current A487 (T) may follow the line of the Segontium – Pen Llystyn – Tomen y Mur Roman Road (PRN 17553) as a route connecting Segontium with the fort at Pen Llystyn and a bathhouse at Tremadog.

The westernmost part of the proposed route lies within the medieval centre of Dolbenmaen in the commote of Eifionydd, and formed part of the medieval township of Dolbenmaen (PRN 7341). The current village core is to the east of the WTW and the proposed route passes a number of significant archaeological remains from the medieval period including the Scheduled Ancient Monument of Dolbenmaen motte (PRN 161 (SAM CN063)). The motte is located to the south of Dolbenmaen, directly to the north of the working corridor. The castle mound and ditch stand on a low ridge running parallel to the river Dwyfor at a fordable crossing point on an important route way. The motte’s early history is unclear and it may either be Welsh or Norman built.

Geophysical Magnetometer Survey

GAT subcontracted Stratascan Ltd. to conduct a standard resolution magnetometer survey of all accessible portions of the easement route and compound areas in advance of groundworks. The survey corridor was 30m wide and centred on the centreline of the easement, extending approximately 5m beyond the edges of the affected corridor.

Both the client and curators have assessed the provisional results of the survey (Prestidge 2013).

The main areas of probable archaeological activity are:

- At the western end of the pipe route in the vicinity of the motte at Dolbenmaen between SH5011043100 and SH5083042860 numerous anomalies were identified including linears and a possible enclosure (Figure 2).
- At SH5334042170 north of the junction for Cwmystradllyn a fairly large anomaly which appears to contain a number of right angles seems to be archaeological in origin (Figure 5).
- At SH5429042690 a possible sub-rectangular enclosure was identified (Figure 6).

A number of other more ephemeral anomalies which may be archaeological have also been identified and will be targeted by the trenches. The archaeological trial trenches proposed in this design will assess the results of the survey on the ground.

Airborne Lidar Data

Inspection of the 1m resolution Lidar data revealed a number of archaeological features, some of which corresponded to anomalies seen on the geophysical survey results. The majority of these were linear features, likely to be field boundaries and drainage some of which were present on the Ordnance Survey 1st edition 25" map of 1889. Ridge and furrow plough marks, associated with medieval ploughing, were also identified in a number of fields along the route.

Topography

The western part of the pipeline route roughly follows the course of the Afon Dwyfor and the A487(T) in a general southeasterly direction with the road standing at approximately 95m above OD adjacent to the WTW. The surrounding fields are characteristically floodplain pasture land, generally clawdd enclosed. This terrain continues largely unaltered, with only minor changes in the quality of pasture, until the route turns to the east at the junction of the A487 towards Golan. This part of the pipeline route follows the Afon Henwy and is boggy in character with no good pasture; this area however, is still enclosed with cloddiau. To the south of the road the ground improves, once again becoming enclosed pasture, although showing signs of being poorly drained and waterlogged in places. This mixed landscape of pasture and wet ground continues until the pipeline route reaches the hamlet of Ynys Pandy and turns ENE. Beyond Ynys Pandy the pipeline route begins to climb and becomes enclosed upland pasture. The location of the proposed Cwmystradllyn WTW sits at approximately 195m above OD.

The floodplain of the Afon Dwyfor, to the west of the pipeline route, cuts through an area of primarily Ordovician rocks (Bassett & Davies 1977). To the east, the underlying geology consists of basalt, dolerite, and diabase (British Geological Survey). There are likely to be other isolated deposits with the potential for peaty deposits within the more waterlogged areas and alluvial river terraces.

Method Statement

The archaeological trial trenching will target anomalies identified in the magnetometer survey and features seen on the Lidar data. All of the trenches will be located within the working areas of the scheme and will vary in shape and dimensions (tailored to the targeted features). 17 trenches will be within the confines of the main easement, one trench will be located on a spur to connect properties at the junction for Cwmystradllyn (SH53354204). It is possible that trenches will need to be extended, or additional trenches excavated, to further assess and interpret identified features.

Proposed Archaeological Trial Trenches

18 trial trenches are proposed to target features along the length of the scheme. These are:

ET01 2m x 15m, SH5012643100 (Figure 2)
Located to investigate a linear feature running east-west identified on both the geophysical survey results and Lidar data and a curving feature identified on the geophysical survey. It is suggested by Stratascan in their preliminary report that the features are both positive, suggesting that they are cut features e.g. ditches rather than built walls or banks. The trench intersects both features where they are in closest proximity to each other where a physical relationship is most likely.

ET02 5m x 5m, SH5014843100 (Figure 2)
Located to investigate the same east-west orientated linear as ET01 at a point where it appears to be intersected by another short linear running north east- south west. Excavation should provide a relationship between both features.

ET03 2m x 10m, SH5027343076 (Figure 2)
Located to investigate a linear running north east-south west identified on both the geophysical survey and Lidar data.

ET04 2m x 15m, SH5040243041 (Figure 2)
Located to investigate two roughly parallel linear features running roughly east- west which may be a bank and ditch.

ET05 8m x 8m, SH5043243022 (Figure 2)
Located to investigate a cut feature which may form part of a sub-rectangular enclosure. The trench has been positioned to investigate the perimeter and what appears to be a break in the feature, possibly indicating an entrance with associated pit or post hole.

ET06 2m x 20m, SH5045843018 (Figure 2)
Located to generally assess area surrounding potential archaeological features.

ET07 2m x 10m, SH5048143007 (Figure 2)
Located to investigate a possible sub-circular feature identified on the geophysical survey.

ET08 2m x 20m, SH5053842981 (Figure 2)
Located to investigate a north-south running linear identified on the Lidar data which corresponds to a field boundary shown on the Ordnance Survey 1st edition 25” map of 1889 and anomalies shown on the geophysical survey.

ET09 2m x 20m, SH5059942958 (Figure 2)
Located to investigate a large curving feature, which may be natural, identified on both the Lidar data and geophysical survey and will also assess the location of a field boundary, which roughly respects the curve of the main feature, shown on the Ordnance Survey 1st edition 25” map of 1889.

ET10 2m x 20m, SH5079342875 (Figure 3)
Located to investigate a fairly large sub-rectangular feature identified on the geophysical survey.

ET11 ‘T’ shaped 4m x 15m, SH5103642724 (Figure 3)
Located to investigate what appear to be two parallel linears running roughly north-south and a possible spur heading east, which can be seen on the geophysical survey.

ET12 2m x 20m, SH5273842366 (Figure 4)
Located to assess an area of amorphous magnetic variation which may be archaeological in origin.

ET13 2m x 20m, SH5332842114 (Figure 5)
Located on a spur from the main easement in an area of possible archaeological activity, close to a large magnetic anomaly which appears to be archaeological.

ET14 8m x 8m, SH5336342181 (Figure 5)
Located to investigate a large magnetic anomaly identified on the geophysical survey which appears to have a number of right angled corners and is suspected to be archaeological in origin.

ET15 4m x 10m, SH5428842686 (Figure 6)
Located to investigate a possible sub-rectangular feature, roughly orientated north east-south west, identified on the geophysical survey. The trench is positioned to investigate the south-western end of the feature including a corner and possible break in the perimeter.

ET16 2m x 10m, SH5428842703 (Figure 6)
Located to investigate the same feature as ET15, targeting the north-western side.

ET17 2m x 20m, SH5468942929 (Figure 6)
Located to investigate possible sub-circular features identified on the geophysical survey. One well defined example appears to be beyond the limits of the easement, ET17 and ET18 will target possible anomalies of similar appearance.

ET18 2m x 20m, SH5469742919 (Figure 6)
Will be excavated with ET17 to investigate possible sub-circular features.

Specific Methodology

- All trenches will be excavated using plant supplied by client using a toothless, flat, ditching bucket under constant direction by an archaeologist.
- Trenches will be accurately located and marked out with a Trimble R6 GPS system.
- The trenches will be excavated until archaeological deposits are identified or the underlying natural deposits are encountered, where deep alluvial or colluvial deposits are encountered the trench will not be excavated beyond the proposed depth of the pipe trench.
- All identified features within the trenches will be cleaned by hand and partially excavated to attempt to determine date and function.
- With the exception of post-medieval features, at least 50% of all pits and post holes and 10% of each linear feature will be excavated.
- Where appropriate deposits are encountered, bulk soil samples will be collected for environmental analysis, macroscopic artefact recovery and potential radiocarbon dating.
- All trenches and identified features will be recorded in writing, measured drawings and digital photographs (RAW format). Digital surveys using a Trimble R6 GPS system may also be required.

- If trenches containing archaeology need to be temporarily back-filled, upon specific approval by curators, a geotextile will be laid at the base prior to backfilling.
- Client, GAPS and SNPA will be given opportunities to inspect trenches before backfilling. If trenches are to remain open overnight they will be cordoned off with orange mesh fencing and road pins, particularly deep excavations may require the erection of heras fencing.

Evaluation Aims

The evaluation will aim to address the following:

- Verify the efficacy of the geophysical survey for identifying archaeological remains within the site
- Establish the extent to which archaeological remains survive at the site
- Establish the date and nature of archaeological remains at the site and assess their implications for understanding the historical development of the area
- Establish the depth of archaeological remains and the quality, value and level of preservation of any deposits
- Assess the level of risk any surviving remains may pose to the progression of the development.

NB. If significant archaeological activity is identified within any trench during the trial trenching submission of a Further Archaeological Works Design (FAWD) may be required, as outlined in the WSI (Para. 3.4), see Para. 4.0 below for FAWD procedure.

Report

Following completion of the stages outlined above, a brief report will be produced incorporating all results and will include:

1. Introduction
2. Project Design
3. Methods and techniques
4. Archaeological Background
5. Results of the Archaeological Trial Trenching
6. Summary and conclusions and further recommendations.
7. List of sources consulted.

All information will also be incorporated into the final fieldwork report which will be produced following the completion of all work on site.

Further Archaeological Works

The identification of significant archaeological features during the evaluation stage may necessitate further archaeological works.

The application of a further archaeological works design (FAWD) will be dependent on the initial identification, interpretation and examination of an archaeological feature and the establishment of a threshold of significance over which a FAWD might be triggered. This will include any features of demonstrable or likely prehistoric to medieval date and for post-medieval features, any complex or unusual remains. The requirement for a FAWD will be determined in consultation and liaison with GAPS and SNPA including through the monitoring process.

The FAWD will be instigated through a GAT produced document that will include:

- feature specific methodologies;
- artefact and ecofact specialist requirements, with detail of appropriate sampling strategies and specialist analysis
- timings, staffing and resourcing.

The FAWD document will need to be approved by GAPS and/or SNPA depending on the area in which the work is located.

Environmental Samples

If necessary, relevant archaeological deposits will be sampled by taking bulk soil samples (maximum of 30.0 litres) for flotation of charred plant remains and macroscopic artefact recovery. Bulk samples may also be taken from waterlogged deposits for the recovery of macroscopic plant remains, and deposits such as middens may be sampled to recover small animal bones and artefacts.

Human Remains

Any finds of human remains will be left *in-situ*, covered and protected, and the coroner, GAPS and SNPA archaeologist informed. If removal is necessary it will take place under appropriate regulations and with due regard for health and safety issues. In order to excavate human remains, a licence is required under Section *25* of the Burials Act 1857 for the removal of any body or remains of any body from any place of burial. This will be applied for should human remains need to be investigated or moved.

Small Finds

The vast majority of finds recovered from archaeological excavations comprise pottery fragments, bone, environmental and charcoal samples, and non-valuable metal items such as nails. Often many of these finds become unstable (i.e. they begin to disintegrate) when removed from the ground. All finds are the property of the landowner, however, it is Trust policy to recommend that all finds are donated to an appropriate museum where they can receive specialist treatment and study. Access to finds must be granted to the Trust for a reasonable period to allow for analysis and for study and publication as necessary. All finds would be treated according to advice provided within *First Aid for Finds* (Rescue 1999). Trust staff will undertake initial identification, but any additional advice would be sought from a wide range of consultants used by the Trust, including National Museums and Galleries of Wales at Cardiff, ARCUS at Sheffield and BAE at Birmingham.

Unexpected Discoveries: Treasure Trove

Treasure Trove law has been amended by the Treasure Act 1996. The following are Treasure under the Act:

- *Objects other than coins* any object other than a coin provided that it contains at least 10% gold or silver and is at least 300 years old when found.

- *Coins* all coins from the same find provided they are at least 300 years old when found (if the coins contain less than 10% gold or silver there must be at least 10. Any object or coin is part of the same find as another object or coin, if it is found in the same place as, or had previously been left together with, the other object. Finds may have become scattered since they were originally deposited in the ground. Single coin finds of gold or silver are not classed as treasure under the 1996 Treasure Act.
- *Associated objects* any object whatever it is made of, that is found in the same place as, or that had previously been together with, another object that is treasure.
- *Objects that would have been treasure trove* any object that would previously have been treasure trove, but does not fall within the specific categories given above. These objects have to be made substantially of gold or silver, they have to be buried with the intention of recovery and their owner or his heirs cannot be traced.

The following types of finds are not treasure:

- Objects whose owners can be traced.
- Unworked natural objects, including human and animal remains, even if they are found in association with treasure.
- Objects from the foreshore which are not wreck.

All finds of treasure must be reported to the coroner for the district within fourteen days of discovery or identification of the items. Items declared Treasure Trove become the property of the Crown, on whose behalf the National Museums and Galleries of Wales acts as advisor on technical matters, and may be the recipient body for the objects.

The National Museums and Galleries of Wales will decide whether they or any other museum may wish to acquire the object. If no museum wishes to acquire the object, then the Secretary of State will be able to disclaim it. When this happens, the coroner will notify the occupier and landowner that he intends to return the object to the finder after 28 days unless he receives no objection. If the coroner receives an objection, the find will be retained until the dispute has been settled.

Staff & Timetable

Staff

The project will be supervised by John Roberts, Principal Archaeologist at GAT: Contracts. The work will be carried out by fully trained Project Archaeologists who are experienced in conducting project work and working with contractors and earth moving machinery. (Full CV's are available upon request).

Timetable

Providing the current design is accepted by client, GAPS and SNPA trial trenching will begin on 17/02/2014 and is estimated to be completed in 10 working days. Provisional results will be reported within 1 month of the end of the trial trenching programme.

Health and Safety

The Trust subscribes to the SCAUM (Standing Conference of Archaeological Unit Managers) Health and Safety Policy as defined in **Health and Safety in Field Archaeology** (2007).

Insurance

Liability Insurance - Aviva Policy 24765101CHC/00045

- Employers' Liability: Limit of Indemnity £10m in any one occurrence
- Public Liability: Limit of Indemnity £5m in any one occurrence
- Hire-in Plant Insurance: £50,000.00 any one item; £250,000.00 any one claim

The current period expires 22/06/14

Professional Indemnity Insurance – RSA Insurance Plc P8531NAECE/1028

- Limit of Indemnity £5,000,000 any one claim

The current period expires 22/07/14

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15 Appendix II: Written Scheme of Investigation

Transfer Pipeline Between Dolbenmaen WTW and Cwmystradllyn WTW: Written Scheme of Investigation for a Staged Programme of Archaeological Evaluation and Mitigation

Prepared for BLACK & VEATCH LTD December 2013

Introduction

Gwynedd Archaeological Trust has been asked by Black & Veatch Ltd to provide a written scheme of investigation (WSI) for a staged programme of Archaeological Evaluation and Mitigation works in advance of and during the Dolbenmaen water treatment works to Cwmystradllyn water treatment works pipeline transfer scheme.

The transfer pipeline route is located between Dolbenmaen water treatment works (**NGR SH49864926**) and Cwmystradllyn water treatment works (**NGR SH54714286**), as indicated on *Black and Veatch* Drawing No. 174357-20-9100 (reproduced as Figure 01). The route measures *c*.5km in length and the proposed easement will be 21.8m in width, as indicated on *Black and Veatch* drawing *Cwmystradllyn to Dolbenmaen – Pipeline Easement Sequence* (reproduced as Figure 06). The easement route will be surrounded by a stockproof fence.

The scheme route starts at the Dolbenmaen water treatment works (WTW) and runs eastwards for 300.0m across an open field before turning south for 80m crossing Afon Dwyfor and then running southwestwards for 560.0m to then run parallel to the south side of the A487(T) road for 190.0m to then cross the A487(T) road, following the route of a local road for 550.0m and then crossing a series of irregular fields to the east for a distance of 720.0m and then southeast for 780.0m, before continuing northeast for 1.87km to terminate at the Cwmystradllyn WTW (*cf.* Figure 01).

Based on current information the easement route will be separated into an intrusive zone and a non-intrusive zone: intrusive works are limited to a 13.8m wide portion of the easement, which will be segregated from the non-intrusive zone by an internal fence. The intrusive works zone will be stripped of topsoil to a mean depth of 100mm and the material stockpiled in the non-intrusive zone; a 5.0m wide haul road built from geotextile membrane and crushed stone will then be laid within the intrusive zone. This haul road will be used to transport pipe along the route, which will then be stockpiled prior to burial in the non-intrusive zone. The 4.8m wide pipe trench for the treated water and raw water mains will then be excavated in the intrusive zone parallel to the haul road and the excavated material stockpiled alongside. On completion, the pipe trench will be buried, the haul road removed and the topsoil reinstated. This staged process is detailed in Figure 06.

The archaeological evaluation and mitigation strategy will be completed as a pre-construction, construction and post-construction programme of works, as summarised in para. 1.1 and detailed in para. 3.0.

In addition to the transfer main, there will also be the following programmed works:

- a 50mm branch pipeline that will run from Dolbenmaen WTW to Dolbenmaen village that crosses the A487(T) c.500m from the scheme start point and then continues along the local road into Dolbenmaen village, where it terminates (as detailed on *Black and Veatch* Drawing Nos. **174357-20-0404 Rev C** and **174357-20-0405 Rev C**).
- 5No pipeline cross connections that will connect the transfer main to existing smaller diameter branch pipes, replacing the existing set up for the 18" main. These cross connections will be of small diameter (50 to 200 mm) and of short length, as indicated on *Black and Veatch* Drawing Nos. **174357-20-9100 Rev B**.
- Reconnections to all properties or cattle troughs that are currently supplied directly off the treated water main. The locations and quantities of these are not recorded by Dŵr Cymru but it is expected that these will be very small diameter connections and the works will be normally carried out within the notified construction easements.

Black and Veatch Drawing No.**174357-20-9100 Rev B** locates three compounds alongside the route that will be constructed for the scheme:

- Contractor Compound Number 1 – located next to a minor road 1.13km from scheme start point at NGR SH25123425
- Contractor Compound Number 2 - located at NGR SH25123425, 2.40km from scheme point
- Contractor Compound Number 3 - located at NGR SH25393424, 3.18km from scheme start point

These additional works will also be subject to the archaeological evaluation and mitigation strategy.

The route is located partly within the Snowdonia National Park: the initial *c*.3.0km are located outside of the Snowdonia National Park, the final *c*.2.0km are within the Park.

The scheme will be monitored by the Gwynedd Archaeological Planning Services (GAPS) and the Snowdonia National Park Authority (SNPA) Archaeologist. The SNPA has outlined the structure of the required evaluation and mitigation programme in an email and written correspondence further to feedback on the screening opinion and the WSI requirements (SNPA letter dated 20/11/13; email correspondence dated 25/11/13 from SNPA to Dwr Cymru; SNPA letter dated 28/11/13; email correspondence from SNPA to GAT dated 10/12/13).

T*he content of this WSI and all subsequent designs and reports must be approved by both GAPS and SNPA*.

Works

The Archaeological Evaluation and Mitigation works will be completed as a staged process and will be undertaken as pre-construction works, construction works and post- construction works:

Pre-construction works

1. Geophysical survey of the pipeline transfer route easement and compounds;

2. Investigative works targeting the results of the geophysical survey as necessary.

3. A written and photographic record of all field boundaries affected by the scheme.

Note a construction phase record of the boundaries will also be completed to record the exposed boundary profiles

Note: please cf. para. 3 for additional information on the respective methodologies

Construction works

Preservation in record:

This will incorporate the archaeological investigation and recording of **all intrusive works** and attendant excavation and recording of all identified features of archaeological interest including, but not necessarily restricted to, the following intrusive works which have been identified to date:.

1. A controlled topsoil strip within the easement route to accommodate all areas subject to intrusive works; based on current information, this is limited to a 13.8m wide portion of the 21.8m easement;
2. A controlled topsoil strip of the Compounds – no deeper excavations are currently proposed for the compounds;
3. A controlled strip of the 4.8m wide transfer pipeline trench.
4. A controlled strip of the directional drilling zone to cross Afon Dwyfor
5. A controlled strip of the 50mm wide Dolbenmaen village branch pipeline, from Dolbenmaen WTW as far as the A487(T) crossing point c.500m to the east; the controlled strip will be completed for the 300mm pipe trench;
6. An archaeological watching brief of the 50mm wide branch pipeline along Dolbenmaen village road; *Note: once the branchline crosses the A487 (see Figure 01), it will follow the local road/road verge in Dolbenmaen and does not cross any fields north of the A487. The branchline in the local road run to the north of the Scheduled Ancient Monument Cn161 (Dolbenmaen Castle Mound), and at the closest point will be 24.0m north of Cn161.*
7. An archaeological watching brief during the crossing of the A487(T) road;
8. An archaeological watching brief for all instances of minor intrusive works, to include:
    a. 5No pipeline cross connections that will connect the transfer main to existing smaller diameter branch pipes, replacing the existing set up for the 18” main.
    b. Reconnections to all properties or cattle troughs that are currently supplied directly off the treated water main.
9. A written and photographic record of all field boundaries affected within the easement corridor.

Note: please cf. para. 3 for additional information on the respective

methodologies; ***Preservation in situ:***

Avoidance of all currently known features of archaeological interest in the vicinity of the scheme, to be ensured by their identification to construction contractors etc. and their fencing or marking-out to prevent ingress of machinery. Similar arrangements will be needed for the reinstatement works to prevent inadvertent damage, both along the easement and within the compounds.

Sampling/Specialist Advice:

1. Palaeoenvironmental sampling (particularly for palynology/pollen analysis and radiocarbon dating, where applicable)
2. Specialist advice and analysis (to be confirmed further to requirements during works)

Post-construction phase

The management of the post-construction phase will follow guidelines specified in *Management of Archaeological Projects* (English Heritage, 1991), and relevant guidelines from *Management of Research Projects in the Historic Environment* (English Heritage 2006). Five stages are specified:

- Phase 1: project planning (WSI)
- Phase 2: fieldwork
- Phase 3: assessment of potential for analysis
- Phase 4: analysis and report preparation
- Phase 5: dissemination

The post-excavation stage for the project will include phases 3 to 5.

Phase 3 involves an objective assessment of the results of the fieldwork phase (Phase 2) in order to ascertain the appropriate level of post-excavation analysis and reporting. This phase culminates in the production of a post-excavation assessment report. The second involves carrying out the work identified within the post-excavation assessment report, and culminates in a final report and project archive (Phases 4 and 5).

Institute For Archaeologists Standard And Guidance

This WSI conforms to the relevant Institute for Archaeologists standard and guidance:

- *Standard and Guidance for Archaeological Excavation* (Institute for Archaeologists, 1995, rev. 2001 and 2008).
- *Standard and Guidance for Archaeological Field Evaluation* (Institute for Archaeologists, 1995, rev. 2001 and 2008).
- *Standard and Guidance for Archaeological Geophysical Survey* (Institute for Archaeologists, 2011).
- *Standard and Guidance for Archaeological Watching Brief* (Institute for Archaeologists, 1995, rev. 2001 and 2008).
- *Standard and Guidance for the Creation, Compilation, Transfer and Deposition of Archaeological Archives* (Institute for Archaeologists, 2009).
- *Standard and Guidance for the Collection, Documentation, Conservation and Research of Archaeological Materials* (Institute for Archaeologists, 2008).

Background

Archaeological Background

The easement route lies within a rich archaeological landscape with extensive archaeological evidence from many periods. Numerous archaeological features are known to be situated in the environs of the route, both along its length and within similar topographical situations, including in particular bronze age ceremonial and domestic sites, iron age/roman period settlements and sites and medieval settlements together with an earthen castle and possible site of a royal court ('llys') of the princes of Gwynedd and its bond settlement ('maerdref').

The known archaeological features within or within proximity of the easement is listed in Table 1 and Figures 02 to 05, and a list of sites on the Gwynedd Historic Environment Record database within 500m of the study area is listed Appendix II.

Table 1 – List of archaeological features within or within proximity of the easement

Feature Nos	Name	Impact	Archaeological Evaluation	Archaeological Mitigation	NGR Location
1	Remains of a building at Pen-y-Cafn	None	None	Avoidance	SH52854229
2	Possible Burnt Mound at Corsoer	None	None	Avoidance	SH51304267
3	Motte at Dolbenmaen SAM Cn063	None	None	Avoidance	SH50654307
4	Dolbenmaen Medieval Township	Likely	None	Controlled Strip	SH50604300 C
5	Pont Dolbenmaen Listed Building Grade II; Ref;	None	None	Avoidance	SH 50754297
6	Slate Quarry, Ysgubor Cerrig, Dolbenmaen	Unlikely	None	Proximity area will be mitigated via the evaluation and mitigation strategy	SH51004270
7	Ynys Pandy Carved Stone	None	None	Avoidance	SH52804230
8	Clwt y Ffolt, Dolbenmaen	None	None	Avoidance	SH53104220
9	Milestone	None	None	Avoidance	SH51614247

Feature Nos	Name	Impact	Archaeological Evaluation	Archaeological Mitigation	NGR Location
10	Stone building west-south-west of Cefn Coed Isaf	None	None	Avoidance	SH53984244
11	Sheepfold	None	None	Avoidance	SH54374275
12	Field Boundaries	Likely	None	Basic Recording	Scheme wide
13	Beudy Tai Duon	None	None	Avoidance	SH50084307
14	Segontium – Pen Llystyn – Tomen y Mur Roman	Unknown	None	None	SH48324359 C
15	Segontium – Pen Llystyn – Tomen y Mur Roman Road	Unknown	None	Watching Brief at A487(T) Road crossing point for the transfer main (1.55km from scheme start point) and the branch pipeline through Dolbenmaen Village	SH52553973C
16	Segontium – Pen Llystyn – Tomen y Mur Roman Road	Unknown	None	Watching Brief at A487(T) Road crossing point (1.55km form scheme start point) for the transfer main and the branch pipeline (500m from	SH59233829C
17	Brynkir Mill Race	None	None	Will be avoided	SH53064215

The location of these features is detailed on Figures 02, 03, 04 and 05.

There is demonstrated potential for the presence of buried archaeological remains with no surface manifestation within the area. Important prehistoric features were found during recent archaeological excavations in advance of extension works for the Dolbenmaen Water Treatment Works. The controlled strip completed by the Gwynedd Archaeological

Trust, identified evidence for prehistoric domestic and ritual activity. The latter included three possible ring ditches that were as extant as circular or near circular ditches that measured 8.5m, 9.5m, and 11.5m in diameter (internally) respectively, as well as five cremation pits containing burnt bone, two of which were located centrally within one of the ring ditches, suggesting it could be the remains of a ploughed out round barrow burial site. The post-construction archaeological assessment and analysis stage has not been completed at the time of writing to allow for further information on date, function and interpretation of the features but the recorded information indicates a more extensive prehistoric landscape within this area than was previously understood.

Geotechnical Investigation

Black and Veatch has completed a geotechnical investigation programme along the easement route that was completed by *Ground Investigation (Wales) Limited* between July and October 2012 (document ref.: 174357-20-2718-A, June 2013; reproduced as Appendix III). The programme was completed as two phases of work: Phase 1 comprised 34 trial pits that were excavated along the proposed route; Phase 2 comprised 4 boreholes sunk at strategic positions along the route of the Afon Dwyfor crossing point and 2 boreholes located on the banks of the Afon Ddu.

The geotechnical programme divided the easement route into three sections:

- The eastern third of the pipeline route, which ran from the Cwmystradllyn WTW southwestwards to the local Golan road and included Trial Pits TP11 to TP19, starting with TP11 near the Cwmystradllyn WTW;
- The central third of pipeline route, which ran generally east to west along the easement route where it ran parallel to the local Gloan road and included Trial Pits TP20 to TP31;
- The western third of the pipeline route, which ran generally parallel to the northern side of the A487(T) road to Dolbenmaen village and included Trial Pits TP32 to TP38; and an additional series of Trial Pits (TP43 to TP52), which were located along the current proposed easement route, from the crossing point over the A487(T) and then west Dolbenmaen WTW.

The results of the geotechnical investigation provide valuable information on the depths of the topsoil and succeeding deposits, including alluvia and colluvia, as well as the location of deposits, especially peats, of palaeoenvironmental value. The value of this information will be to provide background data that can be used during the controlled strip programme to assist interpretation of the deposits encountered beneath the topsoil and to assist with strategising the palaeoenvironmental sampling programme.

The geotechnical investigation results suggested that the thickness of the topsoil and subsoil horizons varied along the route (subsoils are classed here as degraded topsoil or former ploughsoils and do not include alluvia and colluvia, which are characterised separately).

The topsoil/subsoil horizon varied at the western end of the route (south of the A487; cf. Figure 02) between 0.19m and 0.38m and between 0.21m and 0.53m at the eastern end of the route. The western portion of the route included the Afon Dwyfor river valley and this was reflected in the identification of alluvia beneath the topsoil/subsoil horizons in several trial pits at the lower portions of the valley. A cemented/oxidised ironstone horizon was identified in two trial pits at this end: TP46 and TP47; this will need to be considered both by the geophysical survey and the controlled stripping teams as the ironstone could impact on the local geophysical survey results and also needs to be identified and interpreted correctly by the controlled stripping team. A high water table, at 0.50m below the ground level was also identified in TP46 and TP47, suggesting flooding of the pipe trench is a possibility in this section. The prevalence of alluvia in the western section needs to also be considered by the controlled stripping team, both for the likelihood that the glacial horizon may not be encountered within the 1.50m limit of excavation for the pipe trench and the potential for the recovery of organic remains, including timber and the requirements for suitable recovery and analysis as determined by the FAWD process (cf para. 3.4).

The central section, north of the A487 (Figure 03 and Figure 04) is characterised by semi-improved pasture. The wetland nature of this area was typified by the identification of peat deposits in Trial Pits TP20, TP21, TP29 and TP31. The peat varied in thickness between 0.50m (TP20) and 1.00m (TP31) leading onto clay-rich glacial till. Very shallow water inflow was recorded from 0.15m in trial pits TP20 and TP21. This is an area of high palaeoenvironmental potential, particularly palynological (pollen) remains. The thickness of the peat (0.50m to 1.00m) suggests the entire sequence of peat deposits above the glacial horizon will be encountered as the maximum pipe trench depth will be greater at 1.50m. The involvement of a palaeoenvironmental specialist from an early stage in the controlled stripping process is a key component of the archaeological programme in this section. The shallow water table suggests flooding will be an issue during the excavation of the pipe trench.

The eastern section (Figure 05) comprised level pasture leading towards elevated field enclosures: colluvia was identified in three trial pits in the elevated section that varied in thickness between 0.30m and 0.90m beneath the topsoil/subsoil, followed by glacial till; bedrock was encountered in one example – TP15, at 1.05m below ground level. This suggests that the pipe trench in the vicinity of this test pit location will encounter bedrock prior to reaching maximum pipe trench depth. As the colluvia was encountered directly beneath the topsoil in this instance, it is likely the controlled strip for the pipe trench at this point will terminate once the top of the bedrock is reached. The other areas where colluvia was encountered is likely to require the controlled strip of the pipe trench be continued until the glacial horizon is identified (currently expected between 0.30m and 0.90m below the topsoil/subsoil horizon). Along the more level portion of the eastern section, towards the Afon Ddu river valley, two trial pits (TP17 and TP18) recorded 0.40m and 0.21m of topsoil respectively that led onto river alluvials; as with the western section there is the potential for the recovery of organic remains within these deposits.

The archaeological evaluation and mitigation methodology below is subdivided into three main sections:

Pre-construction works

- Construction works
- Post-construction phase

Pre-Construction Works (December 2012 to January 2013):

Geophysical survey of the pipeline transfer route easement and compounds

The geophysical survey will be carried out along the centre line of the working corridor, covering a width of 15m either side. The survey will start at the Dolbenmaen WTW and continue in a linear progression to Cwmystradllyn WTW. The three compound areas are located outside of the working corridor. However they will be included within the geophysical survey, with the exception of Compound 3 which is located within an existing hard standing farm yard. The five small spurs will not be covered by the geophysical survey unless they fall within the 30m grid for the working corridor.

The survey will be carried out in a series of 30m grids, which will be tied into fixed local topographic features. The survey will be conducted using a *Bartington Grad 601-2 Dual Sensor fluxgate gradiometer*. The survey will be carried out at standard resolution (1.0m traverse interval x 0.25m sample interval.). The geophysical survey will be completed by *Stratascan Ltd.* A summary of the *Stratascan* geophysical survey methodology is reproduced in Appendix II.

The geophysical survey will target the entire length of the working corridor. The width of the geophysical survey will include the working corridor plus an extra c.8m, which will be located where possible in the area furthest away from the current pipeline so as to minimise disturbance and maximise results. Based on the initial results additional surveying may be required to understand the continued extent of identified anomalies; this will be confirmed in a relevant further archaeological works design (FAWD) that will be approved by SNPA and GAPS.

Access onto land is to be arranged by the Clients. The survey is scheduled between 02/12/13 and 10/12/13; a preliminary report is planned to be ready by the end of December. The report will be completed by Stratascan Ltd.

Investigative works targeting the results of the geophysical survey

Based on the results of the geophysical survey, specific anomalies may be targeted for additional information on archaeological content and context. This will be undertaken using targeted trenching. The extent and location of the targeted areas will be defined in a further archaeological works design (FAWD) that will be approved by SNPA and GAPS.

A written and photographic record of all field boundaries affected by the scheme.

This will be completed using GAT pro-formas and a digital SLR camera set to RAW format.

The written record will include a description of the form and construction of the field boundary, a measurement of height, width and length (overall length and the portion within the easement).

Note a construction phase record of the boundaries will also be completed to record the exposed boundary profiles.

Construction Works (January 2013 to March 2013):

The identification of archaeological features during the archaeological programme detailed below may necessitate the production of further archaeological works designs (FAWD) for the archaeology encountered. The FAWD will define the appropriate excavation and preservation by record methodology and will be agreed in advance of undertaking the works by SNPA and GAPS. The criteria and methodology for this is discussed in para. 3.4.

The archaeological programme throughout will implement the basic archaeological excavation methodological procedures summarised in para. 3.3.

Throughout the controlled strip process the GAT teams will work alongside a contractor appointed plant operator and banksman and will in all instances work to the client/contractor health and safety protocols.

A controlled topsoil strip within the easement route to accommodate all areas subject to intrusive works;

Based on current information, the intrusive works are limited to a 13.8m wide portion within the 21.8m easement (Figure 6), where the topsoil will be reduced by a mean depth of 100mm. The stripped area will accommodate the following:

- A temporary 5.0m wide haul road built from geotextile membrane and hardstanding (stone) to allow the transportation of personnel and equipment along the easement route and to avoid damage to the stripped surface below;
- A 4.8m wide pipe trench;
- A temporary excavated material bund for the material excavated from the pipe trench;
- Plant and vehicle turning areas, at specific points, built to the same methodology as the haul roads.

The reduction of the topsoil horizon will be completed using contractor plant and GAT personnel and will include 2No teams of at least 2No GAT archaeologists per team. Specific lengths will need to be regularly signed off as complete under the remit of the controlled strip, either if no archaeology is found or has been mitigated subject to a further archaeological works design. The areas will be signed off by the SNPA and GAPS at their respective locations and should not be traversed or covered prior to this. There will be no vehicle traversing outside of the confines of the haul road; vehicles and plant will not traverse the fenced easement prior to the establishment of the haul road.

Note: The removed topsoil will be stored within a fenced area along with the pipes (Figure 6). This area will not be stripped prior to the storage of the topsoil and pipes as it does not require direct vehicle access. The plant will access the pipes and excavated topsoil using the machine arm whilst positioned on the haul road; cf. Figure 06 for illustrative detail.

Controlled topsoil strip of the Compounds

The controlled strip will involve a team of at least 2No GAT archaeologists recording the reduction of the compound footprint within the topsoil horizon by the site contractor at each compound. Limit of excavation will be defined by the engineering requirements, but is currently scheduled to be an average depth of 100mm and no deep excavations are currently proposed for the compounds. The stripped area will be covered by geotextile membrane and then hardstanding (stone) to allow the transportation of personnel and equipment into the area and then protect the underlying stripped area. On completion, if no archaeology is found or has been subject to a further archaeological mitigation, then the area will need to be signed off by the SNPA and GAPS and the stripped areas should not be traversed or covered prior to this.

Note: Compound 3 is currently understood to be set on hardstanding (farmyard) and will not include intrusive works and does not form part of the controlled strip.

Controlled strip of the 4.8m wide transfer pipeline trench.

The controlled strip will involve 2No teams of at least 2No GAT archaeologists per team recording the reduction of the pipe trench footprint by the site contractor. Limit of excavation will be defined by the engineering requirements (1.5m deep) or the identification of glacial deposits, whichever is encountered first. On completion, if no archaeology is found or has not been subject to a further archaeological mitigation, then specific lengths will need to be signed off and the excavated area reinstated. The specific lengths will be signed off by the SNPA and GAPS at the respective locations and should not be reinstated prior to this.

Note: the identification of archaeological activity within the pipe trench may require additional mitigation that could include stripping an additional width outside of the 4.8m pipeline trench to fully expose the archaeological features and locate any related features. This could include extending into the areas designated for the temporary excavated material bund and the haul road.

Controlled strip of the directional drilling zone to cross Afon Dwyfor

The controlled strip will involve a team of at least 2No GAT archaeologists recording the reduction of the directional drilling footprint by the site contractor. Limit of excavation will be defined by the engineering requirements or the identification of glacial deposits, whichever is encountered first. On completion, if no archaeology is found or has not been subject to a further archaeological mitigation, then the area will need to be signed off by SNPA and GAPS.

Controlled strip of the 50mm Dolbenmaen village branch pipeline, from Dolbenmaen WTW as far as the A487(T) crossing point c.500m to the east

The controlled strip will involve a team of at least 2No GAT archaeologists. The controlled strip will be limited to the portion of the branch pipeline south of the A487 road (see Figure 01); the remainder of the branch pipeline will be mitigated through an archaeological watching brief. The width of the controlled strip will be 300mm (pipe width is 50mm); limit of excavation will be defined by the engineering requirements (700mm maximum depth) or the identification of glacial deposits, whichever is encountered first. On completion, if no archaeology is found or has been subject to a further archaeological mitigation, then specific lengths will need to be signed off and the excavated area reinstated. The specific length will then be signed off by GAPS prior to reinstatement.

Note: the identification of archaeological activity within the pipe trench may require additional mitigation that could include stripping an additional width outside the branch pipeline trench to fully expose the archaeological features and locate any related features.

A written and photographic record of all field boundaries affected within the easement corridor

The written record will include a description of the form and construction of the field boundary in section and include, a measurement of height, width and length and a record of the profile. For potentially early boundaries samples e.g. of old/buried ground surfaces should be considered - i.e. for soil micromorphology and/or soil pollen could be taken further to the breaching of the field boundaries and the trenching through same. The *Early Fields Project* completed by GAT (Smith, G. 2010 & Smith, G., Caseldine, A., Hopewell, D. and Macphail, R. 2011) studied the general background to early fields and field systems and considered their survival, archaeological value and the effects of modern land use utilising ground survey, geophysical survey, excavation and environmental investigation and provides an indication to the value in collecting samples from any potential buried soils, The *Early Fields Project* also took samples from colluvium within a prehistoric enclosure bank, which produced macrofossils of wheat and barley, as well as corn spurrey, a weed of cultivation and cereal pollen (Smith, G. et al. 2011: 34); this also shows the potential for recovering information from the colluvia and alluvia deposits along the transfer main scheme.

Archaeological watching brief

An archaeological watching brief will be maintained for the following construction stages:

- the 50mm branch pipeline along Dolbenmaen village road;
- the crossing of the A487(T) road;
- all instances of minor intrusive works, to including 5No pipeline cross connections that will connect the transfer main to existing smaller diameter
  branch pipes, replacing the existing set up for the 18” main.
- reconnections to all properties

Palaeoenvironmental sampling & Specialist advice and analysis

The location and quantity of palaeoenvironmental samples and any other specialist advice will be defined and in an appropriate further archaeological works designs (FAWD) that will be agreed in advance of undertaking the works by SNPA and GAPS.

Avoidance

<u>Note: Avoidance of all currently known features of archaeological interest in the vicinity of the scheme is to be ensured by their identification to construction contractors etc. and their fencing or marking-out to prevent ingress of machinery. The known features are listed with Table 1. Similar arrangements will be needed for the reinstatement works to prevent inadvertent damage, both along the easement and within the compounds. This will need to be completed under the supervision of the GAT archaeologist team.</u>

Basic Archaeological Excavation Methodological Procedures

Excavation

All identified features will be recorded using GAT pro-formas and photographed using a digital SLR camera set to RAW format. The extent of the controlled strip areas and any features therein will be located using survey grade (not handheld) GPS with <10cm accuracy (model: *Trimble GNSS/R6/5800*).

All features will be manually cleaned and examined to determine extent, function, date and relationship to adjacent features. The examination strategy will be based on feature type and include an initial 50% sample of sub-circular features and 10% sample of linear features. Any subsequent excavation will be informed by this initial stage and, if required, detailed in an appropriate Further Archaeological Works Design (cf. para. 3.4). Environmental samples will be taken from features where deemed appropriate.

Environmental Samples

Relevant archaeological deposits will be sampled by taking bulk samples (a minimum of 10.0 litres and maximum of 30.0 litres) for flotation of charred plant remains. Bulk samples will be taken from waterlogged deposits for macroscopic plant remains. Other bulk samples, for example from middens, may be taken for small animal bones and small artefacts.

Specific palaeoenvironmental strategies for any peat deposits will be discussed with the GAPS and SNPA if encountered and input from a specialist will be sought during the fieldwork on an appropriate sampling strategy to be rationalised in a further archaeological works design.

Human Remains

Any finds of human remains will be left *in-situ*, covered and protected, and both the coroner and GAPS and the SNPA informed. If removal is necessary it will take place under appropriate regulations and with due regard for health and safety issues. In order to excavate human remains, a licence is required under Section *25* of the Burials Act 1857 for the removal of any body or remains of any body from any place of burial. This will be applied for should human remains need to be investigated or moved.

Small Finds

The vast majority of finds recovered from archaeological excavations comprise pottery fragments, bone, environmental and charcoal samples, and non-valuable metal items such as nails. Often many of these finds become unstable (i.e. they begin to disintegrate) when removed from the ground. All finds are the property of the landowner, however, it is Trust policy to recommend that all finds are donated to an appropriate museum where they can receive specialist treatment and study. Access to finds must be granted to the Trust for a reasonable period to allow for analysis and for study and publication as necessary. All finds would be treated according to advice provided within *First Aid for Finds* (Rescue 1999). Trust staff will undertake initial identification, but any additional advice would be sought from a wide range of consultants used by the Trust, including National Museums and Galleries of Wales at Cardiff and ARCUS at Sheffield.

Unexpected Discoveries: Treasure Trove

Treasure Trove law has been amended by the Treasure Act 1996. The following are Treasure under the Act:

- *Objects other than coins* any object other than a coin provided that it contains at least 10% gold or silver and is at least 300 years old when found.
- *Coins* all coins from the same find provided they are at least 300 years old when found (if the coins contain less than 10% gold or silver there must be at least 10. Any object or coin is part of the same find as another object or coin, if it is found in the same place as, or had previously been left together with, the other object. Finds may have become scattered since they were originally deposited in the ground. Single coin finds of gold or silver are not classed as treasure under the 1996 Treasure Act.
- *Associated objects* any object whatever it is made of, that is found in the same place as, or that had previously been together with, another object that is treasure.
- *Objects that would have been treasure trove* any object that would previously have been treasure trove, but does not fall within the specific categories given above. These objects have to be made substantially of gold or silver, they have to be buried with the intention of recovery and their owner or his heirs cannot be traced.

The following types of finds are not treasure:

- Objects whose owners can be traced.
- Unworked natural objects, including human and animal remains, even if they are found in association with treasure.
- Objects from the foreshore which are not wreck.

All finds of treasure must be reported to the coroner for the district within fourteen days of discovery or identification of the items. Items declared Treasure Trove become the property of the Crown, on whose behalf the National Museums and Galleries of Wales acts as advisor on technical matters, and may be the recipient body for the objects.

The National Museums and Galleries of Wales will decide whether they or any other museum may wish to acquire the object. If no museum wishes to acquire the object, then the Secretary of State will be able to disclaim it. When this happens, the coroner will notify the occupier and landowner that he intends to return the object to the finder after 28 days unless he receives no objection. If the coroner receives an objection, the find will be retained until the dispute has been settled.

Further Archaeological Works Design (FAWD) Process

The application of a further archaeological works design (FAWD) will be dependent on the initial identification, interpretation and examination of an archaeological feature and the establishment of a threshold of significance over which a FAWD might be triggered. This will include any features of demonstrable or likely prehistoric to medieval date and for post-medieval features, any complex or unusual remains. The requirement for a FAWD will be determined in consultation and liaison with GAPS and SNPA including through the monitoring process.

The FAWD will be instigated through a GAT produced document that will include:

- feature specific methodologies;
- artefact and ecofact specialist requirements, with detail of appropriate sampling strategies and specialist analysis
- timings, staffing and resourcing.

The FAWD document will need to be approved by GAPS and/or SNPA depending on the area in which the work is located.

Monitoring Arrangements

The GAPS and SNPA archaeologists will need to be informed of all start dates for the various elements of the evaluation and on-site mitigation scheme listed and of the subsequent progress and findings. This will allow the curators to arrange monitoring visits and attend site meetings and enable discussion about the need or otherwise for FAWDs as features of potential archaeological significance are encountered. In all instances, liaison will be made with both curators to ensure consistency of approach.

Signing-Off Procedures

The signing off procedure is designed to identify areas in which construction work can proceed where archaeological evaluation and mitigation has been completed. Responsibility for ‘signing-off’ areas as having been completed lies with the GAPS and SNPA curators according to their respective areas of jurisdiction. This will be achieved through the monitoring arrangements process.

Airborne Lidar Data

Airborne Lidar (light detection and ranging) measures the height of the ground surface and other features in large areas of landscape and is a spatial analysis tool that can be used to assist in interpreting features in the landscape and can complement the information derived from the geophysical survey and influence the location of archaeological investigation trenches as well interpret features encountered throughout the evaluation and mitigation programme. The *Environment Agency* through their *Geomatics Group* maintain a nationwide archive Lidar data, which includes 1m spatial resolution data for the area traversed by the transfer main, This information will be sourced by GAT for use during the evaluation and mitigation programme.

Reinstatement

On completion of the transfer main contractor groundworks the easement route will be reinstated. This will include the removal of the haul road and the fencing and the reinstatement of the topsoil and the field boundaries. As part of this, the hardcore and geotextile membrane that formed the haul road will be removed by machine. The compound surfaces will be removed in a similar manner,

An archaeological watching brief will be maintained during this process to monitor the removal of the haul road and compound surface material and the subsequent reinstatement of the topsoil. This will monitor the impact from operating plant on the extant soil horizons beneath the haul road.

Post-Construction Phase (Post-March 2013)

As summarised in para. 1.1 the post-construction phase will be managed in accordance with the guidelines specified in *Management of Archaeological Projects* (English Heritage, 1991), and relevant guidelines from *Management of Research Projects in the Historic Environment* (English Heritage 2006). The five stages are specified:

- MAP2 Phase 1: project planning (WSI)
- MAP2 Phase 2: fieldwork (before and during construction)
- MAP2 Phase 3: assessment of potential for analysis (post construction)
- MAP2 Phase 4: analysis and report preparation (post construction)
- MAP2 Phase 5: dissemination and publication (post construction)

MAP2 Phase 3 involves an objective assessment of the results of the fieldwork phase (MAP2 Phase 2) in order to ascertain the appropriate level of post-excavation analysis and reporting. To accommodate this, the MAP2 Phase 2 data will be processed and quantified and non-GAT specialist input identified.

The requirements will be detailed in an appropriate *assessment of potential for analysis project design* that will need to be approved by SNPA and GAPS prior to undertaking the work.

MAP2 Phase 3 culminates in the production of both a MAP2 Phase 3 report and a project design for MAP2 Phases 4 and 5 The final report will be completed at the culmination of MAP2 Phase 4 and will include the results of all specialist analysis.

MAP2 Phase 5 will involve the dissemination of the approved report to SNPA, GAPS and the regional Historic Environment Record, the dissemination of the archive and any artefacts, and the publication of the results in a journal approved by SNPA and GAPS. The location of the archive and artefact deposition will be subject to discussion with SNPA and GAPS.

Dissemination and Archiving

A full archive including plans, photographs, written material and any other material resulting from the project will be prepared during MAP2 Phase 4 and disseminated as part of MAP2 Phase 5.

- A digital report and archive on optical disc will be provided to GAPS/SNPA (minimum 1 set);
- A digital report and archive on optical disc will be provided to Historic Environment Record, Gwynedd Archaeological Trust (minimum 1 set);
- A digital report and archive on optical disc will be provided to Royal Commission on Ancient and Historic Monuments, Wales (minimum 1 set)
- Appropriate number of paper and/or digital copies be provided to the client (minimum 1 set)

Note: The details and location of documentary and artefactual archives will be subject to discussion with GAPS and SNPA

Personnel

The work will be managed by John Roberts, Principal Archaeologist GAT Contracts Section. The evaluation and mitigation archaeological work will be undertaken by a minimum team of 4No GAT archaeologists working in at least 2No teams, based on the current Black & Veatch Ltd. strategy of working on two simultaneous fronts; each team will be led by a GAT Project Officer and will also include a Project Archaeologist. Each officer will manage their section and report to the Principal Archaeologist. The personnel involved will be confirmed prior to the start of the scheme and *curricula vitae* will be distributed at this time.

Health And Safety

The Trust subscribes to the SCAUM (Standing Conference of Archaeological Unit Managers) Health and Safety Policy as defined in **Health and Safety in Field Archaeology** (2006). Risks will be assessed prior to and during the work.

Insurance

Liability Insurance - Aviva Policy 24765101CHC/00045

- Employers' Liability: Limit of Indemnity £10m in any one occurrence
- Public Liability: Limit of Indemnity £5m in any one occurrence
- Hire-in Plant Insurance: £50,000.00 any one item;
  £250,000.00 any one claim

The current period expires 21/06/14

Professional Indemnity Insurance – RSA Insurance Plc P8531NAECE/1028

- Limit of Indemnity £5,000,000 any one claim

The current period expires 22/07/14

Sources Consulted

Black and Veatch Drawings 174357-20-9101 Rev A and 174357-20-0404 Rev C and 174357-20-0405 Rev C).

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16 APPENDIX III: EVALUATION TRENCH DESCRIPTIONS

Trench 001
Trench size: 15x2m Photos: G2231_2014_0071, 0082, 0083, 0087-0101
Max Depth: 0.4m Orientation: N-S
Notes: Features on geophysical survey confirmed as archaeological in origin.

Context No.	Depth below surface (m)	Description
101	0-0.25	Topsoil – Dark orange/grey brown gritty clay silt
102	0.25-0.35	Subsoil - Dark orange brown clay silt
103	0.35	Possible Posthole - Visible at southern end of trench. Contains stones. Appears to be around 0.35m in diameter
104	0.35	Possible Posthole - 0.35m in diameter. Filled with stones. Some slate. Matrix sark orange grey brown clay silt
105	0.35	Curving ditch - 1.8m wide fill. Mid grey brown clay silt. Some cobble sized sub-angular stones
106	0.35	Collection of stones – 7-8 sub-angular sub-rounded stones partly in western section
107	0.35	E-W running ditch – 0.8m wide. Mid orange grey fill, some stones
108	0.35	Natural – mottled orange-yellow glacial sandy-silty clay, pebbles, one large boulder

Trench 002
Trench size: 5x5m Photos: G2231_2014_0070, 0084-0086, 0102-0104
Max Depth: 0.5m Orientation: N-S
Notes: Possible ditch located

Context No.	Depth below surface (m)	Description
201	0-0.2	Topsoil - Dark orange brown clay silt – gritty
202	0.2-0.4	Subsoil – Dark brown-orange clay silt, gritty/pebbles (generally around 0.1m thick)
203	0.4	Ditch? – Dark orange grey brown fill, stony clay silt, running NE-SW, 1.1m wide
204	0.4	Natural – Pebbles/gravel in orangey brown clay silt matrix

Trench 003
Trench size: 10.5x2m Photos: G2231_2014_0072, 1006-1008
Max Depth: 1.1m Orientation: NW-SE
Notes: Stone-filled land drain 3.3m from NW end. Mid trench – brown stony material – quite compacted. Approximately 4m at SE end of trench is a buried soil covered by grey clay silt (stony), which slopes down from NW-SE (Mid trench to SE end). This is covered by upcast possibly from original water main. Buried soil only at SE end of trench.

Context No.	Depth below surface (m)	Description
301	0-0.2	Topsoil – Mid brown clay silt
302	0.2-0.5	Natural – Yellow grey gritty clay silt, stony

303	0.5-1.1	Dark grey brown clay silt (buried soil)

Trench 004
Trench size: 2x13.7m Photos: G2231_2014_0052, 0054-0056
Max Depth: 0.75 Orientation: N-S
Notes: At edge of former channel, numerous layers evident. Edge approx. 11.4m from N end of trench – 2.3 from south end. Likely to be reason for geophysical anomaly.

Context No.	Depth below surface (m)	Description
401	0-0.2	Topsoil – fine clayey silt mid grey-brown
402	0.2-0.3	Subsoil – clayey silt dark orange brown
403	0.3-0.56 (N end)	Alluvial – clayey silt grey-orange brown
404	0.3	Light Alluvial – under (403) – mottled clay silt orange-grey light
405	0.3-05 (N end)	Dark Peaty – Dark brown peaty silt – Under (404)
406	0.6 (N end)	Light Alluvial – Light grey-orange clayey silt under (405)
407	0.55	Uncertain whether this is an undisturbed geological deposit or still alluvium – light brown orange-grey clay silt – dips sharply, possibly edge of channel

Trench 005
Trench size: 8x8m Photos: G2231_2014_0053, 0057, 0058, 0063
Max Depth: 0.75m Orientation: N-S
Notes: Appears likely that the feature on the geophysical survey was caused by mineralisation. Manganese and iron panning present in mixed layer above river gravels.

Context No.	Depth below surface (m)	Description
501	0-0.25	Mid grey brown clayey slit
502	0.25-0.35	Mid orangey brown clayey silt
503	0.35-0.45	Possibly multiple thin layers of clayey silt, vary from light brown yellow to dark orangey brown
504	0.45-0.65	Mixed deposit containing manganese and patches of mineralisation – mottled light to dark orangey brown with black patches
505	0.65	Mixed silty gravel – fairly sharp/angular to rounded

Trench 006
Trench size: 20m by 2m Photos: G2231_2014_0059-0061
Max Depth: 0.65 Orientation: E-W
Notes: Trench flooded as excavated. River gravels with multiple alluvial deposits.

Context No.	Depth below surface (m)	Description
601	0.12	Topsoil - Medium grey brown clay silt
602	0.12-0.27	Subsoil - Light grey brown clay silt
603	0.27-0.62	Natural – Yellow brown clay (river gravel at western end with patches of manganese and darker alluvial deposit above gravel)

Trench 007

Trench size: 9.7x2.3m   Photos: G2231_2014_0062, 0073-0076

Max Depth: 0.5m   Orientation: N-S

Notes: Three possible channels of darker brown clay silt above manganese layer at the base of the trench at the north end and towards the middle of the trench. River gravel at N end of trench with manganese patches.

Context No.	Depth below surface (m)	Description
701	0.15	Topsoil – Light grey brown clay silt
702	0.15-0.25	Subsoil – light orangey grey brown clay/silt
703	0.25-0.5	Deepest channel (?) Dark brown clay silt
704	0.5	Natural – Light yellowy grey clay silt at southern end of the trench

Trench 008

Trench size: 20m by 2m   Photos: G2231_2014_0067, 0077

Max Depth: 0.5m   Orientation: NE-SW

Notes: 11.5m from NE end – area with old roots and stones running across the trench. Full length of trench not excavated – SW end of field waterlogged. Trench filling with water as soon as excavated.

Context No.	Depth below surface (m)	Description
801	0.2	Topsoil – Light grey brown clay silt
802	0.2-0.4	Subsoil – light orange brown clay silt with manganese
803	0.4-0.5	Natural – Blue grey clay
804		Manganese at base of trench

Trench 009

Trench size: 2.5x6m   Photos: G2231_2014_0068, 0210-0212

Max Depth: 0.5m   Orientation: N-S

Notes: Ground waterlogged – only 6m at S end of trench excavated – water filling trench as excavated.

Context No.	Depth below surface (m)	Description
901	0-0.2	Topsoil – Light grey brown clay silt
902	0.2-0.4	Subsoil – Orange brown clay silt
903	0.4-0.5	Thin layer black peaty material
904	0.5	Grey clay

Trench 010

Trench size: 20x1.5m   Photos: G2231_2014_0039, 0040

Max Depth: 0.35m   Orientation: NW-SE

Notes: Trench has geological features, no archaeology. Compacted sand wedge along line of geophysical anomaly and a number of manganese areas at the NW edge of anomaly extending throughout that end of trench.

Context	Depth below	Description

No.	surface (m)	
1001	0-0.2	Topsoil – mid brownish grey, friable sandy silt, soft
1002	0.2-0.3	Subsoil - Lighter brownish grey, slightly clayey silty sand
1003	0.3	Natural – Light yellow grey clayey sand, firmly compacted with manganese inclusions

Trench 011
Trench size: 2x13m, 2x4.5m (2 trenches 'T' shape) Photos: G2231_2014_0041, 1001-1005
Max Depth: 1.00m Orientation: E-W, N-S
Notes: 'T' shaped evaluation trench, positioned to investigate apparent N-S linear features revealed by geophysical survey. Some large blocks of stone (thought to be glacial in origin) appear to be sitting at the base of a probably natural hollow filled with colluvial material. No definitive evidence of linear features was identified. Some stones high up in the longer N baulk section may be the traces of a post med field drain, however these were not observed in plan.

Context No.	Depth below surface (m)	Description
1101	0-0.1	Topsoil
1102	0.1-0.2	Mid grey, stony, silty clay
1103	0.2-0.45	Mid orange brown, slightly stony clayey silt
1104	0.45+	Slightly yellowish grey, stony, silty clay

Trench 012
Trench size: 20x2m Photos: G2231_2014_0234
Max Depth: 0.4m Orientation: E-W
Notes: No archaeology present, the magnetic anomalies probably represent the random areas of stones and boulders within substrate deposit (1202)

Context No.	Depth below surface (m)	Description
1200	0-0.14	Topsoil – Dark brown silty loam
1201	0.14-0.26	Subsoil – greyish brown silty clay, 20% random size/shape
1202	0.26-0.4	Natural – Grey silty clay with orange patches which are sandy in places. Random spread of stones and boulders throughout the deposit – natural substrate to base of trench

Trench 014
Trench size: 6.6x6.6m Photos: G2231_2014_1027-1034
Max Depth: 0.4m Orientation: N-S
Notes: Two large stones in NW corner and centre of trench. Anomaly produced by area of more frequent small stones. Two small pieces of coke in trench and some spreads of modern pottery. SW corner of trench – line of stones 2.5m diagonally across the corner. See photos – running NW-SE – small, medium and large sub-angular stones.

Context No.	Depth below surface (m)	Description
1401	0-0.25	Topsoil – mid brown clay silt small stones
1402	0.25-0.4	Subsoil – mid orange brown clay silt frequent small stones
1403	0.4	Natural – Orange mottled yellow grey gravelly

Trench 015

Trench size: 3x10m Photos: G2231_2014_1021-1023

Max Depth: 0.45 Orientation: NW-SE

Notes: Anomaly likely to be result of stony band in natural running roughly N-S and a band of yellow-grey clay running roughly E-W which was holding water. A few small shallow hollows filled with topsoil/subsoil like material likely to be stone holes. One burnt root at southern corner.

Context No.	Depth below surface (m)	Description
1501	0-0.2	Topsoil – mid grey brown clayey silt
1502	0.2-0.3	Subsoil – mid orange grey brown gritty clay silt
1503	0.3	Natural – mottled orange – yellow grey glacial stony silt clay

Trench 016

Trench size: 10x2.2m Photos: G2231_2014_1020, 1024-1026

Max Depth: 0.5m Orientation: NW-SE

Notes: Two very large boulders at NW end of trench in natural and an area of medium sized boulders at SE end of trench which gave rise to anomaly in trench. Small medium and large stones in natural throughout the trench. A shallow hollow filled with topsoil and stones at SE end of trench 1x0.7x0.1m.

Context No.	Depth below surface (m)	Description
1601	0-0.3	Topsoil – Mid grey brown clayey silt
1602	0.3-0.45	Subsoil – Mid orangey grey brown clayey silt – gritty
1603	0.45-0.5	Natural – Yellowy grey glacial stony silt clay – mottled orange patches.

Trench 017

Trench size: 19.7m by 5m Photos: G2231_2014_1009-1010, 1019

Max Depth: 0.25 Orientation: WSW-ENE

Notes: Trench 18 is an extension of trench 17.

Context No.	Depth below surface (m)	Description
1701		Patch of burning 0.4m diameter. Some grey brown soil present. Not excavated. Burnt out vegetation. Small root holes filled with topsoil, charcoal spread.
1702		Area of possible stakeholes and burning. May be roots. Burnt out vegetation. Small root holes filled with topsoil, charcoal spread.
1703		0.45x0.9m runs into section. 0.25m deep, some charcoal, irregular base, may be glacial. Glacial feature (continues into extension) not convincing as archaeology.
1704		Possible patch of burning – some charcoal running into section. Amorphous Feature – Burrow.
1705	0-0.15	Topsoil – Mid grey brown clay silt
1706	0.15-0.25	Subsoil – orangey brown sandy clay silt

1707	0.25	Natural – Glacial – mottled grey yellow orange

Trench 018
Trench size: 20m by 12m   Photos: G2231_2014_1011-1018
Max Depth: 0.25m   Orientation: NNW-SSE
Notes: Trench 18 is an extension of trench 17. Only two of the potential features are considered to be archaeological: [1806] & [1810]. These are likely to be postholes of indeterminate date/function (temporary posts for fencing?). All of the others are interpreted as either 'stone holes' or the results of bioturbation activity. The fills were derived from the top and sub-soils. These were amorphous in shapes with irregular sides and bases.

Context No.	Depth below surface (m)	Description
1800		Topsoil
1801		Ovoid 0.5x0.6. 0.15m deep, dark grey brown clay silt, charcoal, some small stones Stone hole or bioturbation filled with topsoil
1802		0.4-0.2x3.3m. Mottled orangey brown clay silt, some charcoal, occasional stones. Likely to be burrowing activity
1803		Ovoid 0.35x0.5x0.07m. Mid brown grey with orange patches, some stone. Bioturbation activity
1804		Runs into section 0.3m showing 0.1m deep. Mid brown grey some charcoal, occasional stone. Could not locate this context, machined away?
1805		Runs into section 0.3m showing, probably sub circular, 0.12m deep, mottled grey orange brown, some charcoal. Adjacent to post hole [1806], amorphous shape – stone hole
1806		Posthole
1807		Fill of posthole [1806]
1808		NOT USED
1809		Fill of posthole [1810]
1810		Posthole

Trench 019
Trench size: 15x2m   Photos: G2231_2014_0192, 0195-0198, 0205
Max Depth: 0.55m   Orientation: NE-SW   Sections: 06-023, 06-024
Notes: anomaly picked up by geophysical survey identified just to south of trench centre. Cleaned up and photographed 10/03/14. Also surveyed in by GPS. Northern 'half' of trench backfilled as sterile and sheep in adjacent field with insecure gate.
11/03/14 – Hard cleaned [1902] and then removed the western 1.00m width of fill (1904). Difficult to interpret; may be a trackway filled with soil and stones when worn or part of the base of a former wall, however if was does not fit in with extant walls.

Context No.	Depth below surface (m)	Description
1900	0-0.2	Topsoil – dark greyish brown friable silty loam
1901	0.2	Subsoil – reddish brown silty, 20% small random stone inclusions
1902	0.2-0.25	Linear feature, possibly a track
1903	0.3	Natural - Grey silty stony clay with yellow/orange streaks and

		mottling
1904		Fill of [1902] – random size/shape stones in a matrix of reddish-brown silt

Trench 020
Trench size: 15x2m Photos: G2231_2014_0201, 0226-0227
Max Depth: 0.53m Orientation: N-S
Notes: A stone filled drain 0.80m wide with re-deposited sub-soil at each side runs SE-NW from 2m south of north end on west side across the trench to 4.8m south of north end on east side. The trench started filling with water upon excavation.

Context No.	**Depth below surface (m)**	**Description**
2000	0-0.16	Dark grey humic silty topsoil to 0.16 depth
2001	0.16-0.28	Very dark grey peaty silt subsoil. Contains random irregular patches of stones of all sizes, sub angular and sub rounded, 0.02-0.12 length.
2002	0.36-0.53	Grey silty clay with orange brown steaks, patches and mottling to base of trench at 0.36-0.53 depth from surface.

17 APPENDIX IV: LIST OF FINDS FROM G2231

Find No	Context No	Site subdivision	Material	Period	No of items	Weight (g)	Description	Discarded?
1	topsoil	Trench 18	flint	Prehistoric	1	8.7	Flint flake	
2	subsoil	Trench 1	flint	Prehistoric	1	1.9	Burnt flint	
3	spoil	Trench 1	pot	Roman	1	2	Tiny eroded sherd of Samian ware	
4	topsoil	Field 9	flint	Prehistoric	1	11.3	Flint flake	
5	topsoil	Trench 15	pot	Unknown	1	1	Possible pot, orange fabric	
6	topsoil	Field 27	flint	Prehistoric	1	3.4	Flint flake	
7	topsoil	Field 27	pot	Post medieval	1	9.6	Slipware sherd	
8	topsoil	Field 30	slag	Post medieval?	1	284	Slag	
9	topsoil	Field 51	flint	Bronze Age	1	5.5	Possible plano-convex knife	
10	subsoil	Field 01	flint	Prehistoric	1	3.3	End scraper	
11	topsoil	Field 51	flint	Prehistoric	1	7.5	Pebble flake	
12	09036	Field 9	pot	Post medieval	1	16.6	White glazed post med pot sherd	
13	topsoil	Field 42	pot	Post medieval	1	83	Large pot sherd with red fabric with grog inclusions and brownish glaze, possibly early post-med	
14	02001	Field 20	pot	Post medieval	6	608	Post med pot including large sherd of Buckley ware	Discarded
15	09045	Field 9	iron	Post medieval	3	810	2 complete horseshoes and part of a third	
16	39006	Field 39	iron	Post medieval	1	97	Iron object	
17	09025	Field 9	pot	Post medieval	1	1.2	Small sherd of ceramic, possibly from a tile (not glazed)	
18	subsoil	Field 4	flint	Prehistoric	1	5.5	Worked flint	
19	01054	Field 01	slag	Unknown	0	2.7	Slaggy fragments from soil sample 18	
20	01052	Field 01	slag	Unknown	0	1.4	Slaggy fragments from soil sample 13	
21	01004	Field 01	slag	Unknown	0	1	fragments possibly of burnt peat	
22	01054	Field 01	flint	Prehistoric	1	0.1	Tiny fragment of burnt flint from sample 18	
23	01062	Field 01	bone	Iron Age?	0	0.8	Tiny fragments of burnt bone	
24	01066	Field 01	bone	Iron Age?	0	0.1	Tiny fragments of burnt bone	

18 APPENDIX V: LIST OF CONTEXTS

Context No	Area	Type	Description
101	TR01	Topsoil	Dark orangey grey brown clayey silt, 0.25m thick
102	TR01	Subsoil	Dark orangey brown clayey silt, 0.1m thick
103	TR01	Cut	Possible posthole, 0.35m in diameter
104	TR01	Cut	Possible posthole, 0.35m in diameter
105	TR01	Cut	Curvilinear ditch, 1.5m wide
106	TR01	Layer	Concentration of 7-8 sub angular stones
107	TR01	Cut	Linear ditch, 0.8m wide
108	TR01	Natural	Mottled orangey yellow sandy silty clay and gravel
201	TR02	Topsoil	Dark orangey brown clayey silt, 0.2m thick
202	TR02	Subsoil	Dark brownish orange clayey silt, 0.1m thick
203	TR02	Cut	Possible linear ditch, 1.1m wide
204	TR02	Natural	Mottled orangey yellow sandy silty clay and gravel
301	TR03	Topsoil	Brown clayey silt, 0.2m thick
302	TR03	Subsoil	Yellowish grey clayey silt, 0.3m thick
303	TR03	Layer	Dark greyish brown clayey silt, 0.6m thick
401	TR04	Topsoil	Greyish brown clayey silt, 0.2m thick
402	TR04	Subsoil	Dark orangey brown clayey silt, 0.1m thick
403	TR04	Layer	Greyish brown clayey silt, alluvial layer
404	TR04	Layer	Orangey grey clayey silt, alluvial layer
405	TR04	Layer	Dark brown peaty silt
406	TR04	Layer	Greyish orange clayey silt, alluvial layer
407	TR04	Layer	Light brownish grey clayey silt, alluvial layer
501	TR05	Topsoil	Greyish brown clayey silt, 0.25m thick
502	TR05	Subsoil	Orangey brown clayey silt, 0.1m thick
503	TR05	Layer	Lenses of alluvial, light brownish yellow to dark orangey brown
504	TR05	Layer	Mottled orangey brown sandy clay with manganese deposits
505	TR05	Natural	Natural river gravels
601	TR06	Topsoil	Greyish brown clayey silt, 0.12m thick
602	TR06	Subsoil	Light greyish brown clayey silt, 0.15m thick
603	TR06	Natural	Yellowish brown clay and gravel
701	TR07	Topsoil	Light greyish brown clayey silt, 0.15m thick
702	TR07	Subsoil	Light orangey grey clayey silt, 0.1m thick
703	TR07	Layer	Dark brown clayey silt, alluvial
704	TR07	Natural	Light yellowish grey clayey silt
801	TR08	Topsoil	Light greyish brown clayey silt, 0.2m thick
802	TR08	Subsoil	Light orangey brown clayey silt, 0.2m thick
803	TR08	Natural	Bluish grey clay
901	TR09	Topsoil	Light greyish brown clayey silt, 0.2m thick
902	TR09	Subsoil	Orangey brown clayey silt, 0.2m thick
903	TR09	Layer	Black peat, 0.1m thick
904	TR09	Natural	Grey clay
1001	TR10	Topsoil	Brownish grey sandy silt, 0.2m thick
1002	TR10	Subsoil	Light brownish grey clayey loam, 0.1m thick
1003	TR10	Natural	Light yellowish grey sandy clay
1101	TR11	Topsoil	Topsoil, 0.1m thick
1102	TR11	Subsoil	Greyish silty clay, 0.1m thick
1103	TR11	Layer	Orangey brown clayey silt, 0.25m thick
1104	TR11	Natural	Yellowish grey silty clay

Context No	Area	Type	Description
1201	TR12	Topsoil	Dark brown silty loam, 0.14m thick
1202	TR12	Subsoil	Greyish brown silty clay, 0.1m thick
1203	TR12	Natural	Grey silty clay
1401	TR14	Topsoil	Brown clayey silt, 0.25m thick
1402	TR14	Subsoil	Orangey brown clayey silt, 0.15m thick
1403	TR14	Natural	Mottled yellowish grey clayey gravel
1501	TR15	Topsoil	Greyish brown clayey silt
1502	TR15	Subsoil	Orangey grey clayey silt, 0.1m thick
1503	TR15	Natural	Mottled orangey grey silty clay
1601	TR16	Topsoil	Greyish brown clayey silt, 0.3m thick
1602	TR16	Subsoil	Orangey grey clayey silt, 0.15m thick
1603	TR16	Natural	Yellowish grey silty clay
1701	TR17	Deposit	Small patch of burning - burnt bioturbation
1702	TR17	Natural	Bioturbation
1703	TR17	Natural	Bioturbation
1704	TR17	Deposit	Small patch of burning - burnt bioturbation
1705	TR17	Topsoil	Greyish brown clayey silt, 0.15m thick
1706	TR17	Subsoil	Orangey brown clayey silt, 0.1m thick
1707	TR17	Natural	Mottled greyish yellow sandy clay
1801	TR18	Natural	Bioturbation
1802	TR18	Natural	Bioturbation
1803	TR18	Natural	Bioturbation
1804	TR18	Natural	Bioturbation
1805	TR18	Natural	Bioturbation
1806	TR18	Cut	Possible posthole, 0.23m in diameter
1807	TR18	Fill	Dark reddish brown silt, fill of [1806]
1808	TR18	VOID	VOID
1809	TR18	Fill	Dark greyish brown silt, fill of [1810]
1810	TR18	Cut	Possible posthole, 0.32m in diameter
1900	TR19	Topsoil	Dark greyish brown silty loam, 0.2m thick
1901	TR19	Subsoil	Reddish brown silt, 0.2m thick
1902	TR19	Structure	Possible post-medieval trackway
1903	TR19	Natural	Grey silty clay
1904	TR19	Fill	Stone layer of possible trackway [1902]
2000	TR20	Topsoil	Dark grey silty loam, 0.16m deep
2001	TR20	Subsoil	Dark grey peaty silt, 0.28m deep
2002	TR20	Natural	Grey silty clay
01001	Field 01	Cut	Curvilinear ditch, 2.4m wide, 1.3m deep
01002	Field 01	Fill	Reddish brown clayey silt, fill of [01020]
01003	Field 01	Fill	Brownish grey silty clay, fill of [01020]
01004	Field 01	Fill	Dark greyish brown clayey silt, fill of [01021]
01005	Field 01	Fill	Greyish brown gritty silt, fill of [01021]
01006	Field 01	Fill	Greyish brown silty clay, fill of [01030]
01007	Field 01	Fill	Reddish brown clayey silt, fill of [01030]
01008	Field 01	Fill	Greyish brown clayey silt, fill of [01029]
01009	Field 01	Fill	Light greyish brown silty clay, fill of [01029]
01010	Field 01	Cut	Linear ditch, 1.33m wide, 0.27m deep
01011	Field 01	Fill	Dark reddish brown silty loam, fill of [01010]
01012	Field 01	Fill	Dark reddish brown gravelly clay, fill of [01010]
01013	Field 01	Cut	Circular posthole or small pit, 0.65m in diameter, 0.15m deep

Context No	Area	Type	Description
01014	Field 01	Fill	Greyish brown clayey silt, fill of [01013]
01015	Field 01	Cut	Sub-oval pit, 2.6m x 2.35m, 0.25m deep
01016	Field 01	Fill	Brownish grey clayey silt, fill of [01016]
01017	Field 01	Cut	Posthole, 0.3m in diameter, 0.37m deep
01018	Field 01	Fill	Reddish brown clayey loam, fill of [01020]
01019	Field 01	Fill	Light greyish yellow clayey loam, fill of [01019]
01020	Field 01	Cut	Curvilinear ditch, 2m wide, 1.02m deep
01021	Field 01	Cut	Curvilinear ditch, 2.3m wide, 1.38m deep
01022	Field 01	Fill	Light greyish yellow sandy silt, fill of [01022]
01023	Field 01	Fill	Reddish brown clayey silt, fill of [01023]
01024	Field 01	Fill	Brownish red silty clay, fill of [01020]
01025	Field 01	Fill	Dark reddish brown silt, fill of [01021]
01026	Field 01	Fill	Orangey brown clayey silt, fill of [01021]
01027	Field 01	Fill	Dark reddish brown silt, fill of [01021]
01028	Field 01	Fill	Greenish grey gritty silt, fill of [01021]
01029	Field 01	Cut	Curvilinear ditch, 2.4m wide, 1.33m deep
01030	Field 01	Cut	Curvilinear ditch, 2.18m wide, 1.23m deep
01031	Field 01	Fill	Dark greyish brown clayey silt, fill of [01017]
01032	Field 01	Cut	Posthole, 0.3m in diameter, 0.3m deep
01033	Field 01	Fill	Dark brownish grey clayey silt, fill of [01032]
01034	Field 01	Natural	Bioturbation
01035	Field 01	Natural	Bioturbation
01036	Field 01	Cut	Probable modern posthole, 0.3m in diameter, 0.24m deep
01037	Field 01	Fill	Loose blackish grey clayey silt, fill of [01036]
01038	Field 01	Natural	Bioturbation
01039	Field 01	Natural	Bioturbation
01040	Field 01	Cut	Posthole, 0.3m in diameter, 0.39m deep
01041	Field 01	Fill	Dark brownish grey clayey silt, fill of [01040]
01042	Field 01	Cut	Posthole, 0.3m in diameter, 0.25m deep
01043	Field 01	Fill	Dark brownish grey clayey silt, fill of [01042]
01044	Field 01	Fill	Reddish brown clayey silt, fill of [01030]
01045	Field 01	Fill	Greyish brown clayey silt, fill of [01030]
01046	Field 01	Fill	Reddish brown clayey silt, fill of [01030]
01047	Field 01	Fill	Reddish brown gravelly loam, fill of [01030]
01048	Field 01	Fill	Light greyish yellow clayey loam, fill of [01030]
01049	Field 01	Fill	Reddish brown silty clay, fill of [01030]
01050	Field 01	Fill	Grey silty sand, fill of [01053]
01051	Field 01	Fill	Orangey brown silty sand, fill of [01053]
01052	Field 01	Fill	Dark brown silty sand, fill of [01052]
01053	Field 01	Cut	Circular pit, 1.1m in diameter, 0.45m deep
01054	Field 01	Fill	Greyish brown sandy loam, fill of [01029]
01055	Field 01	Fill	Light greenish grey silty loam, fill of [01029]
01056	Field 01	Fill	Greyish brown sandy loam, fill of [01029]
01057	Field 01	Fill	Brownish grey silty loam, fill of [01029]
01058	Field 01	Fill	Greyish brown sandy loam, fill of [01029]
01059	Field 01	Fill	Orangey brown sandy loam, fill of [01029]
01060	Field 01	Fill	Orangey brown clayey silt, fill of [01029]
01061	Field 01	Fill	Greyish brown gravelly silt, fill of [01029]
01062	Field 01	Fill	Dark greyish brown sandy loam, fill of [01029]
01063	Field 01	Fill	Greyish brown sandy loam, fill of [01029]

Context No	Area	Type	Description
01064	Field 01	Fill	Orangey brown sandy loam, fill of [01029]
01065	Field 01	Fill	Orangey brown clayey silt, fill of [01029]
01066	Field 01	Fill	Orangey brown clay, fill of [01029]
01067	Field 01	Fill	Reddish brown clayey silt, fill of [01069]
01068	Field 01	Fill	Reddish brown and black clayey silt and charcoal, fill of [01069]
01069	Field 01	Cut	Roughly square pit, 0.95x0.86m, 0.2m deep
01070	Field 01	Cut	Linear ditch, 5m long, 0.65m wide, 0.25m deep
01071	Field 01	Fill	Greyish brown sandy silt, fill of [01070]
01072	Field 01	Void	Void
01073	Field 01	Cut	Linear gully, 5.5m long, 0.5m wide, 0.1m deep
01101	Field 01	Cut	Oval pit, 0.65x0.4m, 0.35m deep
01102	Field 01	Cut	Oval pit, 1.9x1.2m, 0.4m deep
01103	Field 01	Cut	Oval pit, 0.7x0.6m, 0.13m deep
01104	Field 01	Fill	Stone and gravel, fill of [01102]
01105	Field 01	Fill	Black charcoal, fill of [01103]
01106	Field 01	Fill	Greyish brown clayey silt, fill of [01107]
01107	Field 01	Cut	Circular pit, 1.1m in diameter, 0.25m deep
01108	Field 01	Fill	Dark reddish brown sandy loam, fill of [01101]
01109	Field 01	Cut	Linear ditch, 0.8m wide, 0.13m deep
01110	Field 01	Fill	Mottled greyish brown clayey silt, fill of [01109]
01111	Field 01	Cut	Linear ditch, 1.4m wide, 0.15m deep
01112	Field 01	Fill	Orangey brown silty clay, fill of [01111]
04001	Field 04	Topsoil	Topsoil
04002	Field 04	Subsoil	Subsoil
04003	Field 04	Layer	Dark reddish brown peat layer
04004	Field 04	Deposit	Spread of burnt stone
05001	Field 05	Structure	Stone trackway
09000	Field 09	Topsoil	Topsoil
09001	Field 09	Subsoil	Subsoil
09002	Field 09	Natural	Natural
09003	Field 09	Cut	Oval pit, 1.55x0.9m, 0.3m deep
09004	Field 09	Fill	Light reddish brown sandy silt, fill of [09004]
09005	Field 09	Cut	Circular pit or posthole, 0.38m in diameter, 0.12m deep
09006	Field 09	Fill	Dark grey sandy silt, fill of [09005]
09007	Field 09	Cut	Circular pit or posthole, 0.68m in diameter, 0.22m deep
09008	Field 09	Fill	Dark reddish brown sandy silt, fill of [09007]
09009	Field 09	Cut	Linear ditch, 2.84m wide, 1m deep
09010	Field 09	Fill	Light bluish grey sandy silt, fill of [09009]
09011	Field 09	Cut	Linear field drain
09012	Field 09	Structure	Stone field drain, fill of [09011]
09013	Field 09	Fill	Light greyish brown silty clay, fill of [09011]
09014	Field 09	Fill	Light greyish brown silty clay, fill of [09011]
09015	Field 09	Fill	Greyish brown sandy loam, fill of [09011]
09016	Field 09	Fill	Dark brown silty clay, fill of [09011]
09017	Field 09	Fill	Greyish brown sandy loam, fill of [09011]
09018	Field 09	Fill	Greyish brown clayey silt, fill of [09009]
09019	Field 09	Cut	Squarish pit, 0.5x0.37m, 0.28m deep
09020	Field 09	Fill	Reddish brown clayey silt, fill of [09019]
09021	Field 09	Cut	Irregular pit, 1.5x1.3m, 0.14m deep
09022	Field 09	Fill	Dark reddish brown clayey silt, fill of [09021]

Context No	Area	Type	Description
09023	Field 09	Cut	Oval pit, 0.77x0.37m, 0.09m deep
09024	Field 09	Fill	Greyish brown clayey silt, fill of [09023]
09025	Field 09	Surface	Bluish grey sandy clay and gravel surface
09026	Field 09	Surface	Cobbled road surface
09027	Field 09	Cut	Sub-rounded pit 7.3x4.8m
09028	Field 09	Fill	Sub-angular stone deposit
09029	Field 09	Cut	Sub-circular pit 4.6x3.3m, >0.5m deep
09030	Field 09	Layer	Greyish brown clayey silt and gravel
09031	Field 09	Cut	Linear foundation cut for wall [09032]
09032	Field 09	Structure	NW-SE aligned stone wall
09033	Field 09	Fill	Light bluish grey clayey silt, fill of [09031]
09034	Field 09	Cut	Sub-circular pit 2.36x1.3m, 0.2m deep
09035	Field 09	Fill	Reddish brown clayey silt, fill of [09034]
09036	Field 09	Layer	Bluish grey clayey silt
09037	Field 09	Fill	Greyish brown clayey silt, fill of [09029]
09038	Field 09	Fill	Bluish grey sandy loam, fill of [09029]
09039	Field 09	Cut	Possible linear ditch, 0.95m wide, 0.19m deep
09040	Field 09	Surface	Compacted stone surface (possibly natural)
09041	Field 09	Cut	Possible linear ditch, 1.7m wide, 0.35m deep
09042	Field 09	Fill	Sub-rounded stones, fill of [09041]
09043	Field 09	Fill	Bluish grey clayey silt, fill of [09041]
09044	Field 09	Fill	Reddish brown clayey silt, fill of [09041]
09045	Field 09	Layer	Yellowish brown silty clay
09046	Field 09	Structure	Slate capped drain
09047	Field 09	Feature	Possible furrow
09048	Field 09	Natural	Bioturbation
09049	Field 09	Feature	Possible furrow
09050	Field 09	Feature	Shallow burnt pit/ bioturbation
09051	Field 09	Natural	Stone-hole
09052	Field 09	Cut	Same as [09009]
09053	Field 09	Natural	Bioturbation
09054	Field 09	Natural	Bioturbation/ hedge boundary
09055	Field 09	Deposit	Stone dump
09056	Field 09	Cut	Same as [09007]
09057	Field 09	Natural	Bioturbation/ hedge boundary
09058	Field 09	Feature	Possible furrow
09059	Field 09	Cut	Same as [09023]
11001	Field 11	Fill	Brownish grey silty clay, fill of [11002] and [11003]
11002	Field 11	Cut	Possible oval pit, 0.8x0.6m, 0.14m deep
11003	Field 11	Natural	Bioturbation
11004	Field 11	Fill	Brownish orange clayey silt, fill of [11005]
11005	Field 11	Cut	Possible irregular pit, 1.72x1.32m, 0.45m deep
14001	Field 14	Deposit	Spread of stones, possible robbed out wall
15001	Field 15	Cut	Linear ditch, 2m wide, 0.36m deep
15002	Field 15	Fill	Greyish brown silty clay, fill of [15001]
15003	Field 15	Deposit	Reddish brown clayey silt and stone deposit
15004	Field 15	Cut	Possible posthole, 0.5m in diameter, 0.14m deep
15005	Field 15	Fill	Greyish brown clayey silt, fill of [15004]
15006	Field 15	Cut	Possible squarish pit, 0.32x0.3m, 0.17m deep
15007	Field 15	Fill	Dark brown silty clay, fill of [15006]

Context No	Area	Type	Description
15008	Field 15	Cut	Probable stone-hole
15009	Field 15	Fill	Brown silty clay, fill of [15008]
15010	Field 15	Structure	Stone wall foundation
15011	Field 15	Natural	Natural concentration of stones
15012	Field 15	Structure	Trackway
15013	Field 15	Feature	Modern ditch
18001	Field 18	Fill	Bluish grey clayey silt, fill of [18003]
18002	Field 18	Fill	Bluish grey sandy loam, fill of [18003]
18003	Field 18	Cut	Linear ditch/ drain, 1.4m wide, 0.37m deep
18004	Field 18	Void	Void
18005	Field 18	Void	Void
18006	Field 18	Fill	Orangey brown silty clay, fill of [18003]
18007	Field 18	Structure	Stone structure over natural spring
20000	Field 20	Structure	Stone trackway
20001	Field 20	Natural	Bank
20002	Field 20	Natural	Bank
20003	Field 20	Feature	Drain
27001	Field 27	Fill	Dark brownish black clayey silt, fill of [27001]
27002	Field 27	Cut	Oval pit?, 0.74x0.47m, 0.11m deep
27003	Field 27	Cut	Irregular feature, 1.5x1.35m, 0.47m deep
27004	Field 27	Fill	Cobble/ stone deposit, fill of [27003]
27005	Field 27	Cut	Possible sub-rectangular pit, 2.65x>0.77m, 0.65m deep
27006	Field 27	Fill	Dark orangey brown clayey silt, fill of [27003]
27007	Field 27	Fill	Dark brown clayey silt, fill of [27003]
27008	Field 27	Fill	Brownish orange clayey silt, fill of [27003]
27009	Field 27	Layer	Ploughsoil
27010	Field 27	Fill	Orangey brown clayey silt, fill of [27005]
27011	Field 27	Fill	Dark greyish brown clayey silt, fill of [27005]
27012	Field 27	Fill	Brown clayey silt, fill of [27005]
27013	Field 27	Deposit	Slate dumped deposit
29001	Field 29	Fill	Brownish grey clayey silt, fill of [29002]
29002	Field 29	Cut	Linear ditch, 1.7m wide, 0.38m deep
29003	Field 29	Fill	Brownish grey clayey silt, fill of [29004]
29004	Field 29	Cut	Linear ditch, 2.1m wide, 0.39m deep
32001	Field 32	Topsoil	Topsoil
32002	Field 32	Subsoil	Subsoil
32003	Field 32	Natural	Natural
32004	Field 32	Cut	Drain
32005	Field 32	Fill	fill of [32004]
32006	Field 32	Cut	Linear ditch?
32007	Field 32	Fill	fill of [32006]
32008	Field 32	Void	Void
32009	Field 32	Void	Void
39001	Field 39	Structure	Stone platform, 5.8x4.1m
39002	Field 39	Cut	Linear ditch, 1.05m wide, 0.35m deep
39003	Field 39	Fill	Light greyish brown, fill of [39002]
39004	Field 39	Feature	Field drain
39005	Field 39	Cut	Sub-circular pit 2.81x2.3m, 0.76m deep
39006	Field 39	Fill	Greyish brown silty clay, fill of [39005]
39007	Field 39	Fill	Brownish orange clayey silt, fill of [39005]

Context No	Area	Type	Description
39008	Field 39	Fill	Reddish brown clayey silt, fill of [39005]
39009	Field 39	Fill	Brownish orange clayey silt, fill of [39005]
39010	Field 39	Fill	Orangey brown clayey silt, fill of [39005]
39011	Field 39	Cut	Irregular pit, 1.7x1.3m, 0.7m deep
39012	Field 39	Fill	Greyish brown clayey silt, fill of [39011]
39013	Field 39	Fill	Greyish brown clayey silt, fill of [39014]
39014	Field 39	Cut	Circular pit, 1m in diameter, 0.18m deep
39015	Field 39	Deposit	Layer of black silty sand and stones
39016	Field 39	Fill	Light yellowish brown silt, fill of [39011]
39017	Field 39	Cut	Sub-rectangular pit, 1.1x1.05m, 0.33m deep
39018	Field 39	Fill	Greyish brown silty clay, fill of [39017]
39019	Field 39	Cut	Pit, 2.05x>1.45m, 0.55m deep
39020	Field 39	Fill	Same as (39024)
39021	Field 39	Cut	Linear field drain
39022	Field 39	Fill	Greyish brown silty clay, fill of [39021]
39023	Field 39	Fill	Brownish grey silty sand, containing numerous large fragments of charcoal, fill of [39019]
39024	Field 39	Fill	Dark brownish grey clayey silt containing a high concentration of fire-cracked stones, including large cobbles, fill of [39019]
39025	Field 39	Fill	Light brownish grey sandy loam with occasional fire-cracked stones, fill of [39019]
39026	Field 39	Fill	Same as (39024)
39027	Field 39	Deposit	Stone layer/ dump
39028	Field 39	Cut	Same as [39019]
39029	Field 39	Fill	Same as (39024)
39030	Field 39	Natural	Natural
39031	Field 39	Natural	Natural
39032	Field 39	Fill	Brownish grey clayey silt, fill of [39017]
39033	Field 39	Fill	Greyish brown sandy silt, fill of [39017]
39034	Field 39	Layer	Light grey clayey silt interface layer
39035	Field 39	Natural	Natural
39036	Field 39	Layer	Same as (39015) just disturbed
39037	Field 39	Layer	Same as (39034)
42001	Field 42	Feature	Drainage ditch
42002	Field 42	Natural	Natural stones
42003	Field 42	Feature	Drainage ditch
42004	Field 42	Fill	Dark brown peaty silt, fill of [42003]
42005	Field 42	Fill	Dark brown peaty silt, fill of [42001]
42006	Field 42	Cut	Possible posthole, 0.4m in diameter, 0.26m deep
42007	Field 42	Fill	Greyish brown sandy loam, fill of [42006]
43001	Field 43	Feature	Drainage ditch associated with field boundary wall
44001	Field 44	Feature	Shallow drainage gully
44002	Field 44	Deposit	Small natural concentration of stones
44003	Field 44	Feature	Drainage ditch
45001	Field 45	Feature	Natural spring
48001	Field 48	Feature	Modern pit
48002	Field 48	Structure	Slate capped drain
48003	Field 48	Fill	Brown silty sand, fill of [48004]
48004	Field 48	Cut	Linear ditch, 1.1m wide, 0.1m deep
48005	Field 48	Cut	Linear ditch, 1m wide, 0.36m wide
48006	Field 48	Fill	Light greenish grey silty clay, fill of [48005]

Context No	Area	Type	Description
50001	Field 50	Structure	Stone wall
50002	Field 50	Layer	Dumped deposit of slate
50003	Field 50	Fill	Brown silty sand, fill of [50004]
50004	Field 50	Cut	Linear ditch, 2.6m wide, 0.2m deep
50005	Field 50	Fill	Grey silty clay, fill of [50004]
50006	Field 50	Natural	Natural depression
50007	Field 50	Natural	Natural
51001	Field 51	Fill	Grey silty clay, fill of [51002]
51002	Field 51	Cut	Linear ditch, 2.8m wide, 0.2m deep
51003	Field 51	Feature	Field drain
55000	Field 55	Fill	Brown silty sand, fill of [55001]
55001	Field 55	Cut	Linear ditch, 1.4m wide, 0.18m deep
66001	Field 66	Cut	Linear ditch, 1.78m wide, 0.38m deep
66002	Field 66	Fill	Reddish brown clayey silt, fill of [66001]
66003	Field 66	Fill	Light yellowish brown clayey silt, fill of [66001]
66004	Field 66	Cut	Linear ditch, 1.1m wide, 0.2m deep
66005	Field 66	Fill	Greyish brown clayey silt, fill of [66004]

19 APPENDIX VI: FIELD BOUNDARIES

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
02	68658	1m	2.4m	Hedgebank and fence running E-W. Hedge bank just to the north of the fence. Hedge growing on earthen bank.	G2231_2014_5166.tif	250215	343120
03	68659	1.2m	0.8m	Hedgebank and fence. Earthen bank with occasional facing stones. Stream/ditch between hedgebank and fence.	G2231_2014_5163.tif to G2231_2014_5165.tif	250363	343113
04	68660	1.5m	0.8m	Stone wall and fence. Wall only survives to 3 courses high, built of boulders. Fence set in top of wall.	G2231_2014_0064.tif G2231_2014_5151.tif to G2231_2014_5153.tif	250374	343042
05	68661	-	1.2m	Modern post and wire fence alongside a ditch/stream 3m wide and >1.1m deep.	G2231_2014_0050.tif G2231_2014_0051.tif G2231_2014_5161.tif; G2231_2014_5162.tif	250701	342917
06	68662	3m	1.5m	Hedge and fence. Thick hedge with modern concrete post and wire fence next to it.	G2231_2014_5155.tif	250861	342858
07	68663	0.6m	0.3m	Bank and fence. Low earthen bank next to path with modern fence along top.	G2231_2014_0123.tif G2231_2014_5159.tif; G2231_2014_5160.tif	250902	342826
08	68664	1.5m	1m	Stone wall only surviving to 0.45m high, with fence alongside. Large boulders used in building the wall.	G2231_2014_0121.tif G2231_2014_0122.tif G2231_2014_5156.tif to G2231_2014_5158.tif	250905	342821
09	68665	-	1.2m	Modern wooden post and wire fence	G2231_2014_0124.tif G2231_2014_5154.tif	250933	342797
10	68666	1.6m	0.9m	Bank and fence. Earthen bank with some stones.	G2231_2014_0167.tif	251209	342601

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
				Modern fence set along centre of bank.	G2231_2014_0168.tif G2231_2014_5167.tif to G2231_2014_5169.tif		
11	68667	-	1m	Modern wooden post and wire fence, with slight bank to west of fence.	G2231_2014_0169.tif G2231_2014_0170.tif G2231_2014_5167.tif; G2231_2014_5170.tif; G2231_2014_5171.tif	251212	342596
12	68668	-	1m	Modern wooden post and wire fence	G2231_2014_5172.tif	251269	342550
13	68669	-	1m	Modern wooden post and wire fence. With a line of trees between field boundaries 13 and 14.	G2231_2014_5173.tif	251280	342561
14	68670	-	1.3m	Modern wooden post and wire fence. With a line of trees between field boundaries 13 and 14.	G2231_2014_5174.tif; G2231_2014_5175.tif	251284	342564
15	68671	1m	0.7m	Hedgebank and ditches. Earthen bank with trees growing on it and a ditch at either side.	G2231_2014_0132.tif G2231_2014_0133.tif G2231_2014_5176.tif; G2231_2014_5177.tif	251328	342568
16	68672	0.8m	0.85m	Drystone wall built with large stones at base, roughly coursed, 0.85m high.	G2231_2014_0130.tif G2231_2014_0131.tif G2231_2014_5209.tif	251409	342539
17	68673	0.9m	0.9m	Drystone wall built with large stones at base, roughly coursed, 0.9m high. Built of sub-rounded stones with smaller angular stones as a core.	G2231_2014_0128.tif G2231_2014_0129.tif G2231_2014_5210.tif; G2231_2014_5211.tif; G2231_2014_5258.tif to G2231_2014_5260.tif; G2231_2014_5265.tif; G2231_2014_5266.tif;	251488	342529
18	68674	0.7m	0.7m	Drystone wall with stream alongside, incorporates a large rock outcrop. Wall roughly, coursed 0.7m high.	G2231_2014_0126.tif G2231_2014_0127.tif	251539	342522

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
					G2231_2014_5212.tif		
19	68675	0.6m	0.8m	Drystone wall 0.8m high forming boundary to trackway.	G2231_2014_0107.tif G2231_2014_0108.tif G2231_2014_5213.tif; G2231_2014_5214.tif	251639	342518
20	68676	0.9m	1.3m	Drystone wall 1.3m high forming boundary to trackway. Fence set long top of wall.	G2231_2014_0105.tif G2231_2014_0106.tif G2231_2014_5215.tif to G2231_2014_5217.tif	251644	342522
21	68677	0.6m	1m	Drystone wall 1m high, roughly coursed. Stream running through the wall. Large boulder foundation, some possibly *in situ* natural boulders.	G2231_2014_0112.tif G2231_2014_0113.tif G2231_2014_0420.tif; G2231_2014_0421.tif	251669	342531
22	68678	0.7m	0.7m	Stone wall and fence. Drystone wall 0.7m high, roughly coursed, with fence set on top.	G2231_2014_0046.tif G2231_2014_5178.tif; G2231_2014_5220.tif	251812	342501
23	68679	0.6m	1.3m	Stone wall, fence, and ditch. Drystone wall 1.3m high, roughly coursed, with ditch next to it on the roadside.	G2231_2014_0045.tif G2231_2014_5179.tif	251817	342495
24	68680	1m	1.2m	Drystone wall 1.2m high, roughly coursed, with fence set on top.	G2231_2014_0148.tif G2231_2014_5180.tif; G2231_2014_5181.tif	251889	342490
25	68681	-	1.1m	Modern wooden post and wire fence	G2231_2014_0044.tif G2231_2014_5182.tif	251942	342488
26	68682	0.8m	0.9m	Drystone wall 0.9m high, roughly coursed, with fence set on top.	G2231_2014_0042.tif G2231_2014_0043.tif G2231_2014_5183.tif	251946	342488
27	68683	1m	1.3m	Drystone wall 1.3m high, roughly coursed, with larger stones at base.	G2231_2014_0152.tif G2231_2014_0153.tif G2231_2014_5184.tif	252049	342483

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
28	68684	1.2m	1m	Clawdd with stone face and stone and earth core. Faced with large boulders. Remains of a ditch on N side largely buried by collapsed bank.	G2231_2014_0154.tif to G2231_2014_0161.tif; G2231_2014_1035.tif to G2231_2014_1053.tif; G2231_2014_1056.tif; G2231_2014_1057.tif; G2231_2014_1059.tif; G2231_2014_1062.tif; G2231_2014_1063.tif; G2231_2014_5185.tif	252111	342495
29	68685	2.4m	0.7m	Low earthen bank with stones protruding and shrubs and trees growing on it.	G2231_2014_0162.tif G2231_2014_5186.tif	252155	342498
30	68686	-	-	? Destroyed before recording	G2231_2014_0163.tif G2231_2014_0164.tif G2231_2014_1089.tif; G2231_2014_5296.tif	252252	342506
31	68687	1.1m	1.1m	Drystone wall 1.1m high built of sub-rounded boulders with a fence on top and a stream alongside.	G2231_2014_0165.tif G2231_2014_0166.tif G2231_2014_5187.tif; G2231_2014_5188.tif	252264	342507
32	68688	0.8m	0.8m	Drystone wall 0.8m high built of sub-angular stones.	G2231_2014_0274.tif G2231_2014_5189.tif	252385	342503
33	68689	0.6m	0.8m	Drystone wall 0.8m high built of sub-rounded boulders, with trees and shrubs growing next to it.	G2231_2014_5190.tif; G2231_2014_5191.tif	252484	342486
34	68690	-	1m	Modern wooden post and wire fence	G2231_2014_0347.tif	252497	342488
35	68691	0.8m	1.4m	Drystone wall 1.4m high with hedge on top and fence next to it.	G2231_2014_0265.tif; G2231_2014_0266.tif; G2231_2014_5192.tif	252461	342545
36	68692	0.6m	0.8m	Drystone wall, 0.8m high, partially collapsed with trees	G2231_2014_0204.tif;	252561	342476

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
				growing in it.	G2231_2014_5082.tif; G2231_2014_5083.tif; G2231_2014_5193.tif; G2231_2014_5194.tif		
37	68693	1.8m	0.4m	Low earthen bank with some stones visible and stream to west. Trees grow on the bank.	G2231_2014_0202.tif; G2231_2014_0203.tif; G2231_2014_5195.tif	252645	342400
38	68694	-	-	Earthen bank with fence built into bank and ditch along side. Trees grow in the ditch.	G2231_2014_0228.tif; G2231_2014_5196.tif; G2231_2014_5292.tif; G2231_2014_5293.tif	252696	342379
39	68695	-	-	Bank	G2231_2014_0229.tif; G2231_2014_5197.tif; G2231_2014_5294.tif; G2231_2014_5295.tif	252704	342375
40	68696	3.6m	1.7m	Wide ditch (3.6m wide) crossed by a track. Trees grow along S side of ditch.	G2231_2014_0235.tif; G2231_2014_0236.tif; G2231_2014_0144.tif G2231_2014_0145.tif G2231_2014_5198.tif; G2231_2014_5199.tif	252817	342298
41	68697	0.9m	0.9m	Drystone wall, 0.9m high, with fence on top.	G2231_2014_0146.tif G2231_2014_5200.tif; G2231_2014_5201.tif	252836	342292
42	68698	-	1.1m	Modern wooden post and wire fence	G2231_2014_5202.tif	252842	342288
43	68699	2m	1.12m	Stone-faced earthen bank, 1.1m high, with large stones in the base of the bank. A ditch runs on each side of the bank, though these are partly infilled with slumped bank material.	G2231_2014_0313.tif; G2231_2014_0314.tif; G2231_2014_0335.tif; G2231_2014_0376.tif; G2231_2014_0377.tif	252965	342219

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
44	68700	2.15m	0.8m	Earth and stone bank, 0.8m high, with 1m deep ditch on S side.	G2231_2014_0315.tif to G2231_2014_0317.tif; G2231_2014_0386.tif; G2231_2014_0387.tif	252987	342178
45	68701	3.5m	0.7m	Stone-faced earthen bank, 0.7m high, with a ditch at either side, up to 1m deep. A modern fence runs along the top of the bank.	G2231_2014_0037.tif G2231_2014_0038.tif G2231_2014_0322.tif; G2231_2014_0323.tif; G2231_2014_0368.tif to G2231_2014_0373.tif	253052	342110
46	68702	1.5m	0.9m	Earthen bank turning into a wall to the S out of the pipe easement. The bank is 0.9m high and has slight traces of a ditch running next to it.	G2231_2014_0035.tif G2231_2014_0036.tif G2231_2014_5203.tif	253139	342092
47	68703	1.2m	1.1m	Earthen bank, up to 1.1m high, with some stones visible and trees growing on top. A fence is set along the top of the bank.	G2231_2014_0033.tif G2231_2014_0034.tif G2231_2014_5204.tif	253220	342126
48	68704	0.9m	1m	Stone-faced bank, 1m high, with ditch on the road side and a fence running along the top.	G2231_2014_0031.tif G2231_2014_0032.tif G2231_2014_5205.tif	253228	342133
49	68705	-	-	The boundary bank has previously been removed with the area of the pipe easement, ends about 20m from the easement, so not recorded.	G2231_2014_5206.tif	253257	342180
50	68706	1.2m	0.9m	Earthen bank, 0.9m high, with ditch/stream on N side and fence along the top.	G2231_2014_0030.tif G2231_2014_5207.tif; G2231_2014_5208.tif	253449	342214
51	68707	2m	1.3m	Earthen bank, 1.3m high, with large cobbles within it especially in the base. There is a ditch, 1.1m deep, on the E side and a fence along the top of the bank.	G2231_2014_0027.tif to G2231_2014_0029.tif; G2231_2014_9000.tif; G2231_2014_9001.tif	253707	342364
52	68708	0.7m	0.8m	Drystone wall, 0.8m high, with large stones at the	G2231_2014_0021.tif	253959	342425

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
				base; fairly well maintained roadside wall.	G2231_2014_0022.tif G2231_2014_9002.tif; G2231_2014_9003.tif		
53	68709	0.5m	1.2m	Drystone wall, 1.2m high, with large stones at the base and a fence set along the top.	G2231_2014_0019.tif G2231_2014_0020.tif G2231_2014_9004.tif; G2231_2014_9005.tif	253962	342511
54	68710	0.85m	0.6m	Earth and stone hedgebank, 0.6m high, with trees growing on it and a fence set in the SSE side.	G2231_2014_9006.tif	253974	342501
55	68711	0.8m	1.2m	Drystone wall, 1.2m high, with large stones at the base and a fence set along the top.	G2231_2014_0017.tif G2231_2014_0018.tif G2231_2014_1308.tif; G2231_2014_1309.tif; G2231_2014_9007.tif; G2231_2014_9008.tif	254077	342569
56	68712	0.6m	1m	Drystone wall, 1m high, with large stones at the base.	G2231_2014_0015.tif G2231_2014_0016.tif G2231_2014_9009.tif; G2231_2014_9010.tif	254139	342638
57	68713	0.7m	1.2m	Drystone wall, 1.2m high, with large stones at the base, well-maintained.	G2231_2014_0013.tif G2231_2014_0014.tif G2231_2014_9011.tif; G2231_2014_9012.tif	254187	342667
58	68714	0.8m	1.3m	Drystone wall, 1.3m high, with large stones at the base, well-maintained.	G2231_2014_0023.tif G2231_2014_9013.tif; G2231_2014_9014.tif	254224	342671
59	68715	1m	0.8m	Stone revetment to higher ground to E. Revetment is 0.8m high and has been disturbed in the past.	G2231_2014_0012.tif G2231_2014_9015.tif; G2231_2014_9016.tif	254218	342658

Field Boundary	PRN	Width	Height	Description	Photographs (see digital archive)	Easting	Northing
60	68716	0.7m	1.1m	Drystone wall, 1.1m high, terminates at road in large (1.4m high) stone gatepost. Stone style built into the wall near the gatepost.	G2231_2014_5221.tif; G2231_2014_5222.tif	254226	342559
61	68717	0.7m	1.2m	Drystone wall, 1.2m high, with boulders in the base, bounding E edge of trackway. Land to the E is at a higher level than that to the W of the wall, so it is also partly a revetment.	G2231_2014_0010.tif G2231_2014_0011.tif G2231_2014_5225.tif	254230	342501
62	68718	0.9m	1.16m	Drystone wall, 1.16m high, built of large stones.	G2231_2014_0006.tif to G2231_2014_0009.tif G2231_2014_5223.tif	254306	342716
63	68719	1.8m	0.9m	Stone-faced earthen bank, 0.9m high, with fence along the top.	G2231_2014_0001.tif G2231_2014_0002. tif G2231_2014_5224.tif	254554	342902
64	68720	0.7m	1.2m	Drystone wall, 1.2m high, with large stones at the base, roadside wall.	G2231_2014_0024.tif G2231_2014_0025.tif G2231_2014_5226.tif	254705	342900
65	68721	0.6m	0.5m	Drystone wall, 0.5m high, roadside wall.	G2231_2014_0026.tif G2231_2014_5227.tif	254711	342893

20 APPENDIX VII: LITHIC REPORT

By George Smith, Freelance Specialist

Methodology

Objects studied by 10X hand lens. Measurements in mm, Length (maximum perpendicular to platform) and Breadth (maximum perpendicular to length) x Depth (maximum). Dimensions of broken object i.e. not original, shown in brackets.

Results

Small Find 01: Topsoil within Evaluation Trench 18.

Complete tertiary flake. Cherty flint, mottled mid-grey/light grey. 48 x 26 x 6. Broad, thick flake. Plain platform with prominent bulb, probable light hammer struck. Some subsequent edge damage. Irregular denticulate retouch on one long side edge which has some probable utilisation polish on raised ridges between retouch scars suggesting use in cutting some soft but resilient material.

Not diagnostic of period but perhaps 2nd millennium rather than earlier.

Small Find 02: Subsoil within Evaluation Trench 01.

Secondary flake fragment. Small and irregular. Fine flint, shattered by burning. A small amount of probable pebble cortex. Dark red colour probably as a result of alteration by burning. (20) x (16) x (6).

Not diagnostic of any function or period.

Small Find 04: Topsoil within Field 9.

Thick secondary flake. Light grey flint with pebble cortex. 53 x 24 x 9.

A concave, core-trimming flake. There is no bulb and the flake has possibly been removed from a pebble by the anvil technique. Some slight edge damage.

There is a narrow band of possible utilisation polish on one long sharp convex side edge.

Not diagnostic of any function or period.

Small Find 06: Topsoil within Field 27.

Thick, broad tertiary flake butt fragment. Light grey fine flint. (22) x (22) x 6. Irregular platform with a prominent bulb, indicating light hammer struck.

Not diagnostic of any function or period.

Small Find 09 (PRN 62671): Topsoil within Field 51.

Plano-convex knife variant? Short, broad, thick tertiary flake. Dark grey fine flint. 34 x 25 x 6

Very prominent bulb with irregular platform and previous scalar thinning flake showing poor quality of technique. Two sides trimmed by steep edge retouch to a broad point, shaped also by a small amount of inverse retouch. One corner has been removed by ?trample damage.

If it is a variant plano-convex knife this indicates a 2nd millennium date but it is all rather odd and has an all-over polish that suggests much handling such as from being carried in a pouch or pocket. However, worth illustration if to be published.

Small Find 10 (PRN 62670): Subsoil within Field 1.

Small end scraper on a blade. Yellow-brown fine flint. 32 x 19 x 5.

A thin tertiary flake neatly abruptly retouched at the tip to a convex scraper edge. There is also some lateral trimming.

End scrapers on blades are typically Mesolithic but not entirely so and this is small and not typical but a Later Mesolithic/Early Neolithic date seems likely.

Small Find 11: Topsoil within Field 5.

A complete, broad, thick, secondary core-trimming flake. Mid-grey, slightly cherty flint 38 x 23 x 10.

Pebble cortex. Prominent bulb suggests hammer struck. Unused. Not diagnostic of any function or period.

Small Find 18: Subsoil with Field 4.

Irregular flake fragment probably from core trimming. Fine mid-brown flint with light brown mottles, the colour possibly resulting from staining. (35) x (20) x (9).

An irregular flake fragment with some crude steep secondary retouch with no obvious purpose that may be just flaking mis-hits or core trimming.

Not diagnostic of any function or period.

Discussion

These objects all came from separate places and so do not constitute a group of any kind. The differences in technique and type show that they are from a range of different periods. There are two retouched objects SF#09 and SF#10, which might deserve illustration if needed although neither are distinctly diagnostic of period. All the objects, where identifiable, are made from pebble flint that could be sourced locally. There is an absence of imported material or of larger flakes or the finer techniques that might suggest Later Neolithic activity. None are specifically Mesolithic in character and most could belong to Early Neolithic activity, which could be widely dispersed in the landscape. The only exception is SF09 which is suggested to be of 2nd millennium date although not of an accepted diagnostic type.

21 APPENDIX VIII: SAMPLE ASSESSMENT

Transfer Pipeline Between Dolbenmaen Water Treatment Works and Cwmystradllyn Water Treatment Works (G2231): Sample Assessment

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CFA Archaeology Report No: 3251

Introduction

Twenty-six bulk soil samples were retained for palaeoenvironmental analysis during a phased programme of archaeological investigations carried out in 2014 along the pipeline route between the Dolbenmaen and Cwmystradllyn Water Treatment Works by Gwynedd Archaeological Trust. The soil samples were provided to CFA Archaeology Ltd (CFA) in January 2015 for processing and assessment.

Methodology

The soil samples, which ranged from 10-30 litres in volume, were processed through a flotation tank.

The floating material (flot) was collected in a 250μm sieve then, once dried, scanned using a binocular microscope (x10-x100 magnifications) and any carbonised plant remains extracted and preliminary identified. Where flots contained large quantities of charcoal and/or other carbonised plant remains, the flot was sub-sampled using a riffle box, and a proportion of the plant remains sorted and identified. The proportion of flot assessed is noted in Appendix 1. Identifications of plant remains were made with reference to the modern collection of CFA and standard seed atlases. Plant remains were stored in either plastic finds bags or plastic specimen tubes.

The retents were scanned for any archaeological significant material. The quantity and quality of any artefacts and small finds present in the retents were noted and the remains stored in plastic find bags.

The quantity of plant remains and small finds (etc) were recorded using a four-point scale (see Table 1). The results are presented in Appendix 1 (Composition of Flots) and Appendix 2 (Composition of Retents), organised by sample number.

Table 1. Four point scale

Scale	Abundance	Approx. quantity
+	Rare	1-10 items
++	Occasional	11-50 items
+++	Common	51-100 items
++++	Abundant	101+ items

Results

The bulk of the samples contained some carbonised plant remains including wood charcoal, cereal grains, hazelnut shell and weed seeds (or wild taxa). Wood charcoal was the most abundant material recovered from the samples.

For ease of discussion the material recovered from the sample is discussed, below, by field number.

Field 1: The bulk of the carbonised plant remains and other material (including one small fragment of burnt flint and some fragments of burnt bone) were recovered from features uncovered in Field 1. The fills of a curvilinear ditch [**01001,** fills **01021**, **01029**] and associated post-holes [**01017**, **01036**, and **01040**] contained a small assemblage of carbonised cereal grain and seeds of wild taxa (weed seeds).

The cereal grains were generally poorly preserved and abraded. Wheat was the most common species identified along with smaller amounts of barley and occasional grains of oat. The wheat grains were characteristic of hulled wheat, emmer/spelt (*Triticum dicoccum*/*spelta*. Neither the barley (*Hordeum* sp.) nor the oat (*Avena* sp.) grains were sufficiently well-preserved to allow identification to species level. The plant assemblage, dominated by hulled wheat and barley, would be consistent with a prehistoric date for these features and their presence, albeit in small amounts, does suggest that some food processing was being carried out at the site.

Occasional weed seeds were also recovered from ditch [**01001**] and postholes [**01017**, **01040**]. In all cases these were much abraded. The taxa present were common seeds of waste places and grassland, including knotgrass (*Polygonum* sp.); ribwort/plantain (*Plantago* sp.) and Gramineae indet (grasses). The seeds could have been either growing on, or near to, the site or brought to the site along with the cereal grains.

Fragments of burnt peat were recovered from the fill of ditch [**01001**, fills **01021** and **01029**]. The recovery of such material along with a small assemblage of cereal grain suggests that the carbonised plant remains are remnants of a domestic hearth which have accumulated in the ditch and associated pit fills.

Field 4: Small fragments of wood charcoal were recovered from a deposit (**04003**) uncovered in Field 4. The charcoal was very fragmentary and in most cases below the level of identification. None would be suitable for dating purposes. No other plant remains or small finds/artefacts were recovered from this deposit.

Field 9: Large concentrations of wood charcoal were recovered from three pits uncovered in Field 9. The charcoal consisted of blocky fragments of oak charcoal, and would not be suitable for AMS dating. In addition, occasional fragments of carbonised hazelnut shell were recovered from the fills of two pits [**09005**, **09019**]. Preservation of the nutshell varied, and sufficiently large enough fragments of nutshell for AMS dating were recovered from one of the pits [**09005**].

No other plant remains or small finds/artefacts were recovered from this deposit.

Field 27: Seven much abraded fragments of hazelnut shell were recovered from one pit [**27002**] uncovered in Field 27. The nutshell was found along with small abraded wood charcoal fragments that were present in the pit fill and one other pit [**27003**]. The wood charcoal was very fragmentary and below the level of identification (BLOI). None of the carbonised plant remains recovered from these features is suitable for AMS dating. No other plant remains or small finds/artefacts were recovered from this deposit.

Field 39: High concentrations of wood charcoal were recovered from the fill of a pit [**39019**] and a deposit [**39015**]. Preliminary identification of the charcoal indicates that a mixture of small round wood fragments of oak and non-oak species (such as hazel, alder, etc) were present and sufficiently large enough fragments of charcoal were recovered for dating purposes. In addition, one small, abraded, fragment of hazelnut shell was recovered from the fill of pit [**39019**]. No other plant remains or small finds/artefacts were recovered from this deposit.

Field 42: A large quantity of fragmentary indeterminate (BLOI) wood charcoal was recovered from one posthole (**42006**) together with one cereal grain and two small fragments of hazelnut shell. The cereal grain was much abraded and could not be identified.

A concentration of carbonised peat was recovered from the fill of what has been identified as a possible drainage ditch [**42001**]. The peat was recovered along with a small amount of heather charcoal, suggesting that the material is remnants of peaty turfs. The origin of this material is unknown, although it may be an accumulation of domestic debris that has been spread on the fields.

No other plant remains or small finds/artefacts were recovered from this deposit.

Table 2. Summary Table: Carbonised Plant Remains

Key: + = rare (1-10 items), ++ = occasional (11-50 items), +++ = (51-100 items), and ++++ = abundant (101+ items)

Feature type	Fill/ Feature no	Approx. Flot vol (ml	Cereal grain	Weed seeds	Nutshell	Peat Frags.	Rhizomes	Charcoal
FIELD 1								
Ditch	01021	30	+			+++		++
Ditch	01029	120	++	+		+	+	++
Ditch	01070	20						+
Deposit	01039	10			+			+
Posthole	01017	10	++	+				+
Posthole	01036	10	+					+
Posthole	01040	20	+	+			+	+
Posthole	01042	20						+
Pit	01053	20			+			+
Pit	01069	750						++++
Pit	01103	500			+			++++
FIELD 4								
Deposit	04003	100						+
FIELD 9								
Pit	09005	20			+			++
Pit	09019	100			++			+++
Pit	09023	500						++++
FIELD 27								
Pit	27002	20						+
Pit	27003	10			+			+
FIELD 39								
Deposit	39015	1000						++++
Pit	39019	600			+			++++
FIELD 42								

Ditch	42001	50 0				++++		+
Posthole	42006	30	+		+			+++

Recommendations

Sufficiently well-preserved cereal grain and nutshell suitable for AMS dating are present in:

- Sample 002 (Context 09020, Pit 09019) – hazelnut shell
- Sample 007 (Context 01031, Posthole 01017) – cereal grain
- Sample 011 (Context 01041, Posthole 01040) – cereal grain
- Sample 013 (Context 01052, Pit 01053) – hazelnut shell
- Sample 015 (Context 01008, Ditch 01029 – Feature 1001) – cereal grain
- Sample 025 (Context 01105, Pit 01103) – hazelnut shell

Sufficiently large enough fragments of charcoal suitable for AMS dating are present in:

- Sample 007 (Context 1031, Posthole 1017)
- Sample 011 (Context 1041, Posthole 1040)
- Sample 015 (Context 1008, Ditch 1029 – Feature 1001)
- Sample 020 (Context 1066, Ditch 1029 – Feature 1001)
- Sample 021 (Context 1004, Ditch 1021 – Feature 1001)
- Sample 026 (Context 39020, Pit 39019)
- Sample 027 (Context 3920, Pit 39019)

The species of cereal grain or wood charcoal present would require to be identified prior to submission for dating.

Further detailed analysis of the carbonised plant remains would add little to that provided above.

Appendix VIII.1. Composition of Flots

Key: + = rare (1-10 items), ++ = occasional (11-50 items), +++ = common (51-100 items) & ++++ = abundant (101+ items)
PH = posthole, PIT = pit, DIT = ditch, DEP = deposit/layer, NAT = natural
BLOI = Below Level of Identification
* = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No	Context No	Field No	Fill of	Feature type	Total sample vol (litres)	Approx. Flot vol (ml)	Flot fraction assesse	Cereal grain				Weed seeds (wild taxa)			Hazelnut shell		
								Qty	Id.	Pres.	AMS	Qty	Id.	Pres.	Qty	Pres.	AMS
001	9006	9	9005	PIT/ PH	10	20	100%										
002	9020	9	9019	PIT	10	100	50%								++	Varied	*
003	9024	9	9023	PIT	10	500	100%										
004	27001	27	27002	PIT	10	20	100%										
005	27004	27	27003	PIT	10	10	100%								+	Much abraded and fragmentary	
007	1031	1	1017	PH	10	10	100%	+	*Triticum sp.* (cf. emmer)	Abraded	*	+	cf. *Gramineae* indet	Much abraded			
009	1037	1	1036	PH	10	10	100%										
010	1039	1	-	NAT ?	10	10	100%										
011	1041	1	1040	PH	10	20	100%	+	*Triticum sp.* (emmer/spelt)	Varied preservation	*	+	*Plantago* sp. cf. *Polygonum* sp.	Much abraded			
012	1043	1	1042	PH	10	20	100%										
013	1052	1	1053	PIT	30	20	100%										
014	1071	1	1070	DIT	30	20	100%										
015	1008	1	1029	DIT	30	50	100%	++	*Triticum* sp. (emmer/spelt) *Avena* sp.	Abraded		+	*Polygonum* sp.	Abraded			
016	1009	1	1029	DIT	10	20	100%	+	*Triticum* sp.	Abraded							
017	1068	1	1069	PIT	10	750	25%										
018	1054	1	1029	DIT	30	20	100%	+	*cf. Hordeum* Sp.	Abraded							
019	1062	1	1029	DIT	30	20	100%	+	*Triticum* sp.	Abraded							

020	1066	1	1029	DIT	20	10	100%										
021	1004	1	1021	DIT	10	30	100%	+	*cf. Triticum* sp. *cf. Hordeum* Sp.	Much abraded							
022	4003	4	-	DEP	30	100	100%										
023	42001	42	42001	DIT	10	500	50%										
024	42007	42	42006	PH	10	30	100%	+	Indeterminate	Much abraded					+	Much abraded	
025	1105	1	1103	PIT	10	500	100%								+	Much abraded	
026	39020	39	39019	PIT	10	100	100%								+	BLOI	
027	39023	39	39019	PIT	10	500	50%										
028	39015	39	-	DEP	30	1000	25%										

Sample No	Context No	Field No	Fill of	Feature type	Total sample vol (litres)	Approx. Flot vol (ml)	Flot fraction assesse	Peat Frags.	Rhizomes	Charcoal			Comments
										Qty	Id.	AMS	
001	9006	9	9005	PIT/PH	10	20	100%			++	BLOI		Flot contains a large amount of modern root debris
002	9020	9	9019	PIT	10	100	50%			+++	Oak charcoal – blocky fragments		
003	9024	9	9023	PIT	10	500	100%			++++	Oak charcoal – blocky		
004	27001	27	27002	PIT	10	20	100%			+	BLOI		
005	27004	27	27003	PIT	10	10	100%			+	BLOI		Flot contains a large amount of modern root debris and moss frags.
007	1031	1	1017	PH	10	10	100%			+	Mixture of oak and small round wood	*	
009	1037	1	1036	PH	10	10	100%			+	Mostly BLOI – other fragments principally oak		Flot contains a large amount of modern root debris
010	1039	1	-	NAT?	10	10	100%			+	BLOI		Flot contains a large amount of modern root debris
011	104	1	1040	PH	10	20	100%		+	+	Mixture of oak and small round wood	*	

	1												
012	1043	1	1042	PH	10	20	100%			+	Principally oak		
013	1052	1	1053	PIT	30	20	100%			+	BLOI		Flot principally modern root debris and frags. of moss
014	1071	1	1070	DIT	30	20	100%			+	BLOI		Flot principally modern root debris
015	1008	1	1029	DIT	30	50	100%			+	Mixture of oak and small round wood	*	Flot contains a large amount of modern root debris
016	1009	1	1029	DIT	10	20	100%		+	+	BLOI		Flot principally modern root debris
017	1068	1	1069	PIT	10	750	25%			++++	Oak charcoal – block fragments		
018	1054	1	1029	DIT	30	20	100%			+	Mostly BLOI – other fragments principally oak		Charcoal vitrified Flot principally modern root debris and
019	1062	1	1029	DIT	30	20	100%			+	BLOI		Flot principally modern root debris – including some grass frags.
020	1066	1	1029	DIT	20	10	100%			+	Mostly BLOI – occ. fragments of small round wood	*	Flot principally modern root debris – including some grass frags.
021	1004	1	1021	DIT	10	30	100%	+++		++	Round wood fragments Heather charcoal	*	
022	4003	4	-	DEP	30	100	100%			+	BLOI		Flot principally modern root debris
023	42001	42	42001	DIT	10	500	50%	++++		+	Heather charcoal		
024	42007	42	42006	PH	10	30	100%			+++	BLOI		
025	1105	1	1103	PIT	10	500	100%			++++	Oak charcoal – blocky fragments		
026	39020	39	39019	PIT	10	100	100%			++++	Mixture of oak and small round wood	*	
027	39023	39	39019	PIT	10	500	50%			++++	Mixture of oak and small round wood	*	
028	39015	39	-	DEP	30	1000	25%			++++	Mixture of oak and small round wood	*	

Appendix VIII.2. Composition of plant remains from Phase 2 (2013)

Key: + = rare (1-10 items), ++ = occasional (11-50 items), +++ = common (51-100 items) & ++++ = abundant (101+ items)
PH = posthole, PIT = pit, DIT = ditch, DEP = deposit/layer, NAT = natural, BLOI = Below Level of Identification
* = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No	Context No	Field No	Fill of	Feature type	Total sample vol (litres)	Pot (modern)	Glass (modern)	Burnt flint	Burnt bone	Cereal grain				Nutshell			Charcoal			Peat
										Qty	Id.	Pres.	AMS	Qty	Pres.	AMS	Qty	Id.	AMS	
001	9006	9	9005	PIT/PH	10									+	Abraded		+	BLOI		
002	9020	9	9019	PIT	10												+	Oak		
003	9024	9	9023	PIT	10												+	BLOI		
004	27001	27	27002	PIT	10												+	BLOI		
005	27004	27	27003	PIT	10												+	BLOI		
007	1031	1	1017	PH	10					++	*Triticum* (emmer/spelt)	Well-preserved	*				+	BLOI		
009	1037	1	1036	PH	10					+	Cf. *Triticum* Sp.	Abraded and fragmentary					+	BLOI		
010	1039	1	-	NAT?	10									+	Much abraded		+	BLOI		
011	1041	1	1040	PH	10												+	BLOI		
012	1043	1	1042	PH	10												+	BLOI		
013	1052	1	1053	PIT	30	+ (SF)	+ (SF)							+	Slightly abraded	*	+	BLOI		
014	1071	1	1070	DIT	30												+	BLOI		
015	1008	1	1029	DIT	30					+	Indeterminat e	Much abraded and fragmentary					+	Oak		
016	1009	1	1029	DIT	10												+	BLOI		
017	1068	1	1069	PIT	10												+	Oak		
018	1054	1	1029	DIT	30			+ (SF)		+	*Triticum* Sp.	Much abraded					+	Oak		
019	1062	1	1029	DIT	30				+ (SF)								+	BLOI		+
020	1066	1	1029	DIT	20				+ (VSF)								+	Oak and small round wood		
021	1004	1	1021	DIT	10												+	BLOI		
022	4003	4	-	DEP	30												+	Small round wood		
023	42001	42	42001	DIT	10												+	BLOI		+
024	42007	42	42006	PH	10												+	BLOI		

025	1105	1	1103	PIT	10									+	Slightly abraded	*	+	BLOI		
026	39020	39	39019	PIT	10									+	Possible nutshell frag. – much abraded		+	BLOI		
027	39023	39	39019	PIT	10												+++	Oak		
028	39015	39	-	DEP	30												+++	Oak		

22 APPENDIX IX: CHARCOAL IDENTIFICATION

Transfer Pipeline Between Dolbenmaen Water Treatment Works and Cwmystradllyn Water Treatment Works (G2231): Charcoal Identification

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Report No: 3440

Introduction

Twenty-two individual charcoal samples were processed for charcoal identification from bulk soil samples retrieved from the Cwmystradllyn pipeline evaluation carried out by the Gwynedd Archaeological Trust. This report outlines the results of charcoal identifications carried out as a pre-requisite for AMS radiocarbon dating selection and to assess the types of wood charcoal identifiable from a range of different archaeological contexts.

Methodology

The soil samples, of between 10-30 litres in volume, were processed through a flotation tank. The floating material (flot) was collected in a 250μm sieve then, once dried, scanned using a binocular microscope (x10-x100 magnifications) and any carbonised plant remains extracted and preliminary identified. Where flots contained large quantities of charcoal and/or other carbonised plant remains, the flot was sub-sampled using a riffle box, and a proportion of the plant remains sorted and identified.

Charcoal identifications were carried out on the >4mm sized charcoal fragments owing to the time, cost and constraint of obtaining cross sections on very small fragments of charcoal (i.e. below 2mm). Samples falling below 2mm were considered to be below the limit of identification and are labelled as BLOI in the identification list (Appendix 1).

Identifications were carried using bi-focal reflective microscopy at magnifications ranging between x50 and x400. Anatomical keys listed in Schweingruber (1992) and in-house reference charcoal was used to aid identifications. Asymmetry and morphological characteristics were recorded using standard in-house methodology.

Results

Four wood species were identified within the assemblage and in order of abundance oak was the most abundant (70%) followed by birch (39%). Hazel attained a frequency of 3.1% with alder producing only trace amounts of charcoal (0.5%).

Species	**No of Ids**	**Total wt (g)**	**% frequency**
Alnus glutinosa	1	1	0.5
Corylus avellana	50	22	3.1

Species	No of Ids	Total wt (g)	% frequency
Betula sp	6	4.6	26
Quercus sp	135	46.3	70

Table 1. Taxonomic composition based on number of identifiable fragments >2mm

Deposit

Deposit [39015] produced over 25 individual fragments of hazel weighing 15.3g and all was comprised of branchwood.

Ditch Features

The ditch features produced hazel, oak and a single fragment of alder. All were low in frequency. Context [1062] contained a fragment identified as dung. The amorphous nature of the ditch assemblage suggests that it is probably residual.

Postholes

The posthole features produced only trace amounts of birch and oak charcoal.

Pits

Pits were dominated by oak charcoal (n=160/55g). Contexts [9020], [9024] and [1068] produced large blocky fragments possibly attributed to mature large statured wood.

Discussion

Charcoal condition

Although a rough indication of woodland composition can be postulated from deposits of fuel debris surviving from burnt spreads, pits, hearths and funerary pyres, the interpretation of such material must take into account the biases inherent in the sub-sampling process and differential survival as a result of pyrolisis in the first instance (Asouti, *et al* 2005, Braadbart *et al* 2008) and the differential survival of taxa as a result of taphonomic processes (Thery-Parisot *et al* 2010).

The amorphous sub-rounding effect on the charcoal is a result of the abrasive nature of the local soils which are derived from mudstone and siltstones of the Dol-Cyn-Afon Formation (British Geological Survey on-line geology viewer). The free draining nature of these types of soil can result in saturation of the charcoal which leads to increased fragmentation. The type of wood being burnt and its position in the fire will also have a direct bearing on how the fragments have been derived, and in the case of cremation deposits how the pyre deposits have been handled as part of the ritual.

Species composition as an index to the local woodland

For the purposes of this report, the overall dominance of species is based on the frequency of charcoal fragments per species in each sample and the overall abundance of species in the total number of samples examined. Although only four species are represented, all four species would have been common within the locality of the site during the Later Prehistoric Period. Oak is at the apex of woodland development and would have been well represented on the soils within the locality. Birch is hardy and most versatile and will grow in everything from wet to relatively dry acidic conditions. It is a small tree (15m), a light demanding pioneer and short lived, only living for 50-80 years. Hazel is often described in palynological literature as a shrub but in the absence of animal grazing it will go on to develop low statured trees. Alder is a wetland species and would have been exploited from riverbanks and seasonally flooded areas. None of the species identified are more resilient to abrasion than the other. Roundwood attributed to twig and branches is low in frequency. Some of the 'blocky' charcoal probably represents mature timber possibly associated with structural elements.

The amorphous nature of the charcoal suggests that the bulk of the material has undergone taphonomic alteration resulting in sub-rounding of the edges of the fragments. None of the species identified are more resilient to abrasion than the other. The bulk of this material was confined to pit features which points to discarded domestic fire residues.

Given the possibility of re-working, very little of the charcoal would be suitable for radiocarbon dating unless it can be certain that the charcoal is from primary undisturbed deposits (basal fills). Contexts containing charcoal marked (*) in Appendix 1 are considered to be the best candidates for AMS radiocarbon dating.

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Appendix IX.1. Charcoal Identifications

Key: PH = posthole, PIT = pit, BL = burnt layer, Dep=Deposit, DIT=Ditch NAT= Natural
BLOI = Below Level of Identification
***** = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
1	9006	PIT/PH	BLOI	N/a		N/a	N/a
1	9006	PIT/PH	N/a	N/a		N/a	N/a
2	9020	PIT	Quercus	25	Mature slow grown	14.9	Blocky frags
2	9020	PIT	N/a	N/a		N/a	N/a
3	9024	PIT	Quercus	25	Some blocky frags	6	Amorphous frags
3	9024	PIT	BLOI	N/a		N/a	N/a
5	27004	PIT	BLOI	N/a		N/a	N/a
7	1031	PH	BLOI	N/a		N/a	N/a
9	1037	PH	BLOI	N/a		N/a	N/a
10	1039	NAT (?)	N/a	N/a		N/a	N/a
13	1052	PIT	BLOI	N/a		N/a	N/a
14	1071	DIT	BLOI	N/a		N/a	N/a
16	1009	DIT	Corylus	1		1	Amorphous frag
17	1068	PIT	Quercus	25		3.7	Blocky frags
18	1054	DIT	Alnus	1	Roundwood	1	small frag
19	1062	DIT	Indet	N/a	Dung?	N/a	Amorphous plant material
20	1066	DIT	Quercus*	2	Roundwood twigs	0.1	
21	1004	DIT	N/a	N/a		N/a	N/a
22	4003	DEP	Corylus	1		0.1	Amorphous frags

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
23	42001	DIT	Quercus	N/a	Fe stained	N/a	N/a
24	42002	PH	Betula	2		0.1	Amorphous frags
24	42002	PH	Quercus	3		0.1	Amorphous frags
24	42002	PH	BLOI	N/a		N/a	N/a
25	1105	PIT	Quercus	25	Fast grown	10.3	Blocky frags
26	39020	PIT	Corylus	7		1	Amorphous frags
26	39020	PIT	Quercus	11		1.6	Amorphous frags
27	39023	PIT	Quercus*	19	1 trimmed facet	9.6	Amorphous frags
27	39023	PIT	Betula*	3		3.5	Amorphous frags
27	39023	PIT	Corylus*	16		4.7	Amorphous frags
27	39023	PIT	Vitrified	4		N/a	N/a
28	39015	DEP	Corylus*	25	Roundwood	15.3	Amorphous frags

23 Appendix X: Auger Survey and Coring Report

Garndolbenmaen – Cwystradllyn water pipeline scheme, North Wales: Auger Survey, Coring and initial assessment

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Introduction

A series of test pits undertaken as part of the Ground Investigation survey along the Garndolbenmaen – Cwystradllyn WTW Pipeline (Ground Investigation Ltd 2013) identified a series of locations where peat deposits and fine grained organic river alluvium were present. These deposits have the potential to hold an 'archive' of the local environmental history, specifically the vegetation history, of the area for the periods during which the peats and organic silts accumulated. It was anticipated that other areas not investigated during the ground investigation may also hold organic deposits of palaeoenvironmental potential so a survey was proposed.

As part of a programme of archaeological mitigation along the Garndolbenmaen – Cwystradllyn WTW Pipeline construction an auger survey and core sampling programme (Rackham 2014) was conducted along the route where peat deposits of a depth of more than 0.4m had been recorded during the geotechnical survey and at other locations established by probing during a walkover of the whole route.

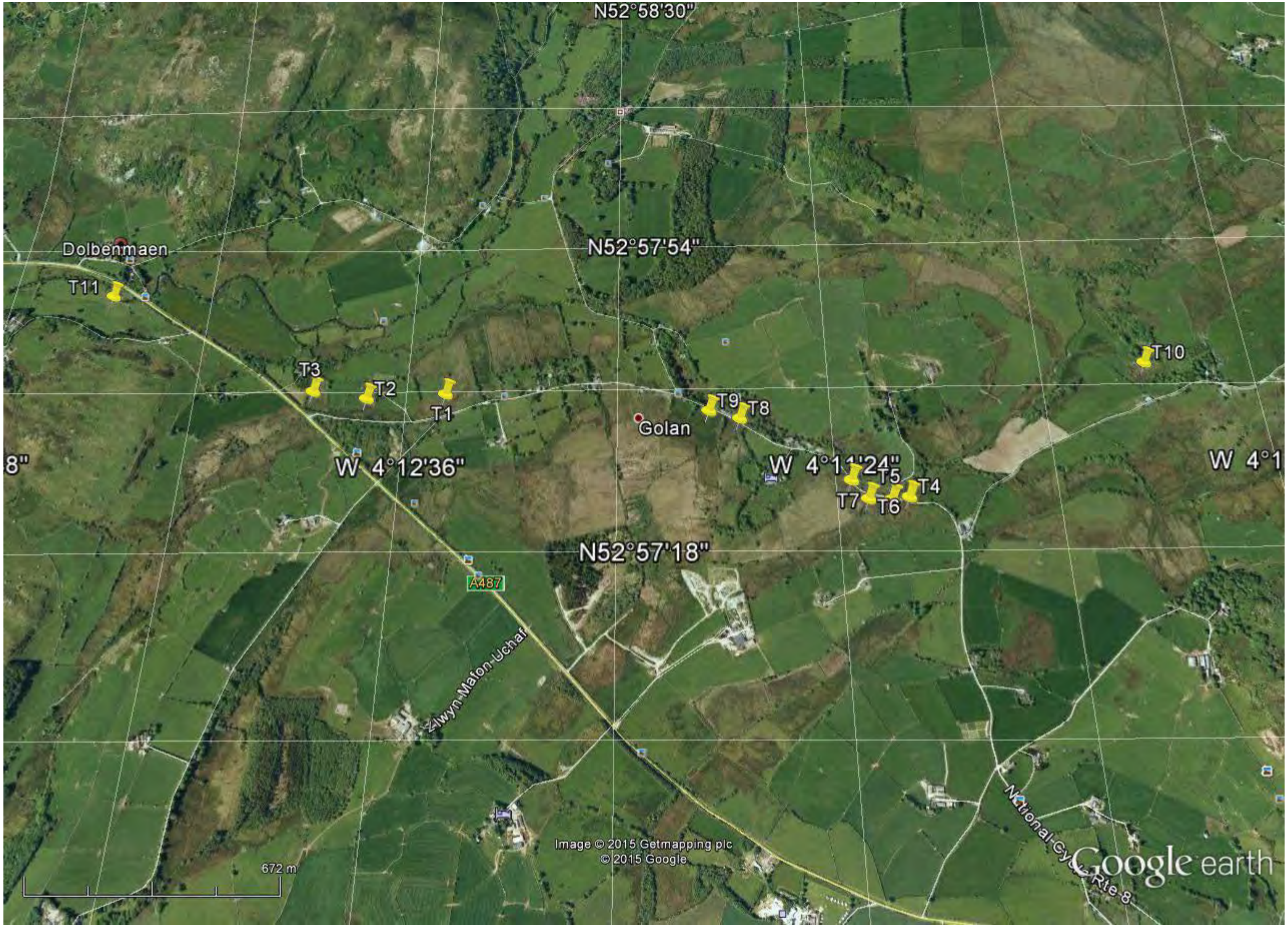
Methodology

The whole route was walked by the author and Mr John Giorgi and the ground probed using a 1.2m pointed stainless steel probe at all locations where peat deposits potentially occurred, largely recognised by the vegetation they carried and soft ground conditions. At each of these locations the stainless steel probe was pushed into the ground at several points to establish the depth of sediments. All locations where the soft sediments were established at over 0.4m depth were flagged for subsequent hand augering, all areas where the probe hit underlying stones or clays in less than 0.4m were ignored and the probing survey moved on.

After the whole route had been surveyed a total of eleven areas had been flagged for hand augering and more detailed evaluation of the soft sediments (Figs. 1). At each of these locations a series of points generally at 5 or 6m intervals (except Transect 11 on the Afon Dwyfor floodplain where auger holes were up to 100m apart) were laid across each area of peats (Fig. 2) within the pipeline easement and flagged with a red flag and subsequently hand augered and the deposits at that location recorded using standard deposit recording (Appendix 1). After hand augering and recording at each of the eleven transects a decision was made as to which transects, and which points along the transects deserved core sampling, on the basis of the sediment depth and character of the sediments. The selected sample location was flagged with a yellow flag and all hand auger points and core samples were surveyed in using a GPS by the Gwynedd Archaeological Trust (GAT) team.

Eight of the eleven transects were chosen for sampling and the deepest deposits recorded during the hand augering of each transect selected for core sampling (Figs 3-5). Core sampling was undertaken using a 110mm diameter plastic earth pipe cut down to the size appropriate for that core. The pipe was driven by hand vertically into the soft peats for the full depth recorded during the auger survey. A slot was then dug on one side of the pipe and the pipe removed with the core intact inside it. Both ends were sealed with gaffer tape and the pipe labelled. At four locations the sediments were too deep for the whole sequence to be recovered in the earth pipe.

Fig. 1. Location of each auger transect along the pipeline route marked on the Google Earth image (Copyright Google Earth).



At these locations the upper approximately one metre of deposits were recovered in an earth pipe and a Russian auger used to recover the sequence of peats and sediments below this depth.

Each 110mm core tube was cut open to expose the core within. This was cleaned, described and logged and photographed. For the cores recovered using the Russian auger, these also were cleaned, described and logged and photographed. A radiocarbon sample was taken from suitable material near the base of each of the eight organic sequences sampled in the earth pipes. These were above the base of the sequence where the Russian corer was used (Table 2). These dates define the early part of peat formation at each sampled location and give an indication of the periods covered by the organic sequences.

The radiocarbon samples were submitted to the Radiocarbon Laboratory at the Scottish Universities Environmental Research Centre (SUERC) for dating.

Fig. 2 Transect 2. Line of flags marks the exploratory auger holes.

Samples for pollen analysis were taken at 4cm intervals through each core, bagged, labelled and stored in a fridge. The cores were subsequently wrapped in cling film to seal them and have been stored until a post-excavation programme is approved. Observation of the condition of the organic deposits at the time of augering and sampling indicated that in general the preservation of pollen was likely to be excellent although much of the peat was humified. The deposits remained waterlogged, although historic/prehistoric episodes of desiccation were suggested by humified horizons in the sequences.

Fig. 3. Looking west along the line of Transect 10. The core TR10 was taken on the far side of the bog.

Radiocarbon results and probable date range

The series of radiocarbon dates summarised in Table 1 indicate that the sampled deposits include a broad range of dates during prehistory from the early Mesolithic through to the Middle Iron Age. In all cores except that from Transect 6 the non-fibrous humic acid fraction of the sampled sediment was radiocarbon dated but in Transect 6 a small fragment of roundwood was dated.

Collectively the eight sampled sequences are likely to span much of the prehistoric period from the early Mesolithic through to the later Iron Age. Since these cores recovered peats right up to the modern ground surface it is probable that significant parts of the historic period will also be represented in the upper parts of the cores. A black humified horizon is present in the upper part of cores Tr1, Tr2, Tr3 and Tr5 (see core logs below) which is likely to equate to a period of desiccation and drying out of the bogs. Such a drier episode occurred in the Roman period and further radiocarbon dating would establish the date of these horizons and whether they are contemporary. It is clear from the series presented in Table 2 that the upper part of all cores must include parts of the historic period, but the final span can only be established through further radiocarbon dating.

Results

The spike and auger survey identified a shallow covering of peats over a palaeosol across several areas of the pipeline route but only in eleven areas was this deemed to be worth augering and of these eleven areas eight were subsequently core sampled (Figs. 3-5). A palaeosol was recognised beneath the peats in several of the auger transects (T3, T6, T7, T8 and T9) but was probably present beneath the peats in the other transects although not visually recognised in the field. Peat depth varied along the route from just a few centimetres to 1.65m in BH1.5 of Transect 8.

The bulk of the augered areas were peat deposits overlying the natural diamicton (boulder clay/till- http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) but Transect 11 specifically tackled the floodplain of the Afon Dwyfor and a possible palaeochannel that was suggested by a wetter area with rushes on the southern floodplain of the river. This latter area produced mainly mineral sediments and the hand augering was stopped repeatedly by stones in the sediments. No significant organic deposits were located in the six auger holes along this transect so the floodplain was not cored. The other transect where no core sample was taken was T4 where the maximum depth of peat was 0.15m.

The basic superficial deposit sequence along the route comprises an underlying diamicton (glacial till) of Devensian age with an *in situ* developed soil. In places the palaeosol may have suffered erosion and been truncated. Peats, silty peats and organic silts subsequently developed or were deposited over the sampled areas at different periods. The formation of the peats was not synchronous along the whole route and the earliest peats which developed in the early Mesolithic were recorded in Transect 8 while those in Transect 3 did not develop until the middle Iron Age.

Table 1. Radiocarbon dates obtained from each sampled core arranged in chronological order, core depth, number of pollen samples taken and height above sea level. (individual date details are presented in Appendix 2)

Core location	Borehole	Depth	C14 date	Period	Lab No.	Total depth of core cm	No. pollen samples at 4cm intervals	OD height in m.
Transect 10	**BH2**	**85-86cm**	**2318 ± 29 BP**	**MIA**	**SUERC-60015**	**88**	**22 samples**	**139.57**
Transect 3	**BH2**	**67-68cm**	**2286 ± 29 BP**	**MIA**	**SUERC-60016**	**73.5**	**18 samples**	**98.03**
Transect 6	**BH3**	**72-73cm**	**2792 ± 29 BP**	**LBA**	**SUERC-60025**	**94**	**23 samples**	**125.82**
Transect 7	**BH2**	**47-48cm**	**4462 ± 29 BP**	**M Neo**	**SUERC-60017**	**65**	**15 samples**	**126.55**
Transect 1	**BH5**	**91-92cm**	**4671 ± 26 BP**	**E Neo**	**SUERC-60022**	**104**	**26 samples**	**100.23**
Transect 2	**BH3**	**63-64cm**	**4930 ± 29 BP**	**E Neo**	**SUERC-60023**	**100.5**	**25 samples**	**97.23**
Transect 5	**BH1**	**83-84cm**	**5656 ± 29 BP**	**L Meso**	**SUERC-60024**	**146**	**36 samples**	**127.58**
Transect 8	**BH1**	**78-79cm**	**8566 ± 28 BP**	**E Meso**	**SUERC-60018**	**165**	**40 samples**	**118.95**

Table 2. Pollen samples taken and position of C14 dates (samples recommended for study highlighted)

Tr1	cal BC	Tr2	cal BC	Tr3	cal BC	Tr5	cal BC	Tr6	cal BC	Tr7	cal BC	Tr8	cal BC	Tr10	cal BC
4		4		4		4		4		4		4		4	
8		8		8		8		8		8		8		8	
12		12		12		12		12		12		12		12	
16		16		16		16		16		16		16		16	

Tr1	cal BC	Tr2	cal BC	Tr3	cal BC	Tr5	cal BC	Tr6	cal BC	Tr7	cal BC	Tr8	cal BC	Tr10	cal BC
20		20		20		20		20		20		20		20	
24		24		24		24		24		24		24		24	
28		28		28		28		28		28		28		28	
32		32		32		32		32		32		32		32	
36		36		36		36		36		36		36		36	
40		40		40		40		40		40		40		40	
44		44		44		44		44		44		44		44	
48		48		48		48		48		48	3336-3210 & 3140-3023	48		48	
52		52		52		52		52		52		52		52	
56		56		56		56		56		56		56		56	
60		60		60		60		60		60		60		60	
64		64	3771-3651	64		64		64				64		64	
68		68		68	404-353 & 292-231	68		68				68		68	
72		72		72		72		72	1013-890			72		72	
76		76				76		76				76		76	
80		80				80		80					7603-7551	80	
84		84				84	4550-4445	84				80		84	
88		88				88		88				84			415-357

Tr1	cal BC	Tr2	cal BC	Tr3	cal BC	Tr5	cal BC	Tr6	cal BC	Tr7	cal BC	Tr8	cal BC	Tr10	cal BC
92	3520-3369	92				92		92				88		88	
96		96	Date!			96						92			
100		100				100						96			
104						104						100			
						108						104			
						112						108			
						116						112			
						120						116			
						124						120			
						128						124			
						132						128			
						136						132			
						140	Date!					136			
						144						140			
												144			
												148	Date!		
												152			
												156			
												160			

The sampled sequences are described below in transect order.

Transect 1, BH5, core (top at 100.23m OD)

Location: SH 51748 42524

0-6cm	fibrous peaty turf
16-14	dark brown (10YR 3/3) fibrous humified peat with penetrating herbaceous roots
14-41	black (10YR 2/1) completely humified peat
41-66	very dark brown (10YR 2/2) soft humified peat with penetrating roots
66-100	dark brown (7.5YR 3/2) humified peats with penetrating herb. roots
100-104	dark brown (7.5YR 3/2) fibrous humified peats Nose (10cm) of Russian corer in clay/stone

Pollen samples taken at 4-104cm at 4cm intervals

C14 sample at 91-92cm – 4671±26 BP (SUERC-60022)

Transect 2, BH3, core (top at 97.23m OD)

Location: SH51517 42518

0-8cm	very dark brown fibrous peaty turf
8-21	very dark brown (7.5YR 2.5/2) humified slightly fibrous peat with herbaceous roots
21-23	black (7.5YR 2.5/1) completely humified peat with fibrous herb. roots
23-30	very dark brown (7.5YR 2.5/2) humified peat with occasional small mudstone
30-49	very dark brown (7.5YR 2.5/2) humified peat with herbaceous roots and occasional penetrating woody roots, slightly silty towards bas (42-48)
49-66	very dark brown (7.5YR 2.5/2) slightly fibrous humified silty peat with penetrating woody roots and herbaceous roots.
66-100.5	very dark brown (7.5YR 2.5/2) slightly fibrous humified peat with occasional small wood and penetrating herbaceous roots Nose (10cm) of Russian corer hit clay or stone

Pollen samples taken at 4-100.5cm at 4cm intervals

C14 sample at 63-64cm – 4930±29 BP (SUERC-60023)

Transect 3, BH2, core (top at 98.03m OD)

Location: SH51338 42555

0-10.5cm	fibrous peaty turf
10.5-14	very dark brown (10YR 2/2) fibrous humified peat with herbaceous roots
14-20	dark reddish brown (5YR 2.5/2 humified fibrous peat with herbaceous roots
20-23	black (10YR 2/1) completely humified oxidised peat with fibrous roots
23-27	dark reddish brown (5YR 2.5/2) humified fibrous peat with roots
27-29	black and very dark brown (10YR 2/1 and 2/2) completely humified fibrous peat with roots

29-40 dark reddish brown (5YR 2.5/2) moist humified slightly fibrous peat with herbaceous roots
40-69 dark reddish brown (5YR 2.5/2) fibrous partly humified moist peat
69-73.5 dark reddish brown (5YR 2.5/2) fibrous partially humified moist peat with wood fragments

Pollen samples taken at 4-72cm at 4cm intervals

C14 sample at 67-68cm (sediment) – 2286±29 BP (SUERC-60016) and 71-72cm (wood)

Transect 5, BH1, core (top at 127.58m OD)

Location: SH 53131 42095

0-8cm very fibrous turf layer
8-12 black (10YR 2/1) completely humified peat – dry
12-26 very dark brown (10YR 2/2) completely humified peat with a little silt and very rare sand grains, slightly fibrous, mainly roots
26-67 very dark brown (10YR 2/2) completely humified peat, with occasional wood (roots?) and root fibres
67-88 very dark brown (10YR 2/2) slightly fibrous humified peat, with penetrating herbaceous roots and occasion al wood
88-95 dark greyish brown/greyish brown (10YR 4/2 and 5/2) soft organic silt with penetrating roots
95-98 very dark brown (10YR 2/2) silty humified peat with herbaceous roots
98-104 very dark brown (10YR 2/2) slightly silty fibrous humified peat
104-109 very dark greyish brown (10YR 3/2) humified peaty silt
109-119 dark grey (10YR 4/1) slightly organic fine silt
119-124 very dark greyish brown (10YR 3/2) humified peaty silt
124-135 very dark brown (10YR 2/2) humified silty peat with occasional wood fragments
135-137 wood
137-143 very dark brown (10YR 2/2) humified slightly fibrous peat
143-146 very dark greyish brown (10YR 3/2) peaty silt
Nose (10cm) of Russian corer hit clay/stone

Pollen samples taken at 4-144cm at intervals of 4cm

C14 sample at 83-84cm – 5656±29 BP (SUERC-60024)

Transect 6, BH3, core (top at 125.82m OD)

Location: SH 53063 42111

0-6cm fibrous dark brown turf with occasional small smoothed stones and beetle elytra
6-18 fibrous dark brown slightly humified peat

18-32	dark brown (7.5YR 3/4) fibrous humified well preserved peat oxidising on exposure
32-44	brown (7.5YR 3/3) slightly fibrous humified well preserved peat and very occasional fragments of mudstone
44-48.5	very dark greyish brown (10YR 3/2) fibrous slightly sandy peat with small grits and some roots
48.5-61	very dark brown (10YR 2/2) humified slightly fibrous peat
61-67	very dark greyish brown (10YR 3/2) humified slightly fibrous peat with occasional roundwood and twigs, and roots
67-81	dark brown (7.5YR 3/2) humified fibrous peat with small roundwood and twigs, and roots
81-94	very dark greyish brown (10YR 3/2) organic sandy gravel with penetrating roots and occasional roundwood or roots

Pollen samples taken at 4-92cm at 4cm intervals

C14 sample take at 72-73cm – wood - 2792 ± 29 BP (SUERC-60025)

Transect 7, BH2, core (top at 126.55m OD)

Location: SH 53007 42153

0-3cm	fibrous turf
3-5	dark brown humified fibrous peat
5-13	very dark greyish brown (10YR 3/2) organic fine silt
13-33	black and very dark brown (10YR 2/1 and 2/2) very humified peat
33-48	black and very dark brown (10YR 2/1 and 2/2) very humified slightly silty peat with roots
48-52	very dark grey (10YR 3/1) slightly gritty humified peaty silt with roots
52-65	grey (10YR 6/1) clay with penetrating roots with stone (mudstone) at base

Pollen sample taken at 4 to 60cm at 4cm intervals

C14 sample at 47-48cm - 4462 ± 29 BP (SUERC-60017)

Transect 8, BH1.5, core (top at 118.95m OD)

Location: SH 52687 42382

0-2cm	rich brown fibrous turf
2-7	dark brown (7.5YR 3/2) fibrous humified peat
7-16	very dark greyish brown (10YR 3/2) humified peaty silt/silty peat
16-32	very dark greyish brown (10YR 3/2) completely humified peats with occasional wood
32-36	very dark brown (10YR 2/2) completely humified peat with traces of wood (roots?)
36-43	very dark brown (10YR 2/2) slightly silty humified peat

43-68	very dark grey (7.5YR 3/1) soft humified peat with occasional wood (poss. roots)
68-80	black (7.5YR 2/1) soft humified peat
80-102	brown (10YR 4/2) clayey silt with penetrating roots to 2cm diameter, becoming darker with depth to very dark brown (10YR 2/2)- slightly organic silt
102-122	very dark greyish brown (10YR 3/2) organic clayey silt
122-136	very dark brown (10YR 2/2) humified organic silt.
136-148	very dark brown (10YR 2/2) humified silty peat with reed rhizomes
148-158	very dark greyish brown (10YR 3/2) organic silt
158-165	dark greyish brown (10YR 4/2) slightly organic silt
	Nose of Russian corer on clay/stone at 177cm

Pollen samples taken at 4-160cm at 4cm intervals

C14 sample at 78-79cm – 8566±28 BP (SUERC-60018)

Transect 10, BH2, core (top at 139.57m OD)

Location: SH 54013 42536

0-3cm	dark brown fibrous peaty turf
3-25	very dark greyish brown (10YR 3/2) fibrous humified peat
25-45	very dark greyish brown (10YR 3/2 patches of 3/1) fibrous humified peat – small stone at 37cm
45-88	dark brown (7.5YR 3/2) very moist fibrous humified peat, oxidising on exposure to air

Pollen samples taken at 4-88cm at 4cm intervals

C14 sample at 85-86cm - 2318 ± 29 BP (SUERC-60015)

Mesolithic

Early and late Mesolithic dates have been obtained from cores Tr8 and Tr5 respectively. Both dates were obtained from sediments halfway up the core sequences (Table 2). On this basis these two cores are likely to cover much of the Mesolithic period and the very end of the Mesolithic is likely to be represented in the basal half of the core from Tr2 which has an early Neolithic date with 40cm of sampled deposit below (Table 2).

Neolithic

Neolithic dates have been obtained from three of the cores, Tr1, Tr2 and Tr7. The early Neolithic date was obtained at 64cm in Tr2 and with 40cm of sediment below this horizon this core is likely to include the whole of the 4th millennium BC. In Tr1 and Tr7 the dates were obtained from deposits near the base of the sequence. In combination these three cores are likely to include sediments from the whole of the Neolithic period. The Tr7 sequence is just 65cm deep and likely to be duplicated in Tr1 and with these two cores lying at 126 and 100m OD respectively it could be argued that they will duplicate each other, but Tr1 lies on the lower valley edge just above the floodplain of the Afon Dwyfor while Tr7 lies on higher plateau lands above the Afon Henwy just south east of Brynkir Woollen Mill. Both cores Tr5 and Tr8 are also likely to include Neolithic peats overlying the dated Mesolithic deposits.

Bronze Age

The only Bronze Age date obtained at this stage of the project was from near the base of the sequence from Tr6 where a late Bronze Age date was obtained (Table 2). But it is probable that cores Tr1, Tr2, Tr5 and Tr7 will include early, and possibly later, Bronze Age deposits. While this cannot be guaranteed, in combination the sequences are likely to cover a large part of the Bronze Age.

Iron Age

Two of the cores, Tr3 and Tr10 produced Iron Age radiocarbon dates from the base of their sequences (Table 2). Tr3 is located at 98m OD just above the southern edge of the floodplain of the Afon Dwyfor while Tr10 occurs at the other end of the pipeline route at 139m OD in a peat filled stream hollow (Fig. 3) below a north facing scarp above which sits the farm of Cefn-coch-isaf . Despite these being the only two cores that have so far produced an Iron Age date it is probable that several of the cores already discussed above will include peats of this period, and Tr6 is likely to include at least the early part of the Iron Age.

Historic periods

Since the initial dating programme was targeted at establishing broadly when the peats began forming in each core the absence of any dates for the historic periods indicates that all the peats investigated started developing in the prehistoric period, presumably as a result of changes in land use, climate and local hydrology. Clearly Tr5 and Tr8 represent areas that have been wet and prone to peat formation throughout the postglacial, but the remaining locations suggest episodes of localised peat formation commencing in the early Neolithic, later Bronze Age and middle Iron Age. The fact that these deposits are very local is reflected in the differences between Tr5, Tr6 and Tr7 which lie in adjacent small stream valleys across 140m of hillside (Fig. 5) and indicate sediments beginning in the Mesolithic, Neolithic and late Bronze Age.

However since every core sample was taken from the modern day surface, which in most of the cores comprises a brown peaty fibrous turf overlying peats it is probable that parts of the historic period will be represented in all the recovered cores. It would be a mistake to assume that the sequences are continuous with no hiatus'. The Roman period is often missing from peat sequences, because being drier the peat surface dried out and humified during this period creating a hiatus with no new peat growth. This can sometimes be recognised by the occurrence of 'black' humified peat (oxidised and completely humified) and such layers are certainly present in these sequences (see above) although whether of Roman date or not is not yet established.

It is perhaps unlikely that the whole of the historic period will be represented in the cores sequences but Tr3 and Tr10 are both likely to include historic deposits, and all the cores are likely to include medieval and post-medieval peats that formed during the period of wetter conditions that began around 1300 AD (Hendon *et al* 2001), following on from the medieval warm period, and followed later by the Little Ice Age.

Discussion

Collectively the peats and sediments in this series of cores are likely to cover a big chunk of the postglacial history of this part of North Wales. There have been many pollen studies across North Wales but the bulk of these have been undertaken on upland peat bogs and mires and moorland areas (Rhind and Jones 2003) with relatively little agricultural activity other than grazing and, of course, early forest clearance. The value of this series of cores is that they all lie between 97 and 139m OD in what is quite clearly an agricultural landscape (see Fig. 1) of pastures, hayfields and even some arable. A landscape that has its origins in prehistory with burnt mounds, standing stones, prehistoric hut circles and a hillfort all lying within this part of the valley of the Afon Dwyfor, and continued in use throughout the historic period with Romano-British huts, Roman roads, medieval huts and a motte, medieval and post-medieval farmsteads and townships nearby (Richards and Smith 2013 – see Figs 4-6 for known sites within the immediate area of the pipeline route). The small and localised scale of the sampled bogs also means that they are likely to reflect the localised landscape and vegetational history with a bit more clarity than some of the large upland raised bogs.

A considerable number of aspects of the landscape history might be addressed. Evidence for early Mesolithic activity in the area based upon evidence for small scale woodland clearance and microscopic charcoal, the start of early forest clearance in this landscape, the beginnings of arable activity, periods of pastoral expansion, changes and developments in land use, the impact of climate change, the date of episodes of drying out and possible agricultural expansion, arrival of crops like cannabis and rye, early post-medieval plantations, etc. Their study would give a landscape context for the known archaeology of the area and for those archaeological discoveries made during the course of the archaeological work along the pipeline during its construction. With three sites near the floodplain of the Afon Dwyfor, four more on the plateau lands above the Afon Henwy, and one a little further up the valley towards the edge of the foothills of Snowdonia there is also the possibility of discerning any localised patterns of land use that might occur as the sites move upstream into slightly more marginal areas for agriculture.

Finally the construction of the pipeline itself may have a negative impact upon the surviving deposits in these small bogs. The pipeline trench and its fill can act as a conduit for subterranean water and effectively lead to a draining of the peats over time with the resultant oxidation and desiccation of the deposits thereby destroying the palaeoenvironmental record that they contain. While the severity of such an impact and its timescale is unknown, and probably variable, for each sampled bog the small size of the sampled locations makes this potential impact more severe than would be the case for a large bog or mire.

Recommendations

The primary objective of this programme of auger survey and core sampling was to recover deposit sequences, primarily peats, that would allow a reconstruction of the vegetational history of the valley through the analysis of pollen and radiocarbon dating. Where the cores were recovered in the 110mm diameter earth pipe there is some potential for the analysis of the plant and insect macrofossils, but since this is most likely to reflect the bog environment in which the peats formed with only minimal input from the broader landscape these approaches are considered to be less important. Where the lower part of the sequences were recovered using the Russian corer the sample size is insufficient for any useful macrofossil studies. Loss on ignition studies of the organic deposits can be undertaken to more closely define the deposit character and establish the mineral input.

The preliminary dating has established that the sampled sequences represent much of the post-glacial period and all the cores could contribute to the original objectives of the project. It is however evident from Fig 2 that the upper parts of many if not all the cores may well cover the same historical periods and it would be inappropriate to duplicate this aspect of the work across all eight cores. It is also probable that the sequence represented in Tr7, the shortest of the sampled sequences is duplicated in the nearby core TR5 (Fig. 4) and cores Tr1 and Tr2 further down the valley.

The following analyses are therefore recommended to establish a vegetational history for the local area, establish the human impact on this vegetation, and give a palaeoenvironmental context for the local archaeology.

The whole sequence in Tr1, Tr2, Tr5 and Tr8 should be studied for pollen and additionally all samples below 20cm in Tr3, Tr6 and Tr10. Selected 10cm core units from Tr1, Tr3, Tr5 and Tr6 should be processed and studied for macrofossil remains. The base of the sequences in Tr2, Tr5 and Tr8 should be radiocarbon dated and samples from the upper part of each core sequence studied should be dated on the basis of the pollen results to give a chronology for the vegetational changes recognised that can then be tied into to the local archaeological evidence. Dating of the top of selected black humified horizons and the less humified peats immediately above will establish the possible existence and duration of any hiatus in the sequences which might reflect a drier period during which agricultural expansion could occur.

These analyses should be used to establish the local and regional vegetational and landscape history of the area, and the human impact on it, and correlate this with the known archaeology and that most recently found during the fieldwork along the water pipeline.

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I should like to thank John Giorgi for his assistance during the field walkover, auger survey and coring programme. Members of the GAT field team kindly assisted during the survey and specifically surveyed all the auger holes and core locations. Members of the construction team also facilitated the programme of field work. The radiocarbon dates were carried out by the Radiocarbon Laboratory at the Scottish Universities Environmental Research Centre.

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Fig. 4. Location of cores Tr1, Tr2 and Tr3. (map taken from Richards and Smith 2013)

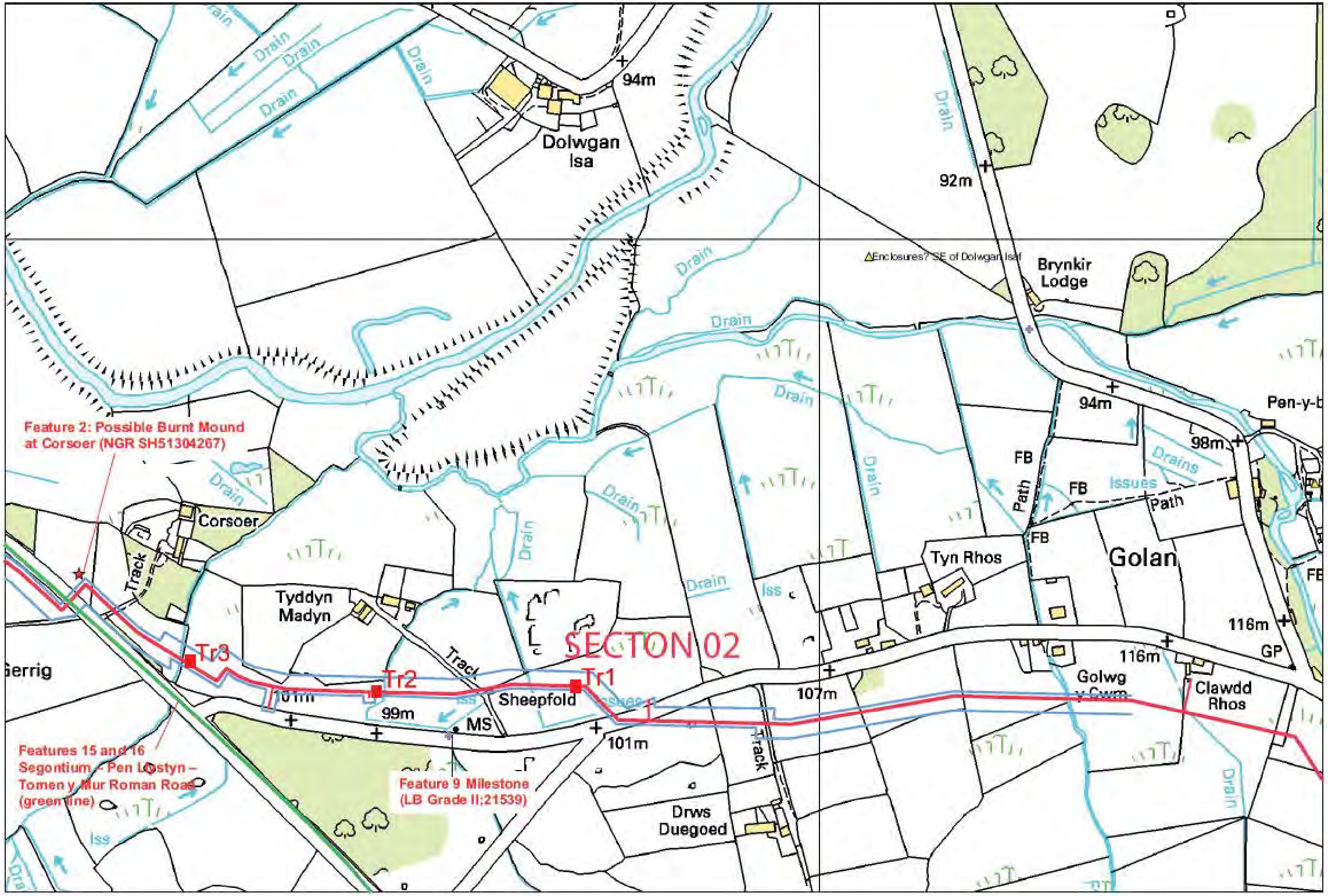


Fig. 5. Location of cores Tr5, Tr6, Tr7 and Tr8**.** (map taken from Richards and Smith 2013)

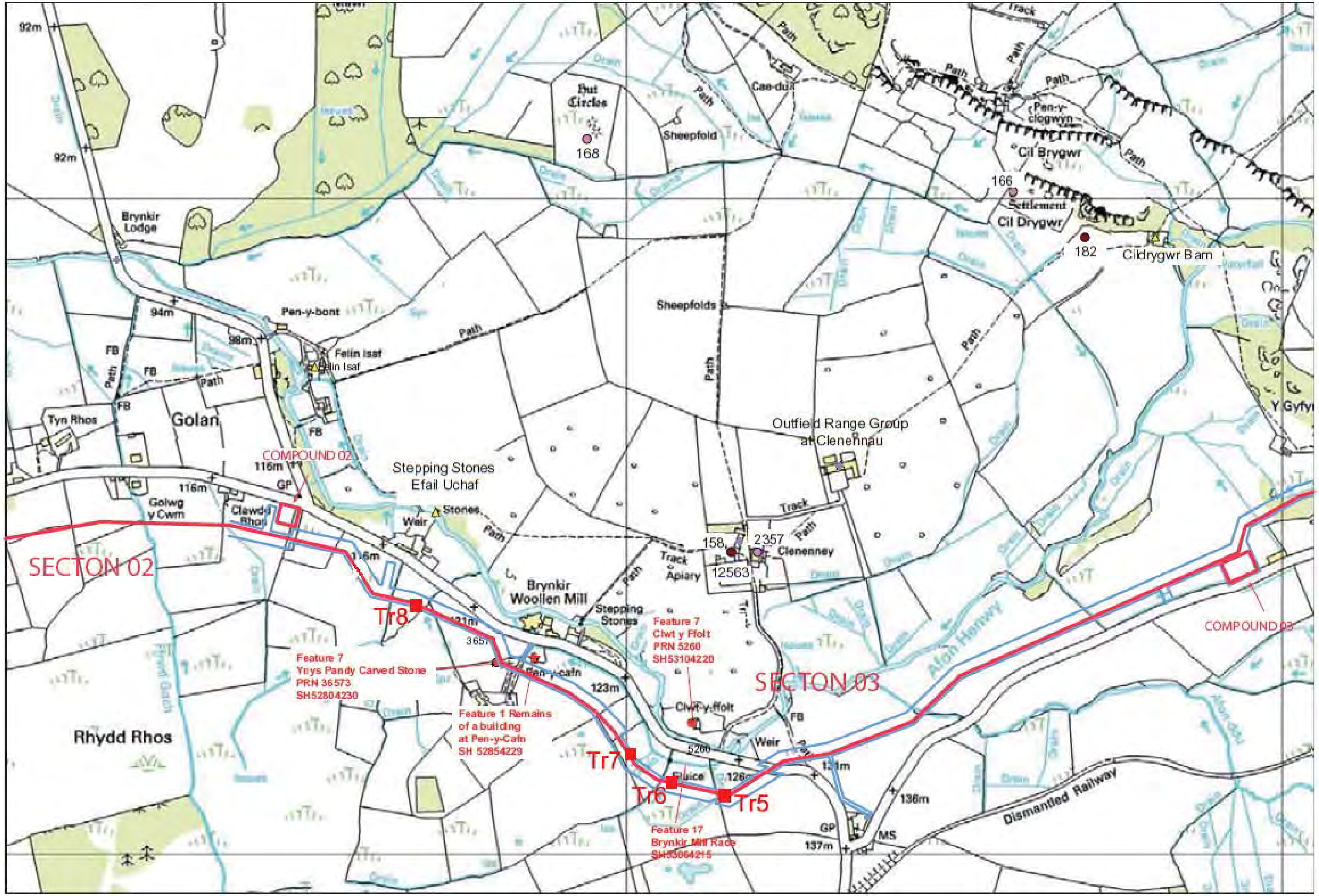
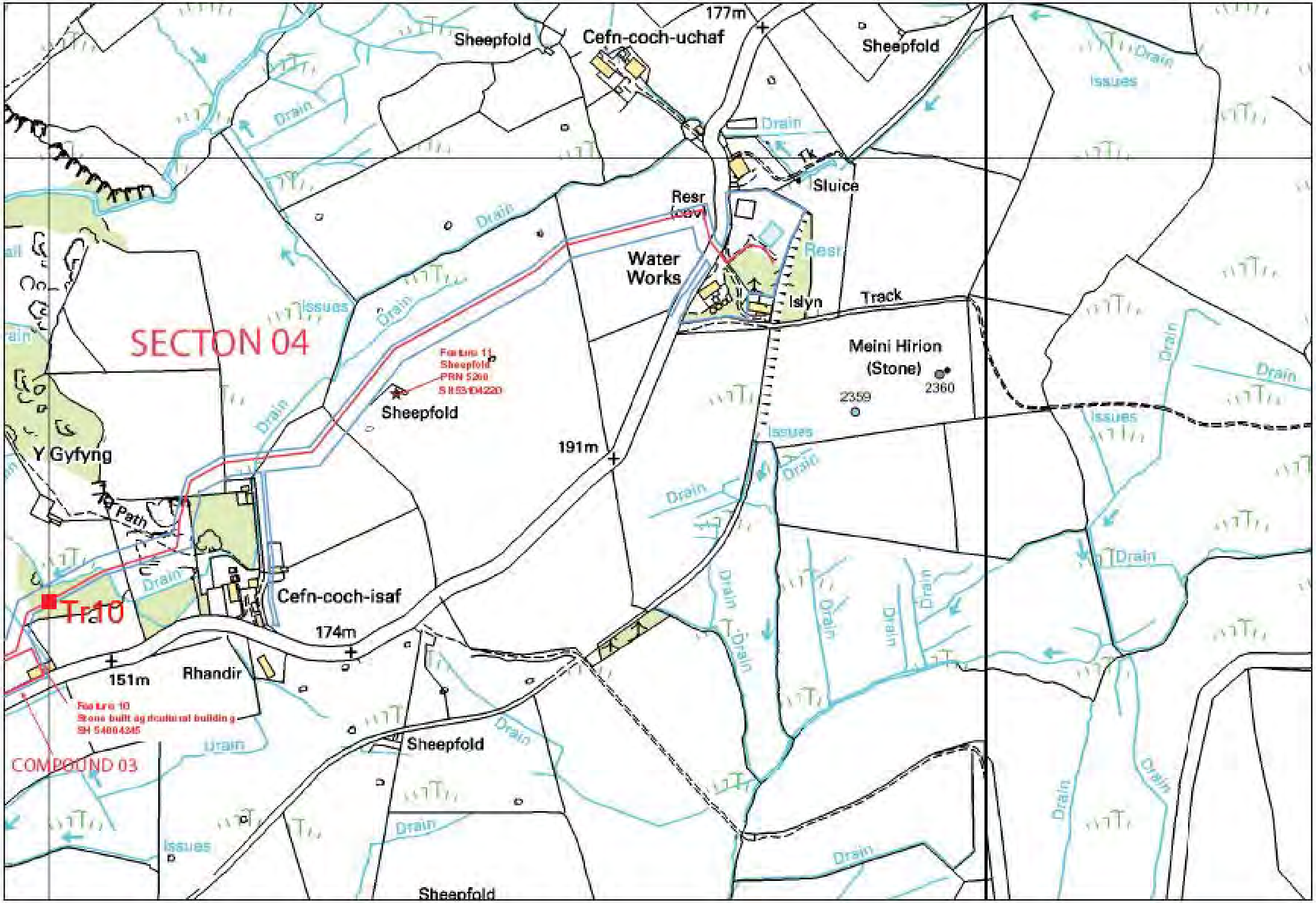


Fig. 6. Location of core Tr10**.** (map taken from Richards and Smith 2013)



Appendix X.1 - Auger survey borehole logs

Transect Line 1

BH1 east end	(GR 251779.494 342524.669 - 100.153 OD)
0-10cm	wet turf
10-33	brown (10YR 4/3) fine silt
33-55	brown (10YR 4/3) fine silt with iron mottling
55-70	fell out – no peats

BH2	(GR 251767.06 342524.685 – 100.288 OD)
0-9cm	fibrous mossy turf
9-20	dark brown fibrous peat
20-41	very dark brown humified fibrous peat
41-68	humified slightly silty peat with wood at 60cm
68-73	very dark brown completely humified peat-sharp boundary below
73-100	grey (10YR 5/1) fine silty clay with occasional small stones

BH3	(GR 251760.794 342524.644 – 100.261 OD)
0-6cm	fibrous mossy turf
6-14	dark brown fibrous peat
14-44	very dark brown fibrous humified peat
44-71	very dark brown well humified slightly fibrous peat
71-80	very dark grey (10YR 3/1) organic silt
80-100	silty clay with occasional pebbles – sharp boundary below

BH4	(GR 251754.725 342524.724 – 100.292 OD)
0-10cm	fibrous mossy turf
10-20	dark brown fibrous peat
20-78	very dark brown slightly fibrous humified peat
78-100	slightly wet, slightly fibrous dark brown peat
100-118	grey silty clay

BH5	(GR 251748.119 342524.249 – 100.226 OD)
0-10cm	fibrous mossy turf
10-18	dark brown fibrous peat
18-52	very dark brown humified peat
52-83	dark brown wet fibrous peat
83-115	very dark brown humified peat
115-130	dark brown wet fibrous peat – stopped by stones at 130cm

BH6	(GR 251742.687 342524.939 – 100.117 OD)
0-10cm	dark brown fibrous mossy peaty turf
10-50	very dark brown slightly fibrous humified peat
50-100	dark brown fibrous peat - stopped by stones at 104cm in 3 holes

BH7	(GR 251736.431 342524.878 – 99.989 OD)
0-13cm	dark brown fibrous mossy turf

13-36	very dark brown humified peat
36-91	dark brown wet fibrous peat
91-100	very dark brown humified peat
100-125	very dark brown humified peats onto silty peat at base (115-125cm)
	Stopped by stones at 125cm

BH8	(GR 251730.616 342524.755 – 99.753 OD)
0-65cm	lost but stopped by stones at 65cm

Transect Line 2

BH1 East end (GR 251527.185 342517.83 – 96.322 OD)

0-15cm	damp fibrous brown peaty turf
15-35	silty humified peat
35-38	dark brown silty non-fibrous peat
38-50	light blue grey stoney clay

BH2	(GR 251522.614 342517.996 – 96.943 OD)
0-20cm	fibrous peaty turf
20-35	black humified fibrous peat (oxidised)
35-77	dark brown fibrous peat
77-90	very dark brown humified peat
90-100	brown slightly organic silt – stopped by stones at 100cm

BH3	(GR 251516.991 342518.226 – 97.228 OD)
0-10cm	fibrous peaty turf
10-30	dark brown fibrous peat – stone at 22cm
30-110	damp dark brown fairly fibrous peat
110-120	lost (fell out)
	Stopped by stones at 120cm

BH4	(GR 251511.391 342518.233 – 97.641 OD)
0-65cm	core lost – stopped by stones at 65cm

BH5	
0-15cm	fibrous peaty turf
15-20	soil horizon
20-45	slightly stoney clays

Transect Line 3

BH1 East end (GR 251342.059 342551.409 – 98.094 OD)

0-12cm	fibrous peaty turf
12-21	dark brown fibrous peat
21-32	black oxidised fibrous peat
32-46	slightly humified brown fibrous peat
46-79	soft wet dark brown fibrous peat
	Stopped by stones at 79cm

BH2	(GR 251337.555 342554.671 – 98.033 OD)
0-15cm	fibrous peaty turf
15-23	brown fibrous peat
23-35	dark brown slightly humified fibrous peat
35-85	damp fibrous brown peat
	Stopped by stones at 85cm

BH3	(GR 251332.414 342557.881 – 97.995 OD)
0-8cm	fibrous peaty turf
8-13cm	brown fibrous peat
13-17	very dark brown oxidised fibrous peat
17-35	dark brown damp fibrous peat
35-50	light brown silt – old soil?
50-56	slightly darker brown organic silt
56-60	grey clay

Transect Line 4

Field south of road crossing

BH1 North east end (road end) (GR 253191.57 342104.568 – 128.22 OD)

0-10cm	empty – compression
10-15	fibrous peaty silt
15-50	humified organic silts
	Stopped by stones at 50cms

BH2	(GR 253187.024 342102.028 – 128.312 OD)
0-14cm	organic silty turf
14-20	dark brown (10YR 3/3) humified peat
20-29	black humified silty peat
29-48	very dark greyish brown (I10YR 3/2) humified slightly organic silts

BH3	(GR 253183.268 342100.048 – 128.367 OD)
0-5cm	empty
5-18	very dark greyish brown (10YR 3/2) organic silt with occasional stone
18-30	very dark greyish brown (10YR 3/3) fine silt with a .little sand and grits
30-40	slightly stoney silty clay – natural

Transect Line 5

BH1 East end (GR 253130.888 342095.349 – 127.579 OD)

0-11cm	dark brown fibrous peaty turf
11-19	fibrous organic silt
19-39	dark brown fibrous slightly silty humified peat
39-80	dark brown damp fibrous humified peat
80-98	dark brown humified soft peat
98-137	very dark brown humified slightly fibrous peat
137-148	very dark brown humified slightly fibrous peat with wood fragments
	stopped by stones at 148cm

BH2	(GR 253126.79 342096.361 – 127.522 OD)
0-18cm	wet loose fibrous peaty turf
18-25	organic silt
25-45	dark brown humified fibrous peat
45-58	very dark brown peat with wood fragments
58-90	very dark brown compacted slightly fibrous peat
90-109	very dark brown compacted fibrous peat with occasional wood fragments
109-126	dark grey (10YR 4/1) organic silt with wood fragments
	Stopped by stones at 130cm

BH3	(GR 253122.643 342097.262 – 127.529 OD)
0-15cm	empty- compression
15-30	wet brown fibrous silty peat
30-43	dark brown fibrous humified peat
43-44	grey silt band
44-50	dark brown fibrous peat
50-60	grey fibrous silty layer
60-61	dark brown fibrous peat
61-80	lost- fell out
	Stopped by stones at 80cm

Transect line 6 (east of stream/drain line)

BH1	(GR 253073.055 342108.254 – 126.246 OD)
0-8cm	empty – compression
8-18	dark brown fibrous peaty turf
18-37	dark brown fibrous humified slightly silty peat
37-39	gritty sandy silt
39-58	small stones and sandy organic silt – soil?
	Stopped by stones at 58cm

BH2	(GR 253067.869 342109.645 – 125.89 OD)
0-4cm	empty
4-16	very fibrous peaty turf
16-23	brown fibrous peat
23-28	dark brown fibrous peat
28-32	brown fibrous peat
32-60	dark brown fibrous humified peat with wood fragments
60-73	lost- fell out
	Stopped by stones at 73cm

BH3	(GR 253063.01 342111.211 – 125.822 OD)
0-30cm	wet fibrous peaty turf
30-80	dark brown fibrous peat
80-100	slipped out

Transect Line 7 (west of stream)

BH1	(GR 253009.467 342148.656 – 126.674 OD)
0-12cm	very dark brown humified silt
12-20	black humified silty peat
20-50	somewhat mixed slightly gritty silt - subsoil?
50-100	brownish yellow (10YR 6/6) silty clay – diamicton

BH2	(GR 253007.34 342153.173 – 126.549 OD)
0-13cm	fibrous silty turf
13-36	black wet humified loose peat
36-53	very dark grey (10YR 3/1) organic silt – palaeosol?
53-65	light grey (10YR 7/1) leached silty clay – palaeosol

Two more holes were sunk to the west but produced no more than BH1 and BH2 and were not recorded

Transect 8 – west of woollen mill

BH1 - East end (GR 252686.589 342382.555 – 118.955 OD)

0-30cm	dark grey (10YR 4/1) humified organic silt – topsoil
30-36	very dark grey organic silt with roots
36-52	dark greyish brown (10YR 4/2) humified organic silt
52-100	very dark brown slightly silty humified peat with occasional wood fragments
100-166	humified peat with occasion al wood fragments (roots?)
166-178	dark greyish brown (10YR 4/2) fine humified organic silt – palaeosol
178-185	grey clay

BH2	(GR 252682.711 342384.129 – 118.923 OD)
0-20cm	dark grey (10YR 4/1) silt loam
20-33	very dark greyish brown (10YR 3/2) very organic silt
33-65	damp brown fibrous humified peat with wood – blacker in top 5cm
65-86	very dark brown humified fibrous peat – oxidised in past
86-105	dark greyish brown (10YR 4/2) fine organic silts
105-157	dark brown humified peat with occasional wood
157-169	dark greyish brown (10YR 4/2) humified organic silt – palaeosol
169-185	grey clay

BH3	(GR 252677.951 342386.415 – 118.867 OD)
0-18cm	dark grey silt loam
18-35	damp brown humified fibrous peat
35-41	black humified peat
41-70	red brown humified fibrous peat with wood fragments
70-85	dark brown humified peat with wood fragments (roots?)
85-106	dark greyish brown (10YR 4/2) humified organic silt
106-115	dark greyish brown (10YR 4/2) silt – palaeosol
	Stopped by stone at 115cm

BH4	(GR 252673.092 342388.198 – 118.811 OD)
0-22cm	dark grey silt loam

22-44	dark brown humified fibrous peat
44-50	dark greyish brown (10YR 4/2) silt – palaeosol
	Stopped by stones at 50cm

Transect Line 9 – west of Transect 8

BH1 - east end (GR 252598.539 342421.769 – 119.23 OD)

0-23cm	silt loam – fibrous topsoil
23-28	black humified peat
28-36	brown fibrous peat
36-44	dark greyish brown (10YR 4/2) silt – palaeosol
44-46	grey clay

BH2 not logged – disturbed, 44cm deep (GR 252595.882 342425.827 – 119.137 OD)

BH3 not logged – same as BH1, 46cm deep (GR252593.077 342430.516 – 119.128 OD)

BH4 not logged – same as BH1, clay at 36cm (GR252590.558 342434.353 – 119.142 OD)

Transect Line 10

BH1 East end (GR 254020.419 342539.945 – 140.188 OD)

0-12cm	fibrous peaty turf
12-60	fibrous slightly humified peat
60-70	lost- fell out – stones at 70cm

BH2	(GR 254013.449 342535.894 – 140.067 OD)
0-10cm	fibrous peaty turf
10-35	dark brown fibrous humified peat
35-52	very dark brown humified fibrous peat
52-100	dark brown humified fibrous peat
100-105	lost – fell out
	Stopped by stones at 105cm

BH3	(GR 254009.03 342533.615 – 139.701 OD)
0-10cm	fibrous peaty turf
10-60	brown fibrous peat
60-90	fibrous organic silt
	Stopped by stones at 90cm

BH4	(GR 254002.843 342530.015 – 139.56 OD)
0-10cm	fibrous peaty turf
10-40	brown fibrous humified peat
40-55	darker brown fibrous peat
55-95	brown fibrous peat
	Stopped by stones at 95cm

BH5 (GR 253998.641 342527.529 – 139.573 OD)

0-10cm	fibrous peaty turf
10-35	brown slightly humified fibrous peat
35-51	darker brown humified fibrous peat
51-100	wet brown fibrous peat
	Stopped by stones at 100cm

BH6	(GR 253993.907 342524.471 – 139.477 OD)
0-10cm	fibrous peaty turf
10-30	brown fibrous peat
30-48	darker brown fibrous peat
48-100	fibrous brown peat
	Stopped by stones at 101cm

Transect line 11

BH1 East end (first low rushy hollow) (GR 250829.351 342858.484 – 88.364 OD)

0-15cm	fine clayey silt – alluvial soil
15-27	dark grey humified organic silt – old soil/marshy turf
27-50	slightly stoney (small clasts) silty clay
50-55	grey stoney clay

BH2	(GR 250736.176 342896.639 – 88.011 OD)
0-17cm	brown (10YR 5/3) silty clay loam
17-35	dark greyish brown (10YR 4/2) silty clay
35-70	brown (10YR 5/3) soft silt
70-100	greyish brown (10YR 5/2) sandy silt with occasional degraded organic traces and sandier bands
100-106	brown slightly organic fine silt
106-118	grey slatey sand and fine gravel

BH3	(GR 250650.891 342930.659 – 88.403 OD)
0-25cm	yellowish brown (10YR 5/4) silt with occasional small rounded pebbles
25-46	dark yellowish brown (10YR 4/4) fine silt with some iron deposition
46-54	brown (10YR 4/3) small slatey pebbles in a clay matrix
54-60	slatey gravel in silty clay matrix
	Stopped by stones at 60cm

BH4	(GR 250589.719 342957.752 – 88.183 OD)
0-16cm	gritty silts – probably dumping!
16-27	old turf – recent
27-48	brown (10YR 4/3) silt with occasion al grits
48-85	brown fine waterlain slightly organic silts – poss. channel fills
85-107	silts and slatey gravel with organic traces and rootlets and organic silts
107-115	slatey gravel in a silt matrix with some degraded organics
115-126	slatey gravel with a silt matrix

BH5	(GR 250558.39 342967.923 – 88.141 OD)
0-10cm	brown (10YR 4/3) silts

10-20	brown (1oYR 4/3) fine silts
20-48	pale brown (10YR 6/3) clayey silt with occasional small pebbles – alluvium?
48-55	gravelly silty clay
55-90	sandy gravels

BH6	(GR 250492.962 342993.933 – 88.024 OD)
0-25cm	fine silts – alluvium
25-40	slightly gritty silts – alluvium
40-60	gravelly silts – stones to 20mm
	Stopped by stones at 60cm

Appendix X.2. Radiocarbon dates from each of the sampled cores.

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RADIOCARBON DATING CERTIFICATE
07 May 2015

Laboratory Code	SUERC-60015 (GU37322)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non fibrous fraction
Sample Reference	Tr10/BH2/85-86cm
Material	Humified peat : Humic Acid Dated
$\delta^{13}C$ relative to VPDB	-29.3 ‰
Radiocarbon Age BP	2318 ± 29

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

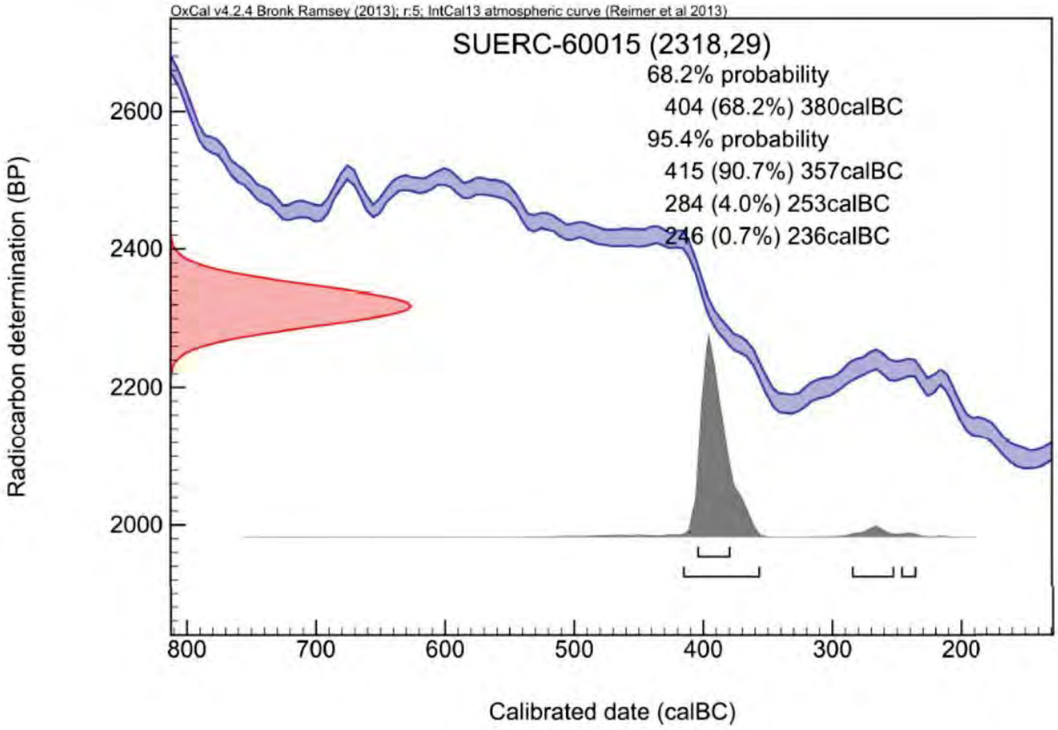
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- E Dunbar   Date :- 07/05/2015

Checked and signed off by :- P. Naysmith   Date :- 07/05/2015

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60016 (GU37323)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction please
Sample Reference	Tr3/BH2/67-68cm
Material	Humified peat : Humic Acid Dated
$\delta^{13}C$ relative to VPDB	-29.3 ‰
Radiocarbon Age BP	2286 ± 29

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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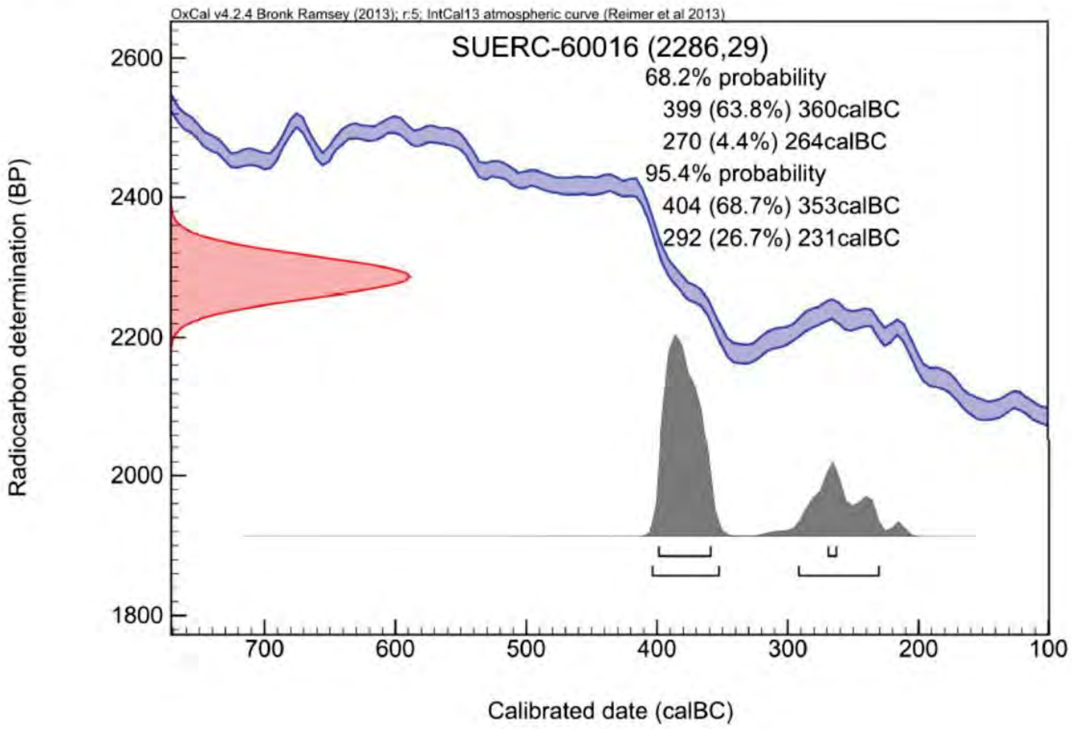
Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60017 (GU37324)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction
Sample Reference	Tr7/BH2/47-48cm
Material	Humified peat : Humic Acid Dated
δ^{13}C relative to VPDB	-29.4 ‰
Radiocarbon Age BP	4462 ± 29

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

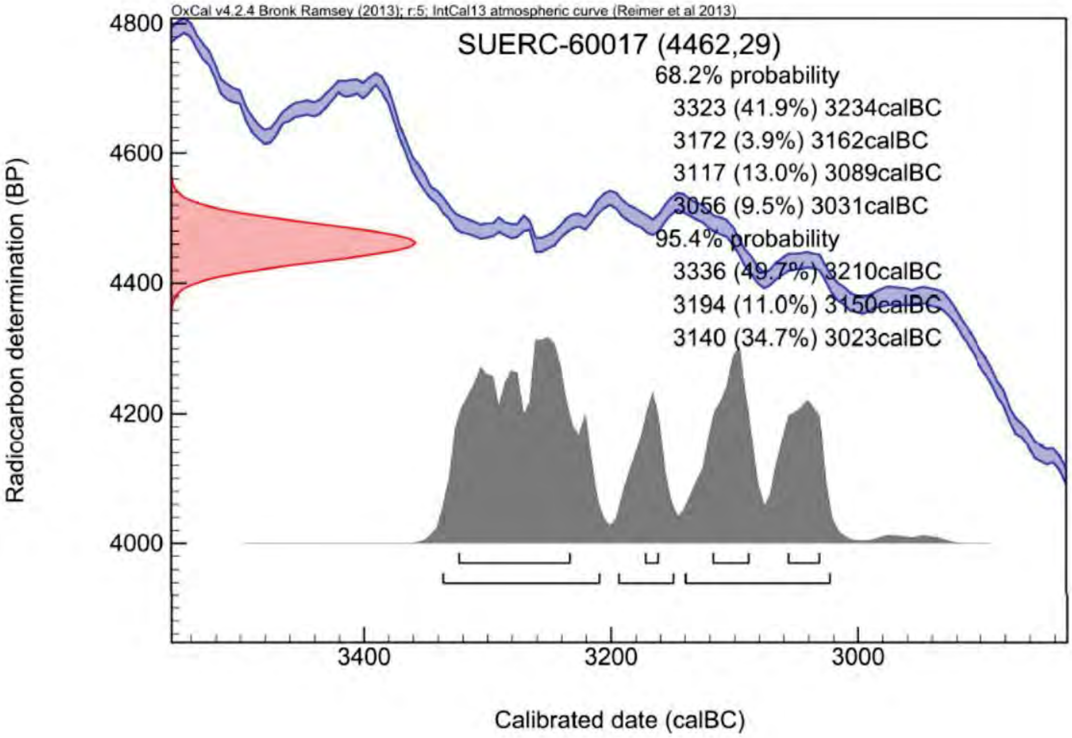
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60018 (GU37325)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction
Sample Reference	Tr8/BH1.5/78-79cm
Material	Humified peat : Humic Acid Dated
$\delta^{13}C$ relative to VPDB	-29.3 ‰
Radiocarbon Age BP	8566 ± 28

N.B. 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.

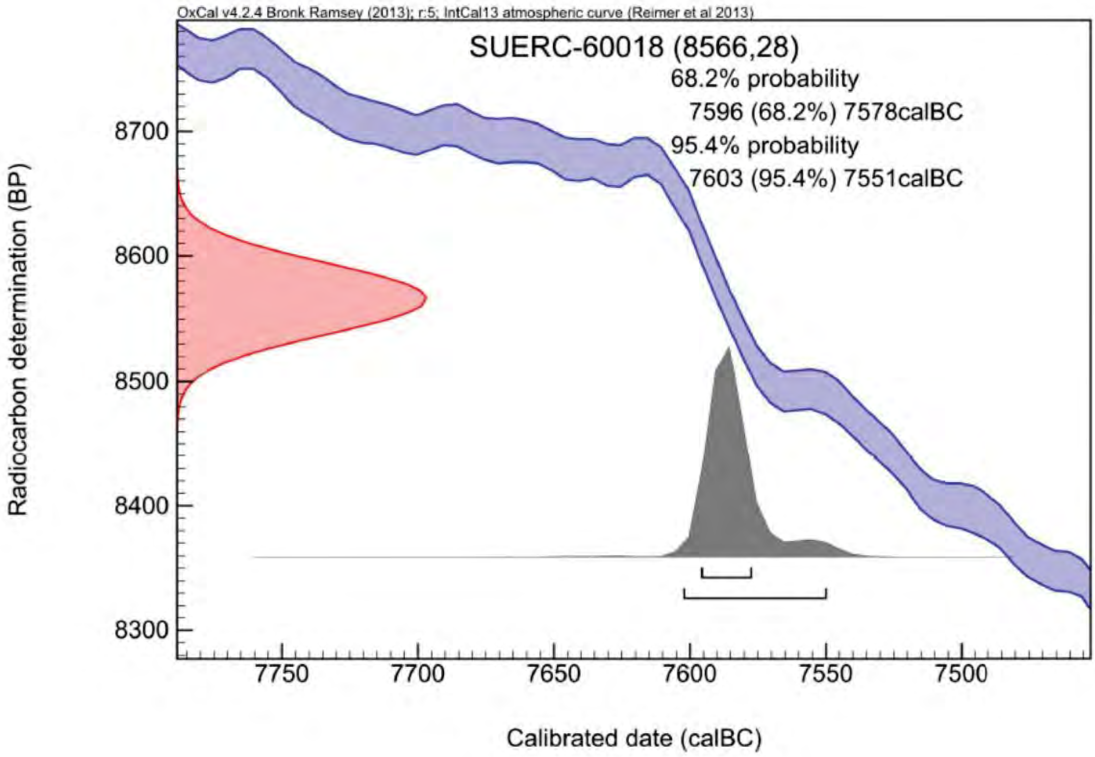
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E. Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60022 (GU37326)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction
Sample Reference	Tr1/BH5/91-92cm
Material	Humified peat : Humic Acid Dated
$\delta^{13}C$ relative to VPDB	-28.9 ‰
Radiocarbon Age BP	4671 ± 26

N.B. 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.

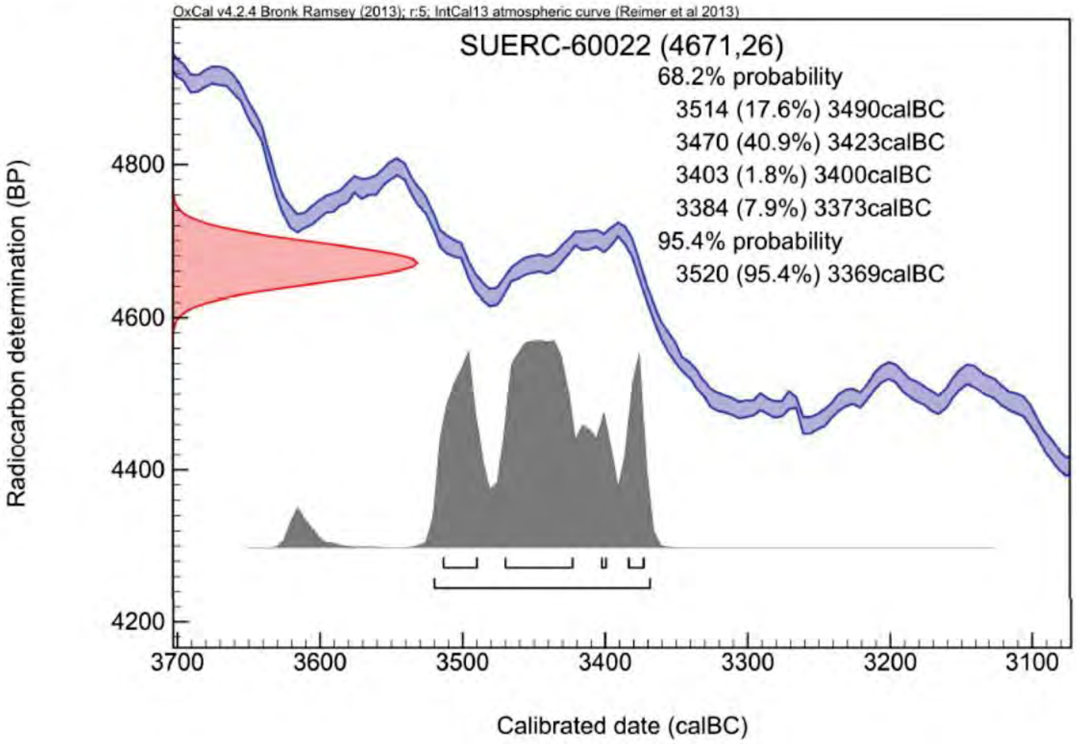
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

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Laboratory Code	SUERC-60023 (GU37327)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction
Sample Reference	Tr2/BH3/63-64cm
Material	Humified peat : Humic Acid Dated
δ^{13}C relative to VPDB	-29.5 ‰
Radiocarbon Age BP	4930 ± 29

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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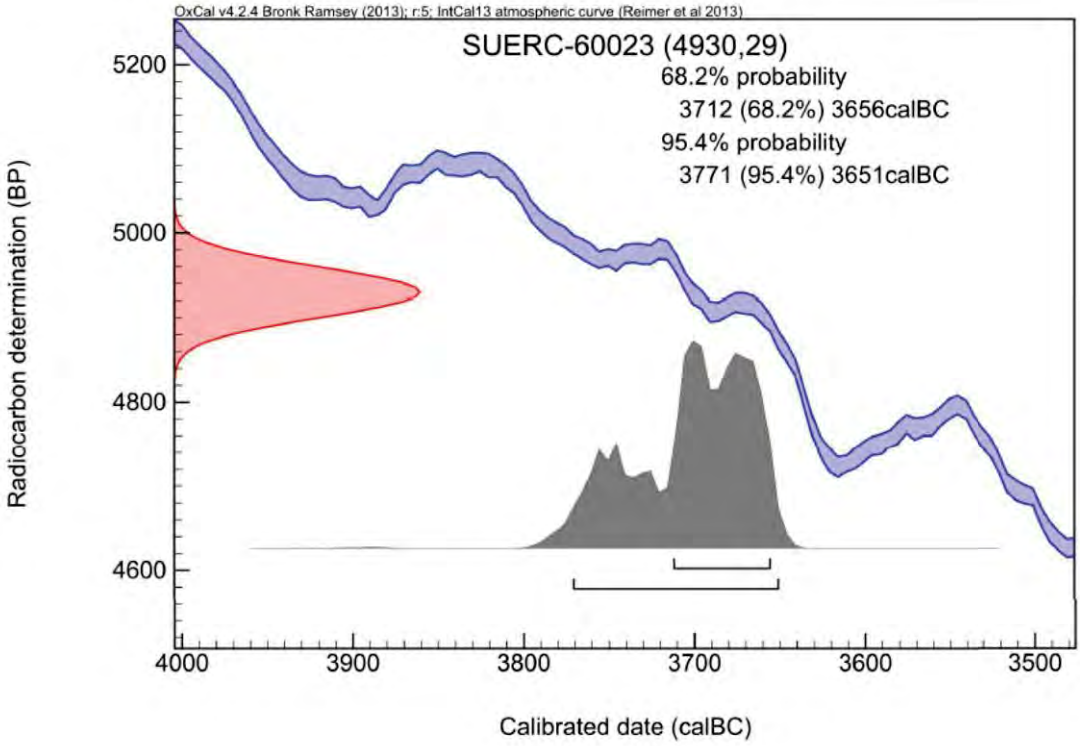
Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60024 (GU37328)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Context Reference	non-fibrous fraction
Sample Reference	Tr5/BH1/83-84cm
Material	Humified peat : Humic Acid Dated
$\delta^{13}C$ relative to VPDB	-29.2 ‰
Radiocarbon Age BP	5656 ± 29

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

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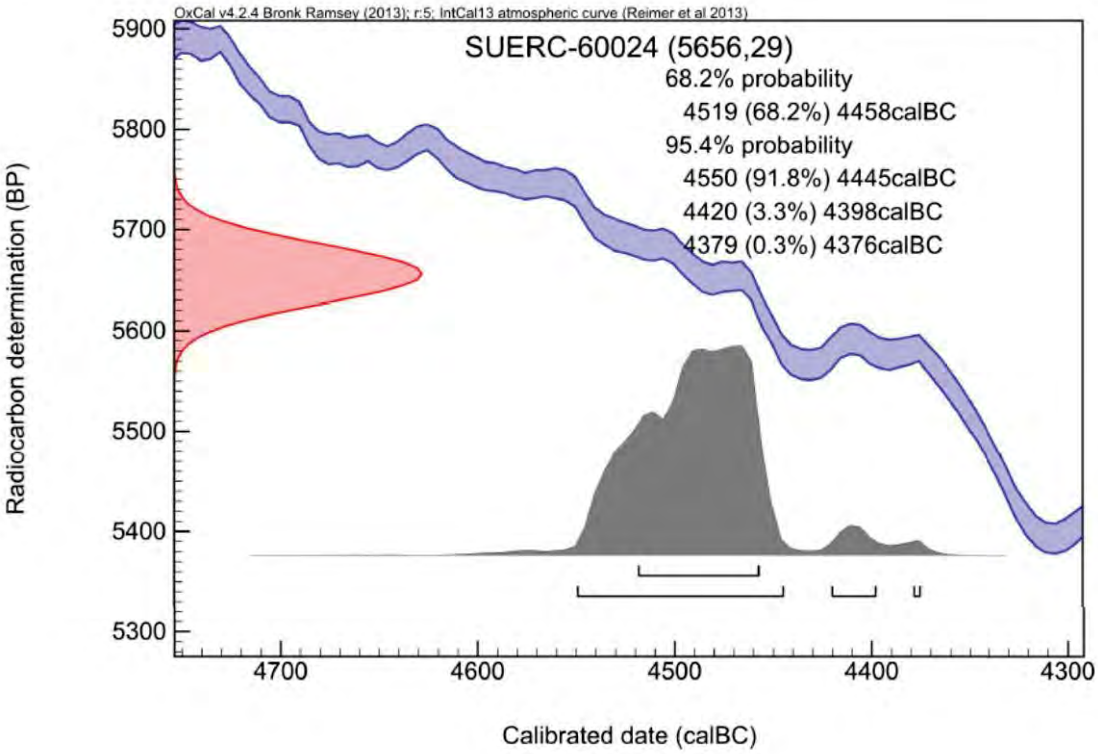
Calibration Plot



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RADIOCARBON DATING CERTIFICATE

07 May 2015

Laboratory Code	SUERC-60025 (GU37329)
Submitter	James Rackham Environmental Archaeology Consultancy 25 Main Street South Rauceby, Sleaford Lincolnshire NG34 8QG
Site Reference	Dolbenmaen pipeline, North Wales
Sample Reference	Tr6/BH3/72-73
Material	wood, small roundwood : in progress
$\delta^{13}C$ relative to VPDB	-30.4 ‰
Radiocarbon Age BP	2792 ± 29

N.B. 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.

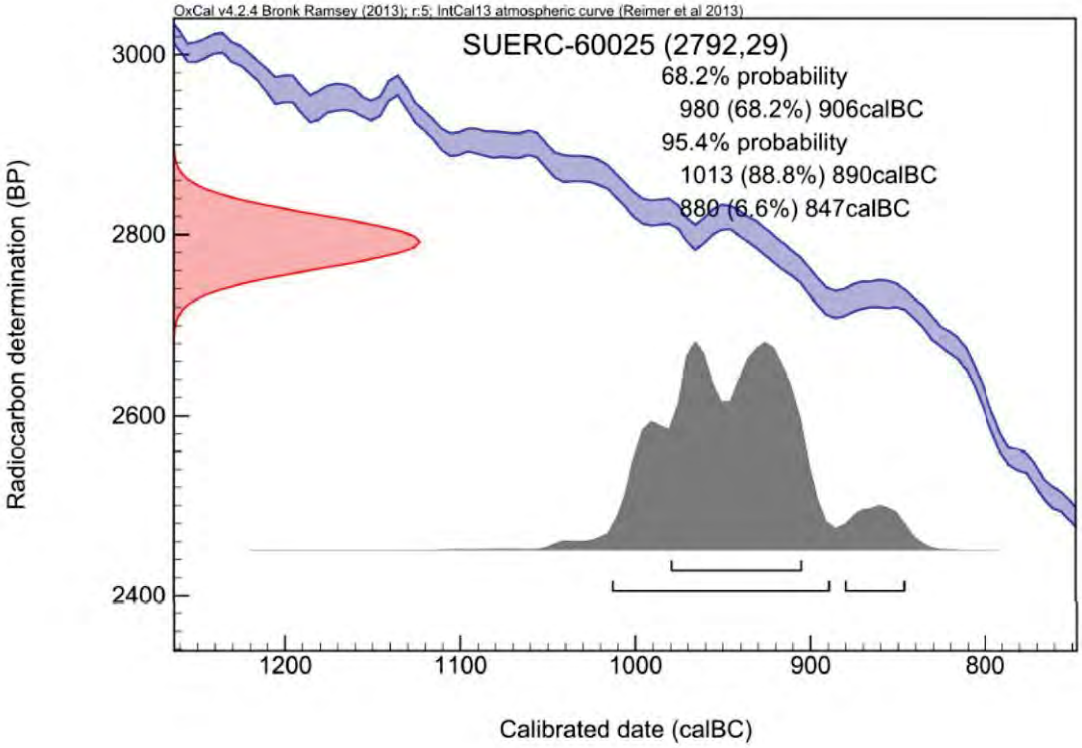
The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- E Dunbar Date :- 07/05/2015

Checked and signed off by :- P. Naysmith Date :- 07/05/2015

Calibration Plot



24 APPENDIX XI: POLLEN REPORT

Dolbenmaen to Cwmystradllyn, Water Pipeline Scheme: Palaeoenvironmental Report on a series of cores taken along the pipeline route

Dr C.T. Langdon and Prof. R.G. Scaife, Geography and Environment, University of Southampton and D. J. Rackham, The Environmental Archaeology Consultancy,

Introduction

One element of the archaeological programme for the Garndolbenmaen-Cwmystradllyn water pipeline near Porthmadog, Gwynedd, on the western edge of the Snowdonia National Park was a survey of the route for potentially important palaeoenvironmental sequences that might be affected by the pipeline works. The Environmental Archaeology Consultancy was commissioned by the Gwynedd Archaeological Trust to conduct the field survey and subsequently the post-excavation analysis of the recovered cores on behalf of *Dŵr Cymru Welsh Water*. The *c*. 5km pipeline runs from the Water Treatment works at Dolbenmaen just north of Beudy Mawr, drops east across the Afon Dwyfor floodplain at 88m OD, and then eastwards primarily across pasture and rough pasture lands to the Water Treatment Works at Cwmystradllyn above 190m OD (see McNichol *et al* 2017).

A survey was conducted by walking the route and using a spike and gouge auger to assess the depth of organic deposits with potential for detailed palaeoenvironmental study (Rackham 2015). Suitable deposits (peats and organic silts) less than 0.5m in depth were excluded from sampling on an assumption that they might be less secure and contain only a limited chronological sequence. Deposit sequences in excess of 0.5m were core sampled and their basal deposits subsequently dated to assess the potential chronological coverage of the deposits along the whole route. Eleven locations with significant deposits (Fig. 1; Table 1) were investigated by laying a short transect of gouge auger holes along the mid-line of the pipeline easement to identify the areas with the greatest depth of peat deposits. Eight of these locations were subsequently cored, and after radiocarbon dating seven were selected for more detailed post-excavation analysis (Rackham 2015).

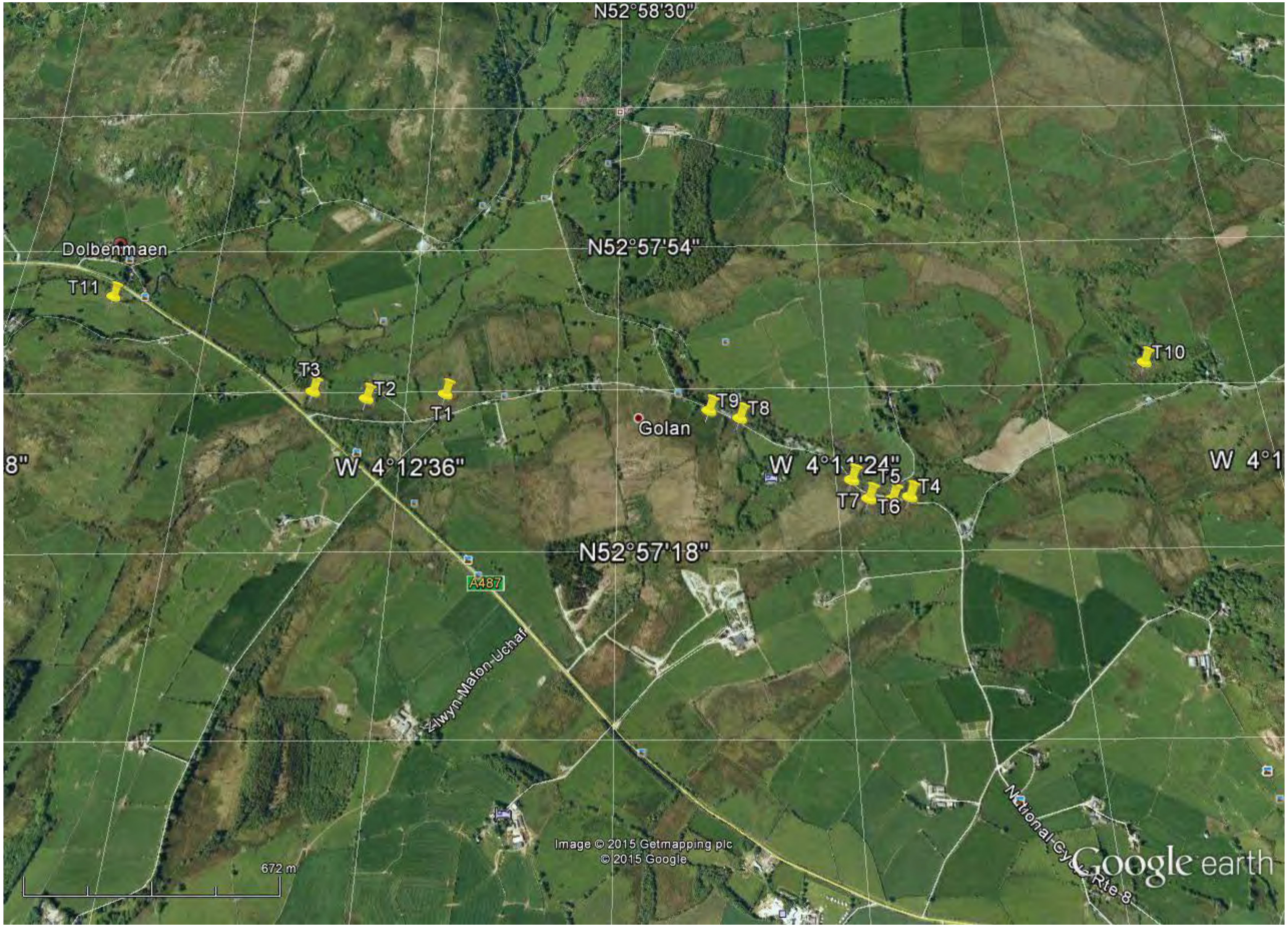
Table 1. Prospected transects and cored sites along the Garndolbenmaen – Cwmystradllyn water pipeline (see Fig. 1).

Field	Transect	Cored auger hole*	Core depth cm	Date of base	OD height in m.	studied
20	Transect 1	BH5	104	E Neo	100.23	X
15	Transect 2	BH3	105.5	E Meso	97.23	X
15	Transect 3	BH2	73.5	MIA	98.03	X
46	Transect 4	(BH1)	50	Not dated	128.22	
45	Transect 5	BH1	146	E Meso?	127.58	X
45	Transect 6	BH3	94	LBA	125.82	X
44	Transect 7	BH2	65	M Neo	126.55	
37	Transect 8	BH1	165	L Glacial	118.95	X
36	Transect 9	(BH1)	46	Not dated	119.23	

Field	Transect	Cored auger hole*	Core depth cm	Date of base	OD height in m.	studied
54	Transect 10	BH2	88	MIA	139.57	X
4&5	Transect 11	(BH4)	126	Not dated	88.13	

* parentheses indicate deepest borehole in transect but deemed not suitable for coring (see Rackham 2015)

Fig. 1. Location of each auger transect along the pipeline route marked on the Google Earth image (Copyright Google Earth)



The basic superficial deposit sequence along the route comprises an underlying diamicton (glacial till) of Devensian age with an in situ developed soil. In places the palaeosol may have suffered erosion and been truncated. Peats, silty peats and organic silts subsequently developed or were deposited over the sampled areas at different periods. The formation of the peats were not synchronous along the whole route and the earliest peats which developed in the early Mesolithic were recorded in Transect 8 while those in Transect 3 did not develop until the middle Iron Age. Transect 11 was undertaken on the floodplain of the Afon Dwyfor and although a total of 1.26m of deposit were cored these were mineral and cobble riverine deposits with very limited palaeoenvironmental potential and little or no material suitable for radiocarbon dating.

In retrospect the radiocarbon dating of the organic deposits in the top 0.5m of those sequences studied has indicated that in some locations these deposits extend back to the Neolithic period, so the exclusion of shallow sequences of less than 0.5m might be considered a mistake. Nevertheless the seven sequences chosen for study have produced sediments covering the period from the late Glacial to the present day and have yielded an exceptional story of the vegetation history of the area.

Most peat sequences studied in the Snowdonia area have been carried out on upland sites of blanket peat and raised bogs. All seven of the sites studied below lie in agricultural areas, in a landscape of small farms, grazing lands of rough and improved pasture, local peatlands, and with occasional arable fields although in the past oats may have been grown more extensively.

Pollen analysis has been undertaken on the seven peat-filled basins located along the length of the pipeline. Such small basins afford an opportunity to study the past character and changes in the vegetation and environment at a more local level than that of extensive ombrogenous mires where pollen found may represent a wide geographical area and span a wide range of habitats. Contrasting with such *Sphagnum* peat bogs, are the fen carr woodland and herbaceous, grass and sedge fen, peat-forming habitats which are controlled by local factors of topography, ground water table, influences of geology and above all human activity on and around these basins. Seven peat profiles of such character have been analysed to provide a vegetation and environmental history of this region. The resulting study presents detailed data on sites dating back to the late glacial period with a late glacial sequence at the base of Transect 8 to medieval and post-medieval sequences in Transects 2 and 10. Overall the sites span virtually the whole of the time period between 10,000 BP and the present day (Table 2).

There is a long history of palaeoecological study in North Wales. However, a large proportion of these palynological analyses tended to focus on upland sites (Godwin, 1940, 1955; Walker 1978; Elner and Happey-Wood, 1980; Ince 1983; Tipping, 1993; Mighall and Chambers, 1995) and valleys within the montane region. For example, the Nant Francon Valley (Seddon 1962). Furthermore, these have tended to focus attention on late-glacial and early post-glacial deglacial sediment sequences rather than the late prehistoric and historic periods. There is little such data detailing the historic period for this part of Wales (Chambers and Price, 1985; Watkins, 1990).

Most of the sites examined in this current study come from valley mires which provide a unique insight into Holocene environmental change and human impact on the local landscape of the lowland zone. Overall, this study tends to show that dominant and dense deciduous woodland existed throughout the region until changes in increased human activity on the adjacent fluves and/or climate (worsening) occurred. Either of these events caused hydrological changes which resulted in transition from dense alder fen carr woodland to more open grass-sedge fen with, in some cases, phases of more acid *Sphagnum* and aquatic habitats.

Methods

At each of the selected locations cores were taken by driving in a 110mm diameter plastic earth pipe to approximately 1m depth, or the full depth of deposit where less, and then digging this out, sealing both ends and labelling. Where the deposits were deeper the lowest part of the sequence was recovered using a Russian peat corer (Jowsey 1966). In one or two holes the earth pipe struck stone before reaching the maximum depth and the Russian corer was used for the recovery of the remaining sequence. The lowest sediments in the deep cores were not recovered owing to the fact that the Russian corer chamber is 10cm behind the tip of the corer nose so where the nose struck stones the lowest 10cm could not be recovered. This is the reason for instance that the palaeosol identified during the field survey in Transect 8 was not recovered in the cores. In retrospect a piston corer may have been better for the recovery of the basal more mineral sediments in the deeper cores.

Each core was split, cleaned, logged and photographed in the laboratory. It was subsequently sampled for pollen analysis at 4cm intervals through the whole core and an initial sample for radiocarbon dating taken near the base of the organic sequence recorded in the earth pipe core. Further horizons for radiocarbon dating were selected on the basis of the results of the pollen analyses. Initially some macrofossil studies were envisaged but with severe humification of the peats in many instances and a need for more radiocarbon dates than had been costed for it was decided to exclude this element of the work. Again in retrospect it would have been useful to analyse the degree of humification of the peats in all sequences, and perhaps the testate amoebae, which would have yielded proxy climate data, but it could be argued that this is 'research' and less relevant to the overall archaeological aims of the project.

Pollen analysis

These cores were described and sub-sampled for pollen analysis in the laboratory and the details of the stratigraphy are given in each section below.

An initial sample interval of 4cm was adopted and samples of 1 to 1.5ml volume, were processed using standard techniques for the extraction of the sub-fossil pollen, spores and other miscellaneous microfossils which were encountered. Details of method are given in Appendix 1. The seven sites examined have been plotted as standard pollen diagrams (Figures 6, 9, 11, 15, 17, 20 and 23) and have been zoned where appropriate to facilitate description of the changing pollen assemblages and inferred changes in the vegetation and environment. Because of the dominance of alder (*Alnus*) pollen in the profiles and the effects of such on the pollen representation of other taxa, this taxon been placed within the wetland sub-division to which it naturally belongs (as opposed to terrestrial/dry land trees and shrubs). Furthermore, the changes in the character of the on-site vegetation types, with for example, their differing degrees of openness will also have affected the pollen taphonomy. In the case of the dense alder carr (Alnetum), pollen ingress from the surrounding vegetation will have been restricted, certainly from any distance from the sample site and, for herbaceous components and entomophilous trees and shrubs (Tauber 1965, 1967a, 1967b). This will have changed to a wider pollen catchment with the more open environment seen after the development of a grass-sedge fen or more acid *Sphagnum* mire which is seen in the upper pollen zones of most of the sites examined.

The data obtained from the individual sites examined are given below.

Radiocarbon Dating

The initial radiocarbon dating was conducted on material from near the base of each 110mm diameter core In order to define the basic chronology for the cores. These were not targeted at any stratigraphic or pollen boundaries. Subsequent dates were targeted at specific pollen horizons to date 'events' in the vegetational history indicated by each core. With a considerable level of humification in many of the cores, and penetrating herbaceous and woody roots, dates were determined on the organic sediment (non-fibrous) fraction of each sample unless small roundwood or twigs were available. In one sequence a result is anomalous. At the base of the core from Transect 5 a piece of 'roundwood' has produced a date a little younger than a date on organic sediment some 0.6m higher in the sequence. The lower date is presumed to be in error on the basis of other dates from the core and the pollen evidence. It is not impossible for branches falling on a wet bog to penetrate some depth into the bog which could account for the apparent error, but unfortunately finances were not available to re-date the lower horizon using organic sediment.

The radiocarbon results are presented in Table 2 and the calibration curves for the initial dates are available in the assessment report (Rackham 2015) and subsequent dates in Appendix 2 of this report.

Table 2. Radiocarbon dates obtained from each sampled core. (calibration curves are presented in Appendix 1)

Lab No.	Core location	material	Depth in cm	C14 date	Period	Calibrated date at 2 sigma
Beta-465762	Transect 1/ BH5	non-fibrous organics	25-26	2120±30 BP	MIA	206-50 (91.2%) and 345-322 (4.2%) cal BC
Beta-465763	Transect 1/ BH5	non-fibrous organics	45-46	3380±30 BP	E-MBA	1746-1616 cal BC (95.4%)
Beta-465764	Transect 1/ BH5	non-fibrous organics	69-70	4230±30 BP	Neo	2908-2857 (54.8%), 2811-2751 (34.3%) and 2723-2700 (6.3%) cal BC
SUERC-60022	Transect 1/ BH5	non-fibrous organics	91-92	4671±26 BP	E Neo	3520-3369 cal BC (95.4%)
Beta-465765	Transect 2/ BH3	non-fibrous organics	17-18	400±30 BP	Med	1436-1522 (76.4%) and 1574-1624 (19%) cal AD
Beta-465766	Transect 2/ BH3	non-fibrous organics	33-34	2620±30 BP	EIA	831-775 cal BC (95.4%)
SUERC-60023	Transect 2/ BH3	non-fibrous organics	63-64	4930±29 BP	E Neo	3771-3651 cal BC (95.4%)
Beta-465767	Transect 2/ BH3	non-fibrous organics	97-99	9300±30 BP	E Meso	8634-8458 cal BC (95.4%)
Beta-465768	Transect 3/ BH2	non-fibrous organics	37-38	1910±30 BP	Rom	21-170 (93.6%) and 194-209 (1.8%) cal AD
SUERC-60016	Transect 3/ BH2	non-fibrous organics	67-68	2286 ± 29 BP	MIA	404-353 (68.7%) and 292-231 (26.7%) cal BC
Beta-465769	Transect 5/ BH1	non-fibrous organics	25-26	2400±30 BP	E-MIA	544-399 (86.6%), 731-691 (7.4%) and 660-651 (1.4% cal BC
Beta-465770	Transect 5/ BH1	roundwood	53-54	4860±30 BP	ENeo	3704-3632 (90%) and 3555-3539 (5.4%) cal BC
SUERC-60024	Transect 5/ BH1	non-fibrous organics	83-84	5656 ± 29 BP	L Meso	4550-4445 (91.8%), 4420-4398 (3.3%) and 4379-4376 (0.3%) cal BC
Beta-465771	Transect 5/ BH1	roundwood	144-145	5390±40 BP	L Meso	4339-4223 (71.5%), 4208-4157 (13.5%) and 4131-4068 (10.4%) cal BC

Lab No.	Core location	material	Depth in cm	C14 date	Period	Calibrated date at 2 sigma
Beta-465772	Transect 6/ BH3	roundwood	45-46	2450±30 BP	EIA	585-411 (53.2%), 754-681 (26.7%) and 670-609 (15.5%) cal BC
Lab No.	Core location	material	Depth in cm	C14 date	Period	Calibrated date at 2 sigma
SUERC-60025	Transect 6/ BH3	roundwood	72-73	2792 ± 29 BP	LBA	1013-890 (88.6%) and 880-847 (6.6%) cal BC
SUERC-60017	Transect 7/ BH2	non-fibrous organics	47-48	4462 ± 29 BP	M Neo	3336-3210 (49.7%), 3194-3150 (11%) and 3140-3023 (34.7%) cal BC
Beta-465773	Transect 8/ BH1.5	non-fibrous organics	21-22	3730±30 BP	EBA	2206-2032 (94.8%) and 2266-2261 (0.6%) cal BC
Beta-465774	Transect 8/ BH1.5	non-fibrous organics	65-66	6930±30 BP	L Meso	5883-5737 cal BC (95.4%)
SUERC-60018	Transect 8/ BH1.5	non-fibrous organics	78-79	8566 ± 28 BP	E-M Meso	7603-7551 cal BC (95.4%)
Beta-465775	Transect 8/ BH1.5	non-fibrous organics	153-56			
Beta-465776	Transect 10/ BH2	non-fibrous organics	33-34	1190±30 BP	E Med	766-898 (89%), 924-945 (3.5%) and 722-740 (2.9%) cal AD
Beta-465777	Transect 10/ BH2	non-fibrous organics	49-50	1780±30 BP	Rom	137-334 cal AD (95.4%)
SUERC-60015	Transect 10/ BH2	non-fibrous organics	85-86	2318 ± 29 BP	MIA	415-357 (90.7%), 284-253 (4%) and 246-236 (0.7%) cal BC

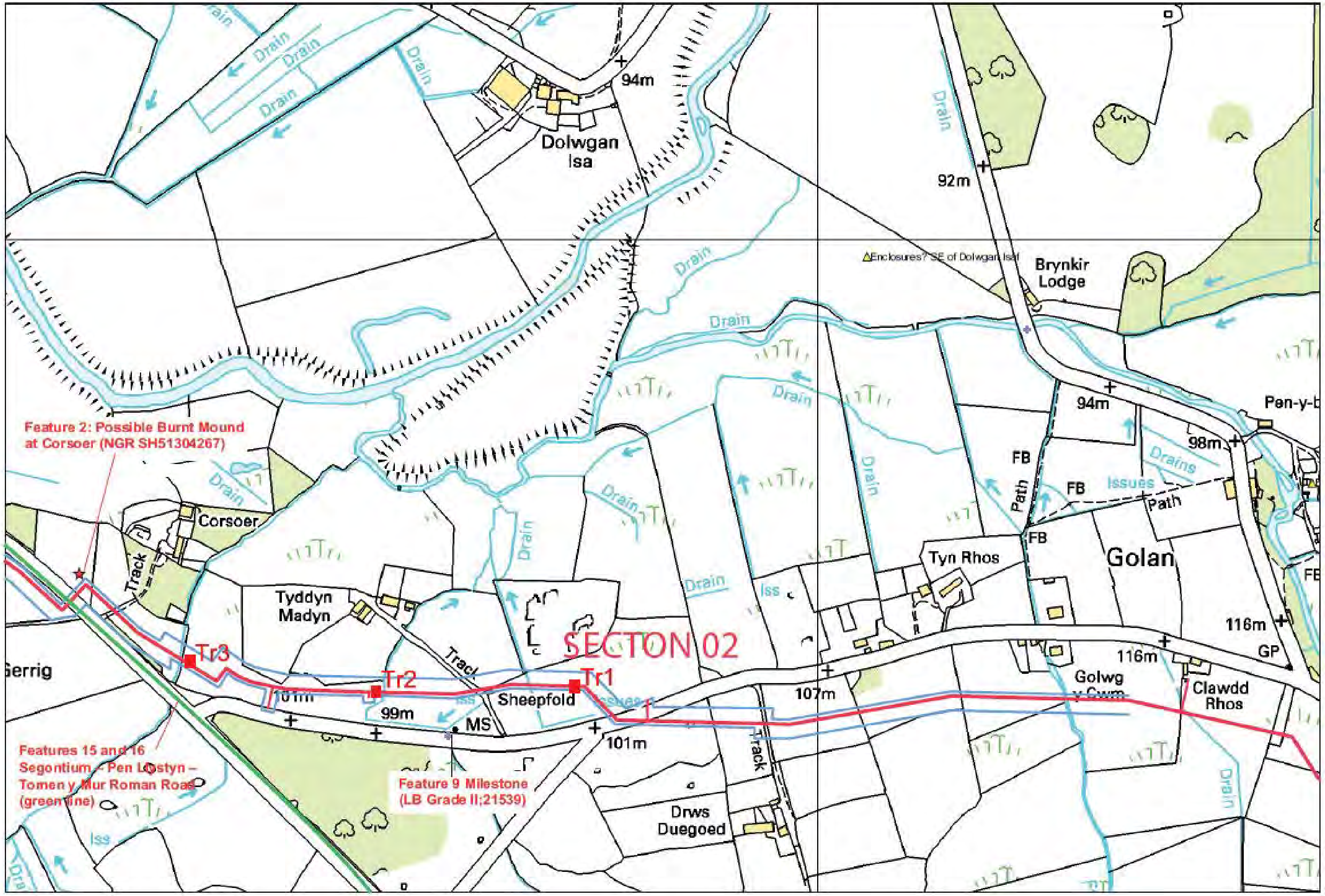
Results

Tyddyn Madyn, Golan, Garndolbenmaen, Gwynedd

Three locations along the pipeline just north of the by-road from the A487 to Golan were prospected (Rackham 2015) for peat deposits (Fig. 3) in Fields 15, 18 and 20 McNicol *et al* 2017). All three locations were selected for post-excavation study and cores taken at BH5 in Transect 1, BH3 in Transect 2 and BH2 in Transect 3. The bedrock geology of all three locations are Ordovician siltstones of the Nant Ffrancon subgroup (http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) with superficial deposits of Devensian diamicton (till). All three lie on peaty soils with rough grazing, some heather and gorse, and flush and bog communities in wetter areas (Fig. 2). They lie between 97 and 101m OD on land a few metres above the floodplain of the Afon Dwyfor and its tributary the Afon Henwy along the southern edge of the floodplain of the two rivers, and the land rises gently to the south. The land is seasonally wet and only useable for summer grazing.

Fig. 2 Transect 2 looking east. The line of red flags marks the exploratory auger holes and the yellow flag the core sample location.

Fig. 3. Tyddyn Madyn, Golan, Garndolbenmaen, Gwynedd – Transects 1-3. (basemap taken from Richards and Smith 2013)



Tyddyn Madyn I, Golan, Gwynedd

Transect 1, BH5 (100.23m OD; GR 251748.119 342524.249)

An exploratory hand auger transect was laid along the centre line of the route of the pipeline immediately north of the road to Golan between GR 251779.494 342524.669 and GR 251730.616 342524.755 (Rackham 2015) in Field 20 (McNicol et al 2017) and the location of BH5 selected for sampling on the basis of the greater depth of organic deposits, and subsequently, after radiocarbon dating the basal peats, for palynological study. The core was taken from an area of rough grazing on peats with 100cm recovered in a 105mm diameter core and the basal 4cms recovered using a Russian corer.

Fig. 4 Transect 1, BH5, core (top at 100.23m OD)

0-6cm fibrous peaty turf

6-14 dark brown (10YR 3/3) fibrous humified peat with penetrating herbaceous roots

14-41 black (10YR 2/1) completely humified peat

25-26 2120±30 BP – *206-50 cal BC (91.2%) and 345-322 cal BC (4.2%)*

41-66 very dark brown (10YR 2/2) soft humified peat with penetrating roots

45-46 3380±30 BP – *1746-1616 cal BC (95.4%)*

66-100 dark brown (7.5YR 3/2) humified peats with penetrating herbaceous roots

69-70 4230±30 BP – *2908-2857 (54.8%), 2811-2751 (34.3%) and 2723-2700 cal BC (6.3%)*

91-92 4671±26 BP – *3520-3369 cal BC (95.4%)*

100-104 dark brown (7.5YR 3/2) fibrous humified peats (recovered in Russian corer). Nose (10cm) of Russian corer in clay/stone

Pollen samples were taken at 4-104cm at 4cm intervals

Silty clays with stone stopped the prospection coring at 115cm (Rackham 2015) and were capped by fibrous humified peats dating to the early to middle Neolithic (Fig. 4) indicating the onset of wet ground conditions and peat formation. The lower peats are significantly less humified than the upper peats which are capped by a black completely humified peat, the latter indicating a period of drying out and humification creating a hiatus in peat growth before wetter conditions resulted in fresh peat growth and the formation of the present peaty turf (Fig. 5) at the top of the sequence.

Fig. 5. The top of the core showing the change from completely humified and oxidised peats below to a fibrous unoxidised peat immediately below the turf.

The upper boundary between local pollen assemblage zones (lpaz) Tr1:3 and Tr1:4 at 25-26cm depth is dated to the late Iron Age, so the top of the humified sequence at about 14cm depth may be Roman in date with an extended hiatus above occurring between pollen samples 12 and 16cm. The appearance of pine at the top of the sequence in the sample at 4cm may reflect the presence of pine plantations in the post-mediaeval period.

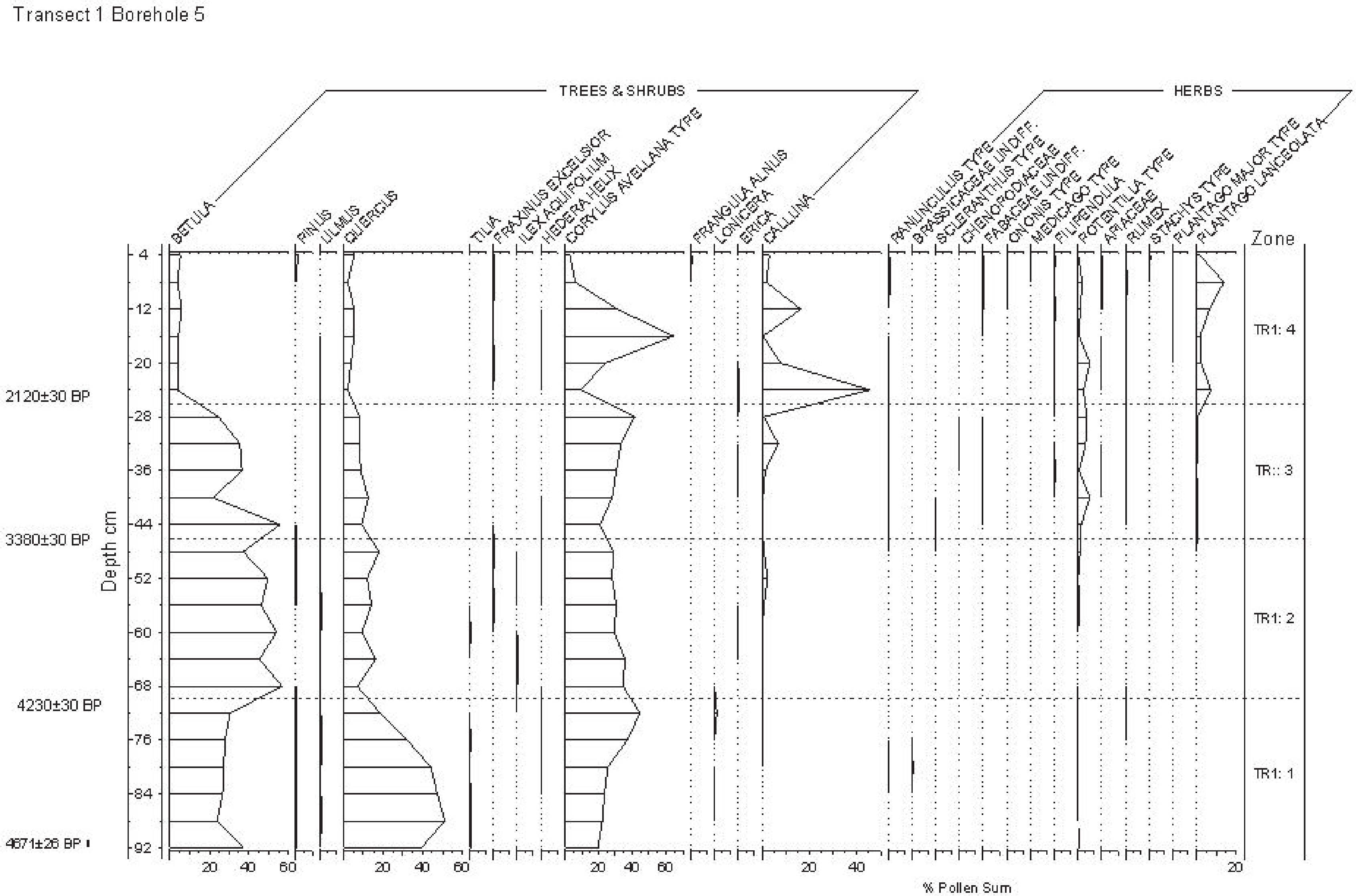
Pollen analysis *(Rob Scaife and Catherine Langdon)*

Transect 1, Borehole 5 lies at 100.23 OD and the deposits are made up of a fibrous peat dated near the base to the early to middle Neolithic (91-92cm - 4671±26 BP; 3520-3369 cal. BC - SUERC-60022). Twenty three pollen samples were analysed and in general, pollen concentration and preservation was excellent. Results are presented in Figure 6 with four local pollen assemblage zones recognised and described in Table 3.

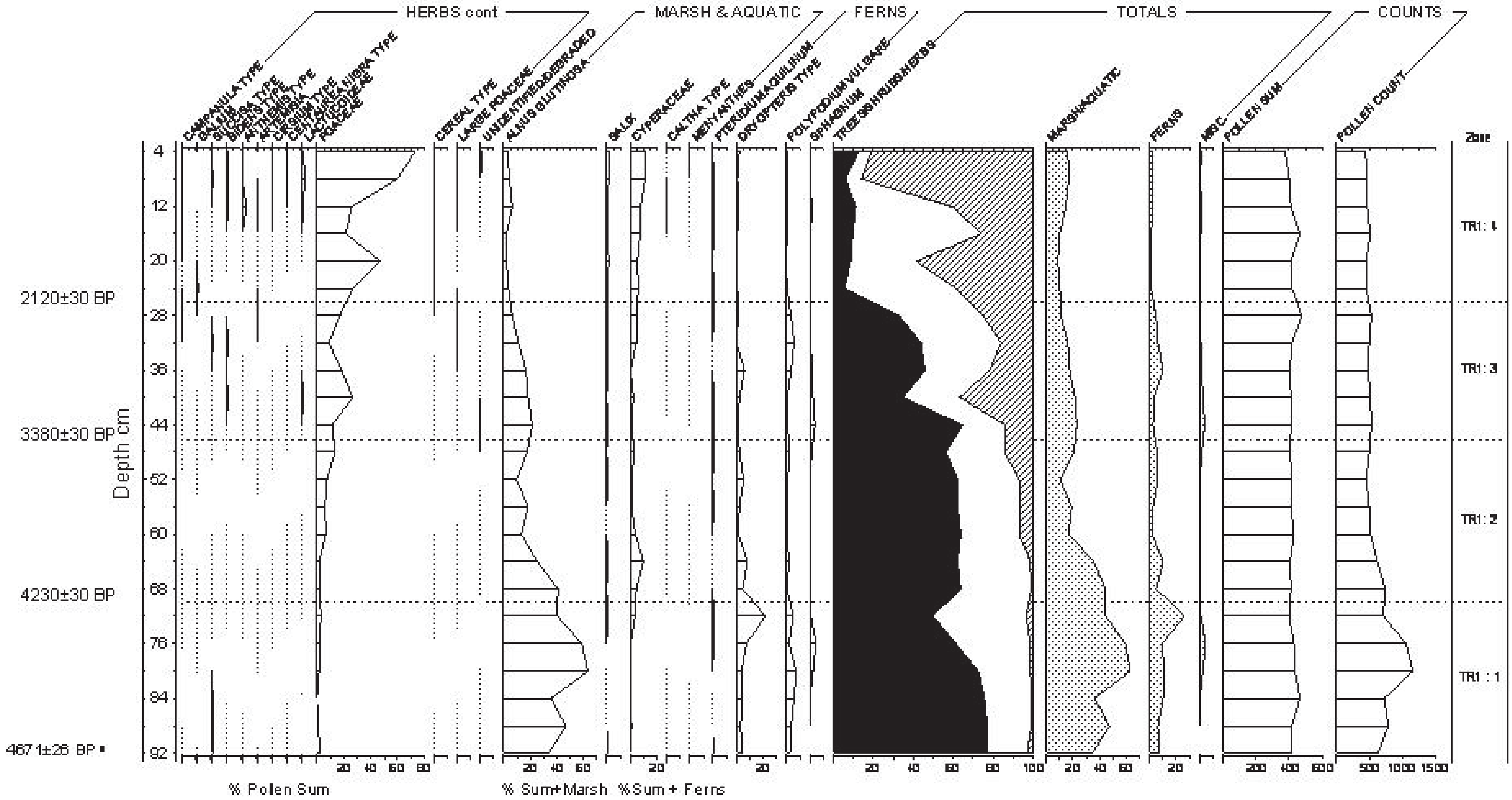
Table 3. Pollen zonation and character of Transect 1 Borehole 5 (see Table 2 for C14 data)

Assemblage Zone	Palynological Characteristics
l.p.a.z. TR1: 4 26cm to 4cm *Corylus avellana* type - *Calluna*-Poaceae 25-26cm 2120±30 BP	Characterised by Poaceae increasing to 75% by the end of the zone with increases in *Corylus* to 12cm (65%), which declines markedly to 5% by the end of the zone. *Calluna* is more dominant during TR1: 3 but values fluctuate between 45% and <2%. Other trees and shrubs recorded at 3% or less, include *Pinus*, *Fraxinus*, *Ulmus*, *Hedera* and *Salix*. *Plantago lanceolata* increases as the zone progresses and *Cereal* type, *Potentilla* type, *Rumex* and *Filipendula* are consistently present throughout the zone. Other herbs present include *Plantago major* type, *Anthemis* type, Lactucoideae and *Campanula* type. Cyperaceae increase slightly as the zone progresses and small numbers of fern spores and *Sphagnum* spores are also recorded.
l.p.a.z. TR1: 3 46cm to 26cm *Betula*-*Corylus avellana type*-Poaceae-*Potentilla* type-*Plantago lanceolata* 45-46cm 3380±30 BP	The principal trees and shrubs in this zone include *Betula* (declining to *c.* 20% by the end of the zone) and *Corylus* which remains between 35% and 50%. Poaceae tends to increase as the zone progresses although dips a little to *c.* 12% at 36cm. *Potentilla* type increases at the start of the zone and peaks at *c.* 10%, whilst *Plantago lanceolata* is consistently present throughout. Diversity of herbs is great in comparison to TR1: 2 with the introduction of Apiaceae, *Succisa*, *Bidens*, *Rumex* and Chenopodiaceae. *Alnus* declines as TR1: 3 progresses, whilst Cyperaceae increases slightly (to *c.* 5%). Some fern spores are evident, with *Polypodium* increasing towards the end of the zone (*c.*5%), whilst *Sphagnum* spores decline in number from 4% to <2%.
l.p.a.z. TR1: 2 70cm to 46cm *Betula*-*Corylus avellana* type 69-70cm 4230±30 BP	TR1: 2 is defined by increased values of *Betula* to 60% and *Corylus* fluctuating between 30-40%. Meanwhile, *Quercus* remains between 15% and 25% of the pollen sum. *Calluna* is present throughout the zone (<5%). Other trees and shrubs recorded include *Ulmus*, *Hedera* and *Salix*. Poaceae rises as the zone progresses from 5%, peaking to 15% at 48cm and very few herbs are present with just a few grains of *Potentilla* type recorded. *Alnus* tends to decline throughout the zone (40-20%) and some Cyperaceae, *Dryopteris* and *Polypodium* are also noted.
l.p.a.z. TR1: 1 92cm to 70cm *Quercus*-*Alnus* 91-92cm 4671±26BP	This zone is delimited by values of *Quercus* reaching 60% at 88cm, declining to 30% by the end of the zone. Meanwhile *Alnus* percentages fluctuate between 40% and 60%. Other dominant tree and shrub pollen types include *Betula* (up to 37%) and *Corylus*, increasing from 20% to 50%. *Pinus*, *Ulmus* and *Tilia* are present throughout the zone and some *Hedera*, *Lonicera* and *Calluna* are also recorded. Herbs include *Ranunculus* type, *Potentilla* type and *Succisa* type at 2% or less and Poaceae remains between 2% and 5% throughout. *Dryopteris* type increases towards the end of TR1: 1 from 5% to 20% and *Polypodium* remains at *c.* 5%. *Sphagnum* spore values also rise towards the end of the zone.

Figure 6. Transect 1, BH5. Pollen diagram



Tr1 Bh5 Cont.


HERBS cont
MARSH & AQUATIC
FERNS
TOTALS
COUNTS
CAMPANULA TYPE
GALIUM
SUCCISA TYPE
BIDENS TYPE
ANTHEMIS TYPE
ARTEMISIA
CIRSIUM TYPE
CENTAUREA NIGRA TYPE
LACTUCOIDEAE
POACEAE
CEREAL TYPE
LARGE POACEAE
UNIDENTIFIED/DEGRADED
ALNUS GLUTINOSA
SALIX
CYPERACEAE
CALTHA TYPE
MENYANTHES
PTERIDIUM AQUILINUM
DRYOPTERIS TYPE
POLYPODIUM VULGARE
SPHAGNUM
TREES/SHRUBS/HERBS
MARSH/AQUATIC
FERNS
MISC.
POLLEN SUM
POLLEN COUNT
Zone
TR1: 4
TR1: 3
TR1: 2
TR1 : 1
Depth cm
2120±30 BP
3380±30 BP
4230±30 BP
4671±26 BP
% Pollen Sum
% Sum+Marsh
%Sum + Ferns

As with the other sites, the pollen data are discussed in terms of the on-site (autochthonous) and off-site (allochthonous) changes in vegetation and environment.

On-site habitat change

Initially in the Neolithic period, on-site alder carr woodland was dominant. It is possible that some *Betula* (birch) and some *Quercus* (oak) may also have been growing locally on drier areas. Ferns were growing as an understorey especially in the drier areas. *Alnus* values decline into l.p.a.z. TR1: 2 where there is also some evidence of increasing wetness with Cyperaceae (sedge) values increasing at the start of the zone. *Salix* (willow) becomes a more important part of the floodplain vegetation and probably as a constituent of more open areas of the carr woodland. The decline in alder carr during the late Neolithic and early Bronze Age suggests it was most likely retreating to the fringes/margins of the site and other areas of the valley bottom as conditions became wetter.

As alder values decline, mixed birch/hazel woodland became a more important part of the terrestrial vegetation growing locally and remained as a significant component of the local vegetation until the late Iron Age (26cm), where there is a distinct shift as Poaceae (grasses) and Cyperaceae (sedges) increase in importance on-site. Trees and shrubs declined markedly at the end of the Iron Age although *Corylus* retained importance locally. Cyperaceae and some *Caltha* type (marsh marigold) and *Menyanthes* (bogbean) attest to somewhat wetter on-site conditions. There is also evidence for the development of heathland most likely associated with this phase of clearance as soils became depleted and more acidic.

The surrounding vegetation

Initially in the Neolithic, the off-site vegetation was dominated by mixed oak, birch, hazel woodland, typical of the prehistoric period. Although pollen percentages of *Tilia* (lime/linden, a low pollen producer) remain at *c.*2% throughout l.p.a.z. TR1: 1, its continued presence indicates that it was most likely growing as part of the local and more regional vegetation mosaic. This taxon is poorly represented in pollen spectra due to entomophily and the fact that it flowers during the mid-summer period when other trees are in full leaf further inhibiting it's pollen dispersal (Andersen 1970, 1973).

Very little evidence of human activity is apparent in the early zones of the profile. The very slow opening of the woodland canopy in the later Neolithic, evidenced in TR1: 2, is possibly from small clearings in the wider environment. More significant opening of the woodland canopy occurred in l.p.a.z. TR1: 3 from the middle Bronze Age with the arrival of *Plantago lanceolata* type (ribwort plantain) pollen into the spectra. This was synchronous with *Potentilla* type (cinquefoil) pollen and *Ranunculus* type (buttercups) which indicate that the landscape was being used for rough pasture more widely. This pastoral activity became considerably more notable towards the end of the pollen profile with values of *Plantago lanceolata* reaching 15% in the final/uppermost zone, perhaps in the medieval period. Further decline in the number of trees growing in the area is apparent in TR1: 4 (with total tree percentages down to <15% of the pollen sum) and a mixed arable/pastoral economy is indicated by the occurrence of *Cereal* type pollen (2%) to the spectra and large grasses, possibly also originating from cereal cultivation.

Tyddyn Madyn II, Golan, Gwynedd

Transect 2, BH3 (97.228m OD; GR 251516.991 342518.226)

Transect 2 (Fig. 2) was located across parts of Fields 15 and 18 (see McNicol *et al* 2017 and Rackham 2015) with BH3, immediately west of the stream selected for the recovery of a core. A total of 65cm were recovered in a 105mm diameter core with the basal 35.5cm recovered using a Russian corer which was stopped by clay or stone at 110.5cm depth.

Fig. 7. Transect 2, BH3, core (top at 97.23m OD)

0-8cm very dark brown fibrous peaty turf

8-21 very dark brown (7.5YR 2.5/2) humified slightly fibrous peat with herbaceous roots

17-18 400±30 BP – *1436-1522 (76.4%) and 1574-1624 cal AD (19%)*

21-23 black (7.5YR 2.5/1) completely humified peat with fibrous herbaceous roots

23-30 very dark brown (7.5YR 2.5/2) humified peat with occasional small siltstone

30-49 very dark brown (7.5YR 2.5/2) humified peat with herbaceous roots and occasional penetrating woody roots, slightly silty towards base (42-48)

33-34 2620±30 BP – *831-775 cal BC (95.4%)*

49-66 very dark brown (7.5YR 2.5/2) slightly fibrous humified silty peat with penetrating woody roots and herbaceous roots.

63-64 4930±29 BP - *3771-3651 cal BC (95.4%)*

66-100.5 very dark brown (7.5YR 2.5/2) slightly fibrous humified peat with occasional small wood and penetrating herbaceous roots (recovered in Russian corer)

97-99 9300±30 BP – *8634-8458 cal BC (95.4%)*

Nose (10cm) of Russian corer hit clay or stone

Clay or stone stopped the Russian corer at 110.5cm depth. The basal recovered material is a well humified peat, with occasional small wood and visible penetrating fibrous herbaceous roots, which has been dated (at 97-99cm depth) to the early Mesolithic (Fig. 7 and Table 2). The peat deposits above are all well humified with some penetrating woody roots in the lower half. A well humified and oxidised dark band at 21-23cm may mark a hiatus (Figs 7 and 8), reflecting a period of drying out of the peats and cessation of peat growth. Although undated this may relate to the Roman period occurring above a late Bronze Age/early Iron Age dated horizon at 33-34cm (Table 2, Fig. 7) and with the non-fibrous organic fraction from the humified peats a few centimetres above (17-18cm depth) dated to the late medieval period. The top of the well humified peats occurs at 8cm depth and indicates the most recent hiatus (Fig. 8), and a period when the peats on the site dried out and humified. The top 8cm indicates a renewed period of damper conditions and further peat formation.

Fig. 8. Top 23cm of Tr2, BH3

4-5cm pollen sample

8-9cm

12-13cm

16-17cm

17-18 1436-1522 and 1574-1624 cal AD

20-21cm

21-23 black completely humified peat (Roman?) hiatus above?

Pine pollen is present in pollen samples at 4 and 8cm, and *Abies* in 4cm, possibly reflecting post-medieval plantations.

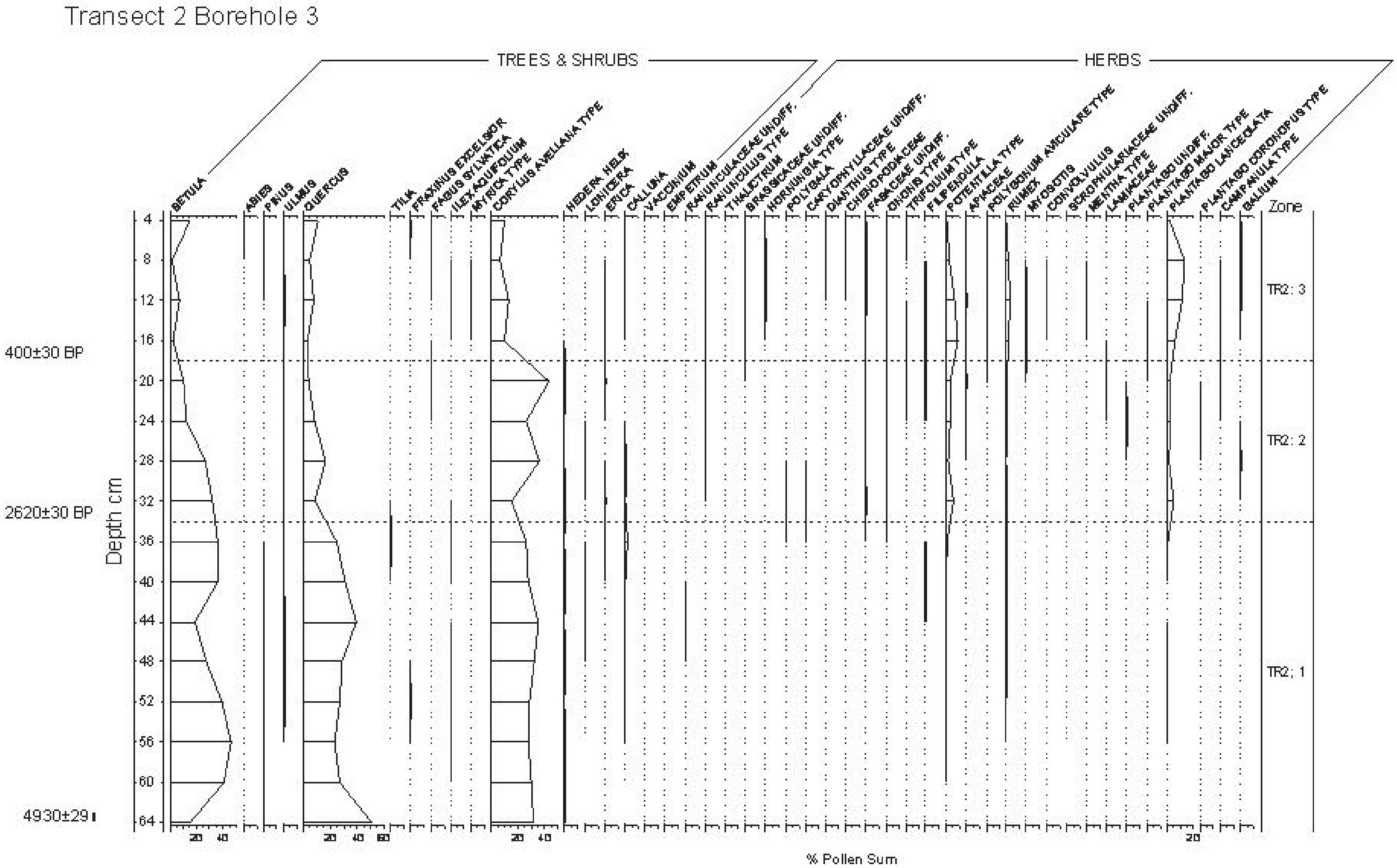
Pollen analysis *(Rob Scaife and Catherine Langdon)*

Sixteen samples have been analysed from this core which comprised of a humified slightly fibrous peat. The pollen data is described in three distinct pollen assemblage zones in Table 4 and is represented in Figure 9. The site has an early Neolithic date of 4930±29 BP at a depth of 63-64cm (SUERC 60023) taken from a sample of humified peat. As with the other sites examined, pollen preservation and concentrations were good and a pollen sum of 400-500 pollen grains (excluding *Alnus*) was easily obtained whilst total pollen counts exceeded 1500 grains in places. The on-site and off-site changes in vegetation are interpreted below and three local pollen assemblage zones have been recognised and are characterised in Table 4.

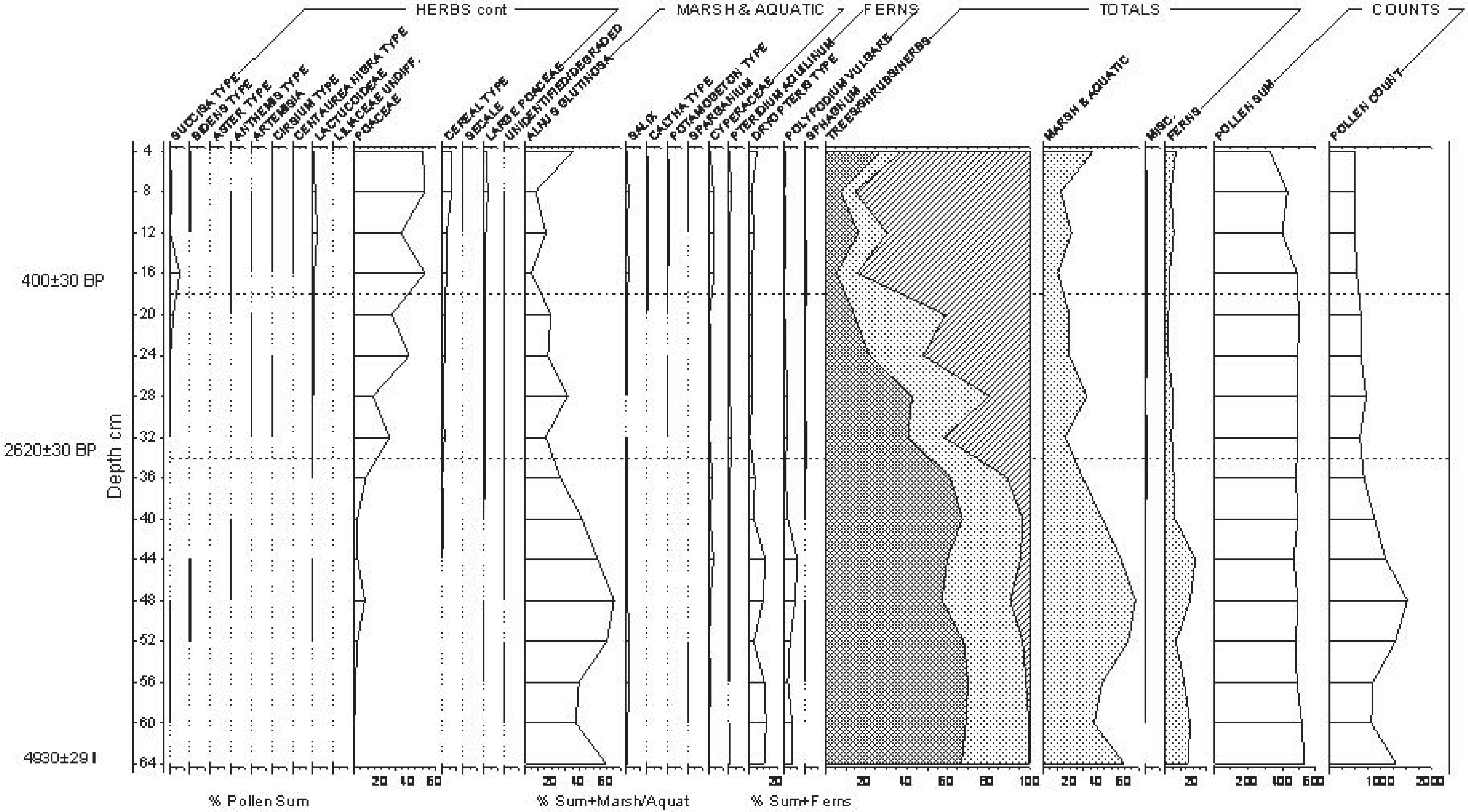
Assemblage Zone	Palynological characteristics
l.p.a.z. TR2: 3 18cm to 4cm Poaceae-Cereal-Plantago lanceolata 17-18cm 400±30 BP	Corylus declines sharply at 16cm to 10% from c. 40% in the upper half of TR2: 2, whilst Poaceae reaches 50% and Cereal type 5%. Plantago lanceolata, Rumex and Potentilla type also increase in this zone (15%, 10%, 3-4% respectively). Some Betula (5-20%), Quercus (10%), Pinus, Ulmus, Fraxinus and Fagus are also present sporadically whilst there is a single incidence of Abies at 4cm. Herbs are diverse and Brassicaceae undiff., Ononis type, Galium, Ranunculus type, Succisa and Lactucoideae which are all consistently present. Alnus remains between 15-30% and Salix, Caltha, Potamogeton and Sparganium are all part of the marsh/aquatic assemblage (2% or less). Few Dryopteris, Polypodium and Sphagnum spores are recorded.
l.p.a.z. TR2: 2 34cm to 18cm Poaceae-Cereal-Plantago lanceolata-Corylus avellana type 33-34cm 2620±30 BP	Characterised by increasing percentages of Poaceae to 55% from c. 20%. Additionally, Cereal type pollen and Plantago lanceolata increase as the zone progresses (7% and 15% respectively). Tree and shrub pollen tend to decline throughout TR2: 2. Betula declines from 40% to c. 10%, Quercus from 20% to 10% and Corylus remains between 30% and 40%. Other trees and shrubs recorded include Pinus, Ulmus, Fagus and Ilex. Small numbers of Calluna pollen are recorded. There is considerable diversity of herbs, more than in the preceding zone with Potentilla type, Rumex and Succisa being the most dominant herb types (as well as Plantago lanceolata noted). Other herb pollen taxa present throughout the zone include Ranunculus type, Ononis type, Succisa and Lactucoideae. Dianthus, Chenopodiaceae, Campanula type, Anthemis type and Cirsium type are also a part of the herb assemblage, amongst others. Alnus tends to decline as the zone progresses and small numbers of other marsh and aquatic types are recorded (Salix, Caltha type, Cyperaceae). Small numbers of fern and Sphagnum spores are notable.
l.p.a.z. TR2: 1 64cm to 34cm Alnus-Betula-Quercus-Corylus avellana type 63-64cm 4930±29BP	TR2: 1 is delimited by generally high tree pollen values. Alnus, rises to 65% at 44cm and then declines to 30% by the end of the zone. Meanwhile Betula fluctuates between 15% and 40% and Quercus and Corylus remain between 30% and 50% and 35% respectively. Other trees and shrubs recorded include Pinus, Ulmus, Ilex and Hedera. Values of Poaceae are general low (c. <5%) however, they increase gradually to c. 7% by the end of the zone. Other herbs include Potentilla type and Rumex throughout most of the TR2: 1 and Plantago lanceolata, Succisa, Bidens type, Anthemis type and Lactucoideae also feature. The incidence of marsh and aquatic taxa is comparatively low with Alnus percentages between 10% and 25% and some Salix, Caltha type, Potamogeton, Sparganium and Cyperaceae also in evidence. Small numbers of fern and Sphagnum spores are also recorded.
97-99 9300±30 BP	

Table 4. Pollen zonation and characteristics of Transect 2; Borehole 3 (see Table 2 for C14 data)

Fig. 9. Transect 2, BH3 Pollen Diagram



Tr2 BH3 Cont.


HERBS cont
MARSH & AQUATIC
FERNS
TOTALS
COUNTS
SUCCISA TYPE
BIDENS TYPE
ASTER TYPE
ANTHEMIS TYPE
ARTEMISIA
CIRSIUM TYPE
CENTAUREA NIGRA TYPE
LACTUCOIDEAE
LILIACEAE UNDIFF.
POACEAE
CEREAL TYPE
SECALE
LARGE POACEAE
UNIDENTIFIED/DEGRADED
ALNUS GLUTINOSA
SALIX
CALTHA TYPE
POTAMOGETON TYPE
SPARGANIUM
CYPERACEAE
PTERIDIUM AQUILINUM
DRYOPTERIS TYPE
POLYPODIUM VULGARE
SPHAGNUM
TREES/SHRUBS/HERBS
MARSH & AQUATIC
MISC.
FERNS
POLLEN SUM
POLLEN COUNT
400±30 BP
2620±30 BP
4930±29 I
Depth cm
% Pollen Sum
% Sum+Marsh/Aquat
% Sum+Ferns

On-site habitat change

Dated to the early Neolithic and typical of some other sites of this period, the on-site vegetation at the base of the studied sequence is dominated by alder carr with *Salix* (willow) also growing on-site co-existing with the alder. *Salix* is a low pollen producer and even small amounts would attest to its local growth (Andersen, 1970, 1973). However, as the zone progresses the incidence of alder pollen tends to decline which would indicate that it was retreating more to the margins of the site and valley bottoms as conditions became wetter and less suited to its growth through flooding of the root boles. In zones TR2: 2 and TR2: 3, starting in the early Iron Age the environment changes to one which is dominated by grasses with alder carr being much less important. Ferns that were an important part of the understorey in TR2: 1 (*Dryopteris* and *Polypodium*) decline in TR2: 2 and may have declined due to increased wetness on-site. This is confirmed to an extent by the incidence of marginal aquatic, fen and aquatic plants/pollen types such as *Caltha* (marsh marigold), *Potamogeton* (pondweed) and *Sparganium* (bur-reed).

The surrounding vegetation

Off-site, the initial zone suggests that mixed oak, birch, hazel woodland was dominant more regionally with some elm and pine also present, typical of the Neolithic and Bronze Age. A decline in the density of this woodland, at the start of the Iron Age, occurred as grassland, most likely used for pasture and arable farming become more prevalent. This is particularly pronounced into TR2: 3, the medieval and post-medieval period, as both *Plantago lanceolata* (ribwort plantain which is a pastoral indicator) and *Cereal* pollen increase while *Corylus* type (hazel) pollen declines further to reveal a much more open landscape. *Cereal* type pollen percentages of up to 7% by the top of the pollen profile infer it is likely that cereal cultivation was occurring in close proximity to the site, in the later medieval and post-medieval periods, as cereal pollen tends to be deposited close to its source. Thus, the pollen spectra here represent elements of a mixed agricultural economy being practised more widely with evidence of arable and pastoral agriculture in these most recent periods. The latter includes *Plantago lanceolata* (ribwort plantain) *Ranunculus* type (buttercup), *Rumex* (docs) and Lactucoideae (dandelions). The occurrence of *Abies* and *Pinus* at the top of the profile suggests planting in the post-medieval period.

Tyddyn Madyn III, Golan, Gwynedd

Transect 3, BH2 (98.033 OD; GR 251337.555 342554.671)

Transect 3 (Fig. 3) was located at the western end of Field 15 (see McNicol *et al* 2017 and Rackham 2015) with BH2 selected for the recovery of a core. A total of 73.5cm were recovered in a 105mm diameter core (Fig. 10).

Fig. 10. Transect 3, BH2, core (top at 98.03m OD)

0-10.5cm fibrous peaty turf

10.5-14 very dark brown (10YR 2/2) fibrous humified peat with fibrous roots

14-20 dark reddish brown (5YR 2.5/2 humified fibrous peat with fibrous roots

___ hiatus?

20-23 black (10YR 2/1) completely humified oxidised peat with fibrous roots

23-27 dark reddish brown (5YR 2.5/2) humified fibrous peat with roots

27-29 black & very dark brown (10YR 2/1 & 2/2) completely humified fibrous peat with roots

29-40 dark reddish brown (5YR 2.5/2) moist humified slightly fibrous peat with herbaceous roots

37-38 1910±30 BP – *21-170 (93.6%) and 194-209 (1.8%) cal AD*

40-69 dark reddish brown (5YR 2.5/2) fibrous partly humified moist peat

67-68 2286±29 BP – *404-353 (68.7%0 and 292-231 (26.7%) cal BC*

69-73.5 dark reddish brown (5YR 2.5/2) fibrous partially humified moist peat with wood fragments

Pollen samples taken at 4-72cm at 4cm intervals

The core recovered 73.5cm of deposit, hitting stones at the base preventing further recovery although the hand auger had penetrated to 85cm before striking stones. The recovered sequence was underlain by grey clays with siltstone (Rackham 2015). The base of the sequence is a fibrous partially humified peat with wood fragments and is dated to the middle Iron Age (Table 2 and Fig. 10)

The whole of the sequence is peats, which are significantly less humified than those in Transects 1 and 2, indicating that the deposits have remained wetter at this location. Peats at 37-38cm are radiocarbon dated to the Roman period but there is no associated evidence for a period of drying out. The first evidence for a dryer episode is indicated by the humified and oxidised black horizon at 20-23cm (Fig. 10) marking the top of a desiccated peat and indicating a hiatus in the sequence. This horizon is undated.

Pollen analysis *(Rob Scaife and Catherine Langdon)*

The profile comprises solely a highly humified detrital and rootlet peat containing, in places, wood. A radiocarbon date of 2286 +/-29 BP (SUERC-60023) was obtained from wood at 71-72cm in the profile placing the inception of peat accumulation during the middle Iron Age. Absence of increasing pine pollen values in the upper samples suggests that the top of the profile pre-dates late historic plantation (Fig. 3).

Three local pollen assemblage zones have been recognised and these are characterised in Table 5 below.

On-site habitat change.

Overall, for non-wetland/mire taxa, arboreal and shrub pollen are dominant in the lower pollen zones (l.p.a.z. TR: 1 and TR: 2) representing the middle Iron Age to early Roman period. *Betula, Quercus* and *Corylus avellana* type are dominant but with declining numbers in the upper part of the profile (l.p.a.z. TR5: 3) where there is a very substantial increase in herbs dominated by Poaceae starting in the late Iron Age/early Roman period. This change is also mirrored in the autochthonous marsh and aquatic assemblages where *Alnus glutinosa* (alder) is dominant in the basal zone (l.p.a.z. 1) but declines progressively in l.p.a.z. 2 and drops to very low levels in uppermost l.p.a.z.3. This change is mirrored by progressive expansion of Cyperaceae (sedges) and possibly a proportion of the Poaceae which may be attributed to a fen habitat. Possible *Hypericum elodes* (Marsh St Johns-Wort) important in l.p.a.z. 2 clearly an autochthonous element given the substantial numbers of this poorly represented herb. The final decline of *Alnus* is associated with change to acidophilous taxa comprising *Sphagnum* moss and *Narthecium ossifragum* (bog asphodel).

The surrounding vegetation

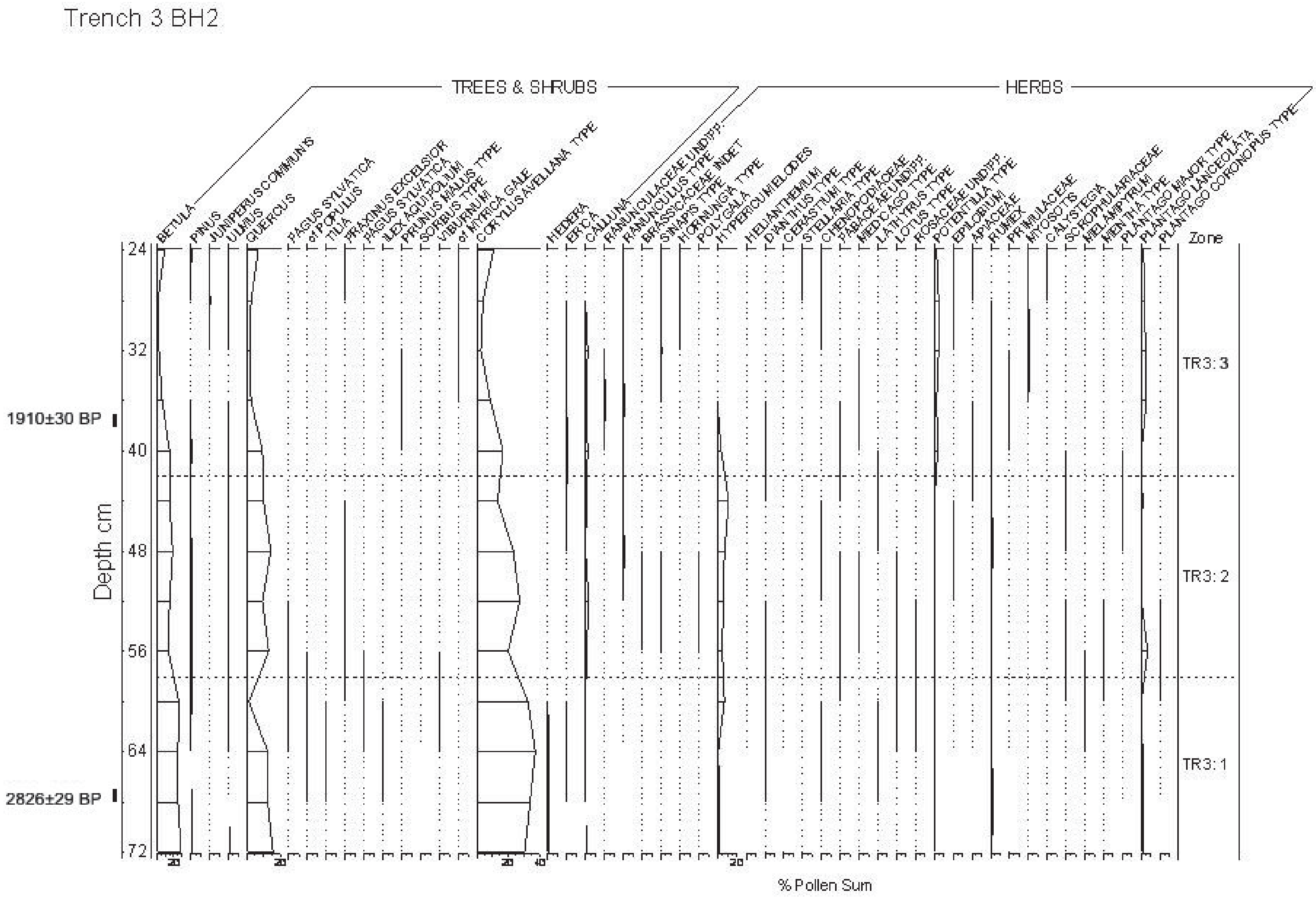
The basal levels of this profile (l.p.a.z. TR3: 1) date to the Iron Age (2286+/-29BP -SUERC-6016) and in spite of this late date, it appears that *Betula* (birch), *Quercus* (oak) and *Corylus* (hazel) woodland remained important if not dominant at least in proximity to the sample site. Given the usual poor representation of *Fagus* (beech), *Tilia* (lime/linden) and *Ilex* (holly) in pollen spectra, the occasional occurrences of these trees suggest that they were locally present as part of this woodland community. A decline of *Betula* and *Corylus* in l.p.a.z. TR3: 2 albeit small, is associated with some increase in *Calluna* (ling), non-cultivated Poaceae (grasses) and continuous but low numbers of cereal pollen and probably dates to the late

Iron Age. This shows some acidification of soils and, as noted above, development of a more open herb fen and bog which progressively ousted *Alnus*. This was due to increased human activity.

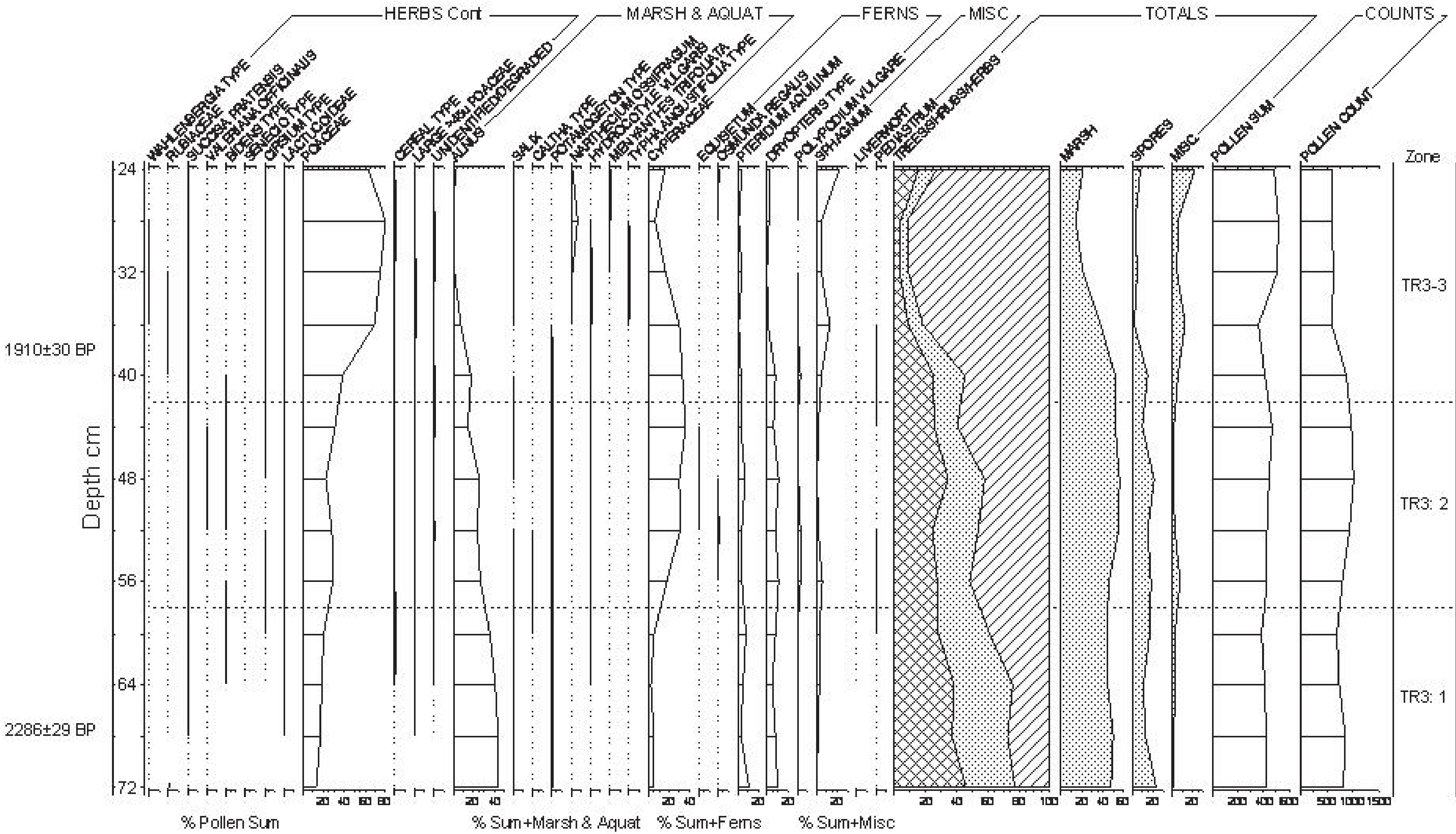
Pollen zone	***Palynological characteristics***
l.p.a.z. TR3: 3 38cm to 24cm Poaceae-*Plantago lanceolata-Sphagnum* 37-38cm 1910±30 BP	The upper zone to 98.03mOD is characterised by expansion of Poaceae to maximum values (peak to 80%) also with lesser increases in *Sphagnum* similarly with maximum values (23%), *Potentilla* type (5%) and *Plantago lanceolata* (6%). In contrast, values of all trees and shrubs of the previous zones decline in the lower part of the zone to low values (<10%) picking up in the uppermost level. Herb pollen assemblages are dominated by Poaceae (noted). In the marsh and aquatic category, *Alnus* rapidly declines to low values along with other tree taxa. Cyperaceae declines progressively as *Sphagnum* (noted) and wetland taxa become more important (*Narthecium ossifragum*, *Menyanthes trifoliata*). There are declines in *Dryopteris* type and *Polypodium* fern spores.
l.p.a.z. TR3: 2 58cm to 38cm *Alnus*-Cyperaceae	This zone is delimited by changes in the on-site flora. Cyperaceae (to 40% and its maximum value) becomes important as values of *Alnus* decline (from >30% to 20%). Arboreal taxa remain important with *Betula* at a lower level than l.p.a.z. TR3: 2 (20%), *Quercus* with similar values (15%) and declining levels of *Corylus avellana* type (30% to 15%). Herbs are dominated by Poaceae (increasing 40% - 60%) with consistent but low levels of *Cereal* type (<1%). *Hypericum elodes* (possibly a marsh taxon) becomes important in this zone (to 15%). Other herbs include remaining *Rumex* and *Plantago lanceolata* plus a more diverse range of sporadically occurring taxa. Marsh and aquatics are dominated by *Alnus* and Cyperaceae (noted). *Hydrocotyle* is incoming (<1%). *Osmunda regalis* (fern) is also attributable to the fen/aquatic group. Fern spores, in general, remain consistent from l.p.a.z. TR3: 1 with *Pteridium aquilinum*, *Dryopteris* type but with some expansion of *Polypodium* (2-3%).
l.p.a.z. TR3: 1 72cm to 58cm *Betula-Quercus-Corylus avellana* type 71-72cm 2286±29 BP	Trees and shrubs are dominant with *Betula* (29%), *Quercus* (16%), *Corylus avellana* type (38%) and *Alnus* (44% sum + marsh & aquatic) significant. Other arboreal taxa include sporadic occurrences of *Pinus, Fraxinus, Tilia, Ilex* and dwarf shrub, Ericales. There are few herbs with low levels of *Potentilla* type, *Rumex, Plantago lanceolata* and Asteraceae types. Poaceae are most important (increasing to 20%). A single cereal pollen grain is present at the top of the zone. Marsh and aquatic taxa are dominated by *Alnus* (noted) with small numbers of *Salix* (1-2%), *Potamogeton* type (1-2%) and Cyperaceae (5%). Fern spores include *Pteridium aquilinum* (to 12%), *Dryopteris* type (10% and occasional *Polypodium*.

Table 5. Pollen assemblage zonation of Transect 3 Borehole 5

Fig. 11. Transect 3, BH2. Pollen Diagram



TR3 BH2 cont.


HERBS Cont
MARSH & AQUAT
FERNS
MISC
TOTALS
COUNTS
Zone
TR3-3
TR3: 2
TR3: 1
Depth cm
1910±30 BP
2286±29 BP
% Pollen Sum
% Sum+Marsh & Aquat
% Sum+Ferns
% Sum+Misc

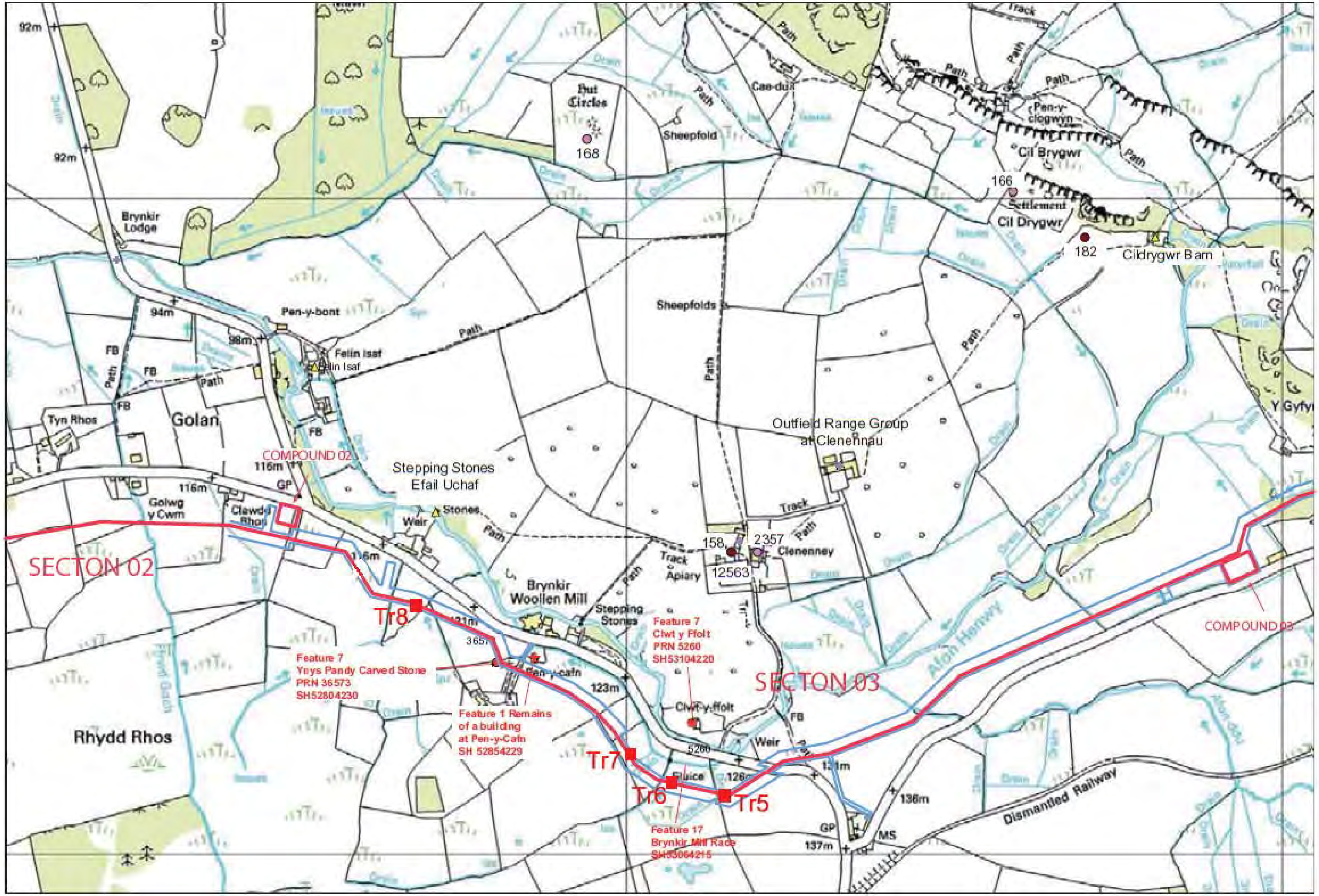
The herb pollen spectra during the early woodland phase (l.p.a.z. TR3: 1) is very restricted with low herb pollen numbers and poor diversity. This, as noted above (2.1) may be partly taphonomic with pollen input from the surrounding area (especially herbs) being restricted by the density of alder growing on the mire. Small numbers of *Plantago lanceolata* (ribwort plantain), *Rumex* (dock) and a proportion of the Poaceae suggest that there was some grassland, probably from pastoral activity at this time (Iron Age to Romano-British period). It is from a depth of 40cm (the late Iron Age/early Roman period) that the woodland was cleared and was associated with increased agricultural activity, both pastoral and arable. In response to this, there was further acidification of the soils and expansion of the *Sphagnum* bog at expense of fen carr. The slight expansion of woodland and drop in grasses at the top of the studied sequence may relate to the immediate post-Roman period.

Ynys Pandy, Golan, Garndolbenmaen, Gwynedd.

Four locations (Transects 4, 5, 6 and 7) on the pipeline easement immediately south of the road from Golan to Penmorfa, just downstream of where the Brynkir mill leat is taken off the Afon Henwy, were prospected for possible peat deposits (Rackham 2015). These lie in Fields 44, 45 and 46 (see McNicol *et al* 2017) and each is associated with a drain or stream draining off the higher land to the south and into the mill race. Transect 4 produced no more than 50cm of organic deposits but locations on Transects 5 - 7 produced sequences that were cored (Fig. 13; Table 1), two of which were subsequently selected for detailed palynological study. The sites lie over siltstones and mudstones of the Dol-cyn-afon Formation of the Ordovician period (http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) with superficial deposits of Devensian diamicton (till). The soils are described as 'freely draining slightly acid loamy soils' (http://www.landis.org.uk/soilscapes/) but at the sampled locations the ground was uneven wet rough pasture with tussocks on peats, localised areas of peat growth adjacent to streams or in poorly drained hollows (Fig. 12). The organic deposits reached a maximum depth of 148cm in Transect 5, 100cm in Transect 6 and 53cm in Transect 7. The latter (Tr7/BH2) produced a middle Neolithic radiocarbon date (Table 2) for organic sediment at 47-48cm depth but was not considered suitable for further study since the much longer core from transect 5 some 150m to the east included the same period. The three cores lie at altitudes between 125.8 and 127.6m OD on the north facing slopes immediately above the Afon Henwy and the land is seasonally wet and only useable for summer grazing.

Fig. 12. Looking east across the area of Transect 5.

Fig. 13. Golan, Garndolbenmaen, Gwynedd. Location of cores from Transects 5, 6, 7 and 8**.** (basemap taken from Richards and Smith 2013)



Ynys Pandy Transect 5, Golan, Gwynedd

Transect 5 was laid along the centre line of the easement in Field 45 between GR 253130.888 342095.349 and GR 253122.643 342097.262 and BH1 was chosen for coring on the basis that it produced the greatest depth of organic sediments. The ground was uneven tussocky rough grazing over peats (Fig. 12). The top metre was sampled in a 100mm diameter plastic earth pipe with the lower 44cm sampled using a Russian corer. The base of the sequence has been dated to the late Mesolithic but the radiocarbon results are anomalous (Table 2; Fig. 14). A small piece of roundwood at 144-145cm depth has produced a radiocarbon age of 5390±40 BP but the organic sediment fraction at 83-84cm depth produced a date of 5656±29 BP (see Section 3 above).

A 146cm core was recovered with stones being hit by the nose of the Russian corer at approximately 156cm depth. Unlike most of the other cores along the pipeline the basal sediments are peaty silts and silts with occasional wood (Fig. 14) indicating a standing water environment rather than peat growth, possibly a stream edge habitat. Peaty silts and organic silts continue up to 88cm depth where slightly fibrous humified peats indicate a change in the depositional environment and the onset of peat growth. The peats are humified throughout their depth, but completely humified above 67cm except for occasional woody and herbaceous roots, and a fibrous turf layer at 0-8cm. A radiocarbon date on the non-fibrous organic component at 26-27cm indicates an early to middle Iron Age date (Table 2; Fig. 14), but although the peats are completely humified unlike the sequences at Tyddyn Madyn there are no clear 'black' oxidised horizons suggesting a specific standstill horizon (Fig. 14) that might represent a hiatus. A rise in pine pollen, the appearance of *Picea* (spruce), and a dramatic fall in oak and hazel in the pollen sample at 4cm suggests that this sample may represent the post-medieval period perhaps suggesting the deposits contain a continuous sequence from the Mesolithic to the post-medieval period.

Pollen analysis *(Rob Scaife and Catherine Langdon)*

This profile comprises 1.46m of humic detrital peat and organic silts with wood fragments. Along with Transect 6, this is a peat deposit perched on the side of a tributary stream to the Afon Dwyfor and may be spring fed. The top 1.0m has been examined. A radiocarbon date of 5656±29BP (SUERC-60024) was obtained at a depth of 83-84cm which places the inception of peat accumulation over organic silts during the middle Holocene, Atlantic (Flandrian II) period. That is, archaeologically, during the later Mesolithic period. Silty peat/peaty silt existing below the lowest level analysed here suggests that sediment accumulation started during the early Holocene as seen in Transect 8 BH1. An expansion of *Pinus* and presence of *Picea* in the uppermost sample level attests to a recent, post *c.*1800 date; that is, after forestry plantation (Fig. 15). Tree and shrub pollen are important throughout the profile with extremely high values in l.p.a.z. TR5: 1). Subsequently, from the start of l.p.a.z. 2 there is an expansion of herbs both of dry-land agricultural affinity and in the mire (autochthonous) habitat. By l.p.a.z. TR5 3, herb assemblages become dominant.

Three local pollen assemblage zones have been recognised and are detailed in Table 6 below.

Fig. 14. Transect 5, BH1, core (top at 127.58m OD)

0-8cm very fibrous turf layer

8-12 black (10YR 2/1) completely humified peat – dry

12-26 very dark brown (10YR 2/2) completely humified peat with a little silt and very rare sand grains, slightly fibrous, mainly roots

25-26cm 2400±30 BP – *544-399 (86.6%), 731-691 (7.4%) and 660-651 (1.4%) cal BC*

26-67 very dark brown (10YR 2/2) completely humified peat, with occasional wood (roots?) and fibrous roots

53-54cm 4860±30 BP – *3704-3632 (90%) and 3555-3539 (5.4%) cal BC*

67-88 very dark brown (10YR 2/2) slightly fibrous humified peat, with penetrating herbaceous roots and occasional wood

83-84 cm 5656±29 BP – *4550-4445 (91.8%), 4420-4398 (3.3%) and 4379-4376 (0.3%) cal BC*

88-95 dark greyish brown/greyish brown (10YR 4/2 and 5/2) soft organic silt with penetrating roots

95-98 very dark brown (10YR 2/2) silty humified peat with herbaceous roots

98-104 very dark brown (10YR 2/2) slightly silty fibrous humified peat

104-109 very dark greyish brown (10YR 3/2) humified peaty silt

109-119 dark grey (10YR 4/1) slightly organic fine silt

119-124 very dark greyish brown (10YR 3/2) humified peaty silt

124-135 very dark brown (10YR 2/2) humified silty peat with occasional wood fragments

135-137 wood

137-143 very dark brown (10YR 2/2) humified slightly fibrous peat

143-146 very dark greyish brown (10YR 3/2) peaty silt

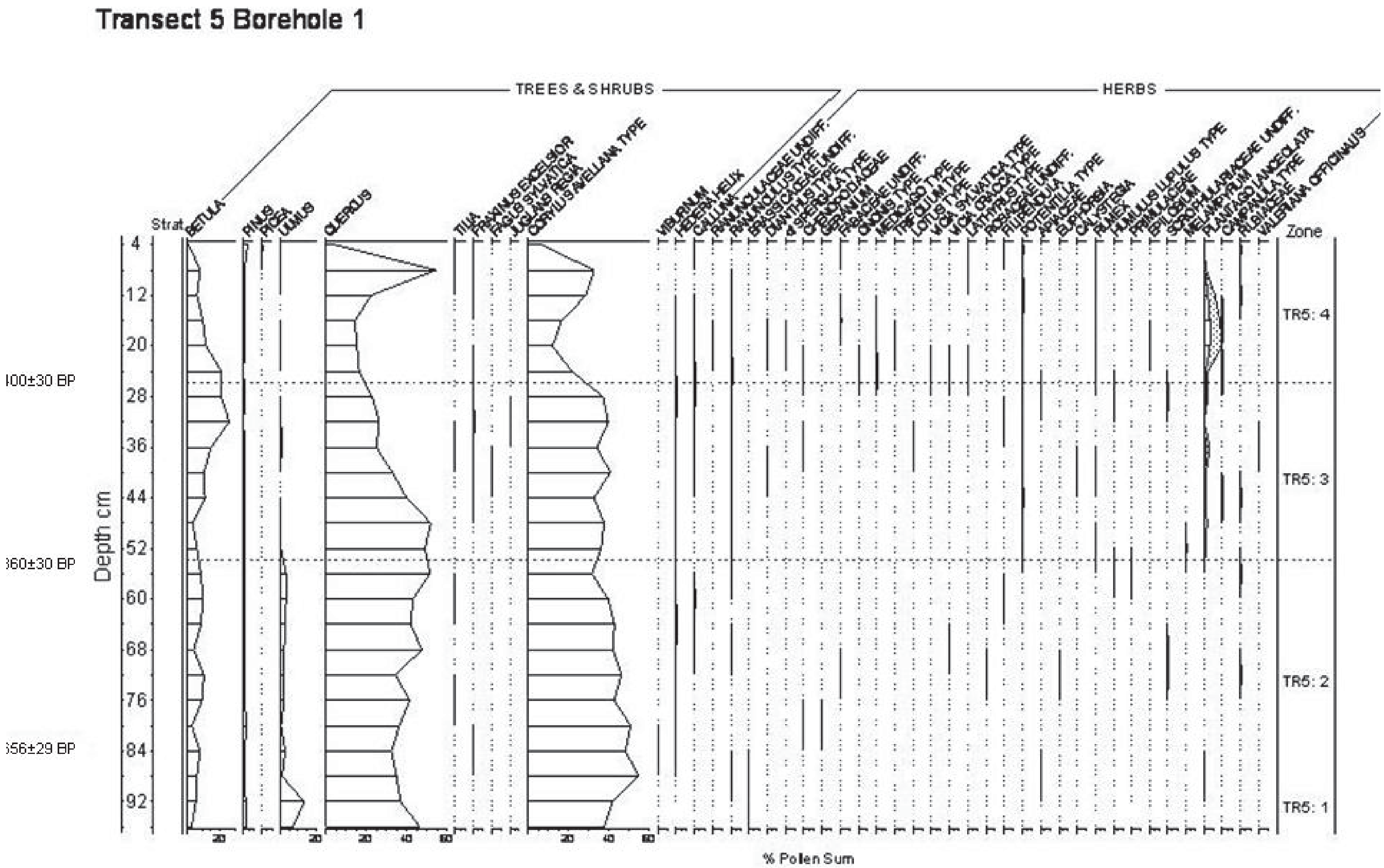
144-145 5390±40 BP – *4339-4223 (71.5%), 4208-4157 (13.5%) and 4131-4068 (10.4%) cal BC*

Nose (10cm) of Russian corer hit clay/stone at approx. 155cm depth. Pollen samples were taken at 4-144cm at intervals of 4cm.

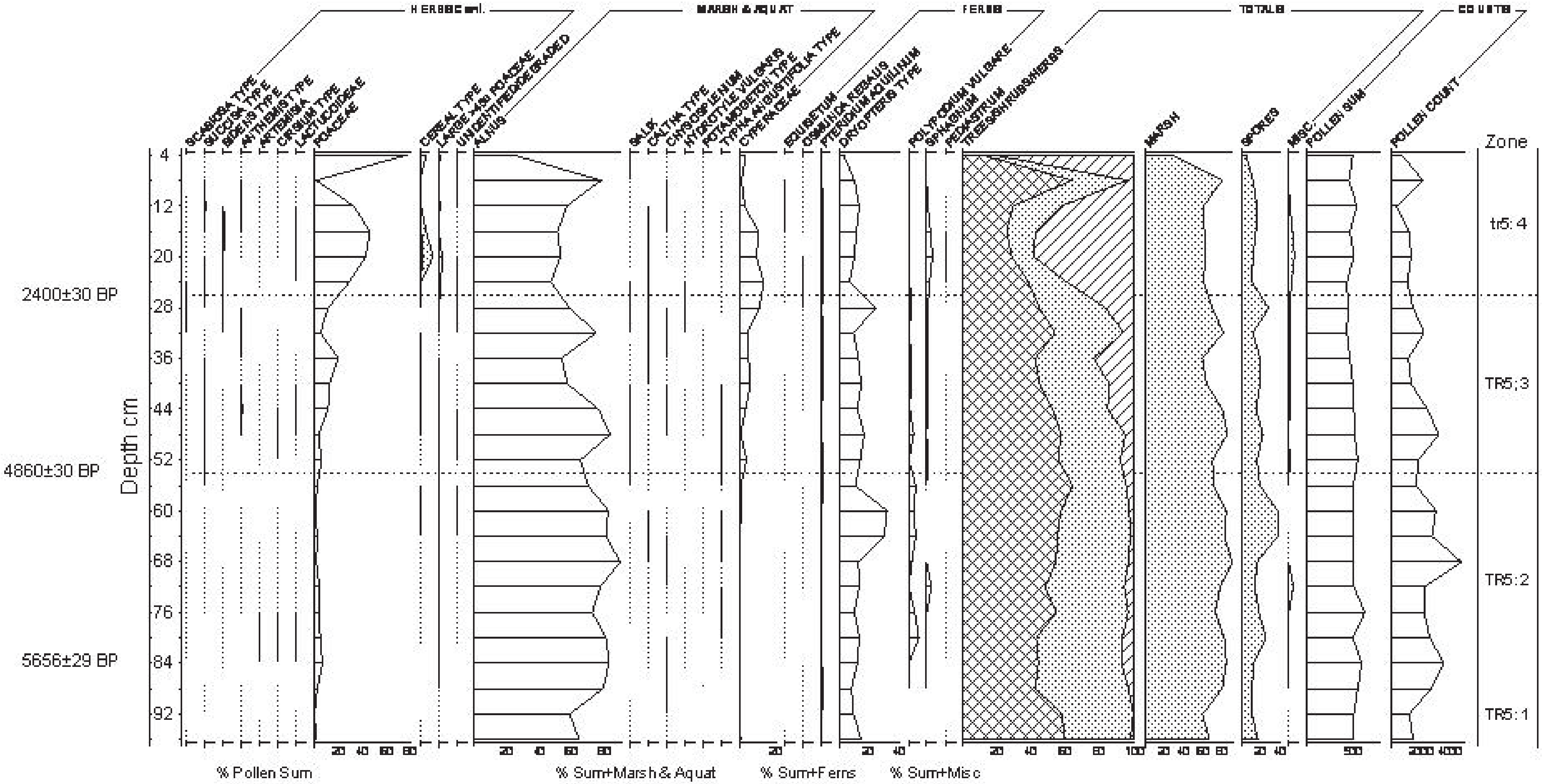
Table 6: Pollen assemblage zonation of Transect 5, Borehole 1.

Pollen zone	**Palynological characteristics**
l.p.a.z. TR5: 4 26cm to 4cm Poaceae-Plantago lanceolata-Cereal 25-26cm 2400±30 BP	Herbs become more important with general declines in arboreal taxa. Poaceae expands to maximum values to a peak of 50% at 16cm and to 76% in the uppermost level. This is accompanied by progressively reduced tree and shrub pollen. The latter remain important with continuation of Betula (declining from 20% to low levels), Quercus (15% with peak to 55% at 8cm) and Corylus avellana type (decline to 12% followed by expansion to a peak of 40%). There are occasional Fraxinus and Tilia pollen. Herbs are dominated by Poaceae (noted) with higher values of Plantago lanceolata (6%) and minor increase in Cereal type (1-2%). Marsh/aquatic taxa remain dominated by Alnus (peak to 75%) with Cyperaceae (declining from l.p.a.z.3/4 peak of c.14% to <5%).). Fern spores remain as in the preceding zone except for fewer Polypodium. There is a minor peak of Sphagnum (7%) at c. 20%.
l.p.a.z. TR5: 3 54cm to 26cm) Betula-Quercus-Alnus-Corylus avellana type-Poaceae. 53-54cm 4860±30 BP	This zone is delimited/defined by a reduction of Ulmus to only sporadic occurrences and an expansion of herbs including Plantago lanceolata (1-2%), Poaceae (peak to 20% at 36cm) and Cereal type pollen. There is also an increase in overall herb diversity. Trees and shrubs, however remain dominant with Betula (increasing upwards to a peak of 28% at 32cm), Quercus (declining throughput from highest values of c. 50% to 20%). There are occasional Fraxinus, Tilia, Fagus and a single Juglans is noted at the top of the zone (32cm). Herb assemblages become more diverse with expansions of Plantago lanceolata and Poaceae (noted) and Asteraceae types. Marsh and aquatic taxa are dominated by Alnus (50-80%) and increasing Cyperaceae (to 10%).
l.p.a.z. TR5: 2 90cm to 54cm Quercus-Corylus avellana type-Alnus 83-84cm 5656±29 BP	Ulmus declines (av. 5%), while Quercus (40-50%) and Corylus avellana type (maximum in sequence of 56%) and autochthonous Alnus (to 85%) are dominant. Pinus has consistent but low values. There are sporadic occurrences of Tilia and Fraxinus. Herbs remain at low diversity but with some increase in Poaceae with a peak of 8% in the lower half of the zone. There are occasional Salix, Chrysosplenium and Hydrocotyle vulgaris.
l.p.a.z. TR5: 1 96cm to 90cm Ulmus-Quercus-Corylus avellana type-Alnus	The basal zone (2 levels) has highest values of Ulmus (to 17%) along with dominant Quercus (to 46%), Corylus avellana type (increasing to 42%) and Alnus (64% Sum + Marsh). Pinus (4%) is more important in this zone but is masked by the dominance of the taxa noted. There are few herbs with only minor traces of Poaceae (1-2%), occasional Ranunculus type and marsh taxa comprising small numbers of Cyperaceae and Potamogeton type. Fern spores include monolete Dryopteris type (14%) and occasional Pteridium aquilinum.
144-145cm 5390±40 BP	

Fig. 15. Transect 5, BH1. Pollen Diagram



TR5 BH1 Cont.


HERBS cont.
MARSH & AQUAT
FERNS
TOTALS
COUNTS
Zone
tr5:4
TR5:3
TR5:2
TR5:1
2400±30 BP
4860±30 BP
5656±29 BP
Depth cm
% Pollen Sum
% Sum+Marsh & Aquat
% Sum+Ferns
% Sum+Misc

On-site habitat change.

Throughout the history of this mire site, Alnus was dominant on-site as carr woodland, probably with some occasional Salix and a ground flora of typical fen carr herbs such as Caltha palustris (marsh marigold), Chysosplenium oppositifolium (golden saxifrage) and Hydrocotyle vulgaris (marsh pennywort). From the base of l.p.a.z. TR5: 1, there is some change to the wetland community with progressive expansion of Cyperaceae to a peak at the l.p.a.z. 2/3 boundary. This is also associated with some increase (a small peak) of Sphagnum and may indicate some acidification of the mire in a localised situation.

The surrounding vegetation

As with the other sites analysed, Betula, Quercus and Corylus are dominant throughout the profile. The radiocarbon date of 5656 ±29BP (SUERC-60024) shows that this was the case here back to the middle Holocene (Atlantic; Flandrian Chronozone II). Initially, however, Ulmus (elm) was also important; possibly during the end of Flandrian Ic at c. 7,000BP?. Throughout l.p.a.z. TR5:1, Ulmus was also present along with the ubiquitous Quercus, Corylus and Betula. This middle Holocene, dominant deciduous woodland from c. 7,000 to 5,000BP represents the climatic maximum (see section 8.1b. below). The l.p.a.z. TR5 2/3 boundary is drawn at the point where Ulmus values decline (54cm) and is dated to the early Neolithic (Table 2). This is also accompanied by increasing herb values especially with non-cultivated Poaceae, occasional cereal pollen and Plantago lanceolata. This is thought to be the important, Neolithic Elm Decline which was widespread across Britain and parts of Europe and saw the broadly synchronous decline of elm from c. 5,500-5000BP (Smith and Pilcher 1963). The Elm Decline is now accepted as due to fungal disease (Ceratosystis) transported by insect (Scolytus) whose spread was facilitated by opening of woodland by Neolithic subsistence. This event has been much discussed in the past and is dealt with in Section 8.2c below.

Above the decline in Ulmus at c.52cm (l.p.a.z. 2/3), Betula, Quercus and Corylus, as at other sites, became the woodland dominants although, as noted, there appears to have been some clearance for agriculture in the neolithic. Thus, there is also some decline in the importance of the oak woodland accompanying the expansion of the agricultural herbs and associated weeds (l.p.a.z. TR5: 3) with clearance continuing to the early-mid Iron Age and later. An increase of Betula towards the top of this zone may tentatively be attributed to scrub colonisation of cleared areas. Because they are palynologically, poorly represented, the small numbers of Fagus, Fraxinus and Tilia suggest some local growth in this more open woodland habitat. Interestingly, a single record of Juglans (walnut) was recorded at 32cm apparently an early Iron Age level in the diagram. This was a Roman introduction to Europe as a whole and as such usually acts as a useful datum point. However, it should also be considered that this individual pollen may be from long distance transport from North America of this anemophilous taxon. The historic period appears crammed into the top 20cms of the profile and there are insufficient samples to define the story, but a period of clearance, associated with grassland expansion and arable activity is observable at 12-24cm which may equate with the Roman, or Roman and early medieval periods. Oak and hazel woodland remained important but at lower levels until the past few centuries, and there is evidence of post-medieval forestry plantation (a Pinus rise and Picea) at the top of the profile.

Ynys Pandy Transect 6, Golan, Gwynedd.

Transect 6 was across the east bank of a small stream draining the higher ground to the south. The ground was uneven, falling to the north, tussocky and wet at the time of augering, with peats underlying the turf, and only suitable for summer grazing. The borehole selected for coring was closest to the stream and wet at the surface. Nearly a metre of peat and organic gravel were recovered in the core (Fig. 16) at GR 253063.01 342111.211 – 125.822 OD) in Field 45 (McNicol *et al* 2017). Small roundwood from near the base of the sequence at 72-73cm depth has been dated to the late Bronze Age (Table 2; Fig. 16) and a second date was obtained for roundwood at 45-46cm depth of the early Iron Age.

Fig. 16. Transect 6, BH3, core (top at 125.82m OD)

0-6cm fibrous dark brown turf with occasional small smoothed stones and beetle elytra

6-18 fibrous dark brown slightly humified peat

18-32 dark brown (7.5YR 3/4) fibrous humified well preserved peat oxidising on exposure

32-44 brown (7.5YR 3/3) slightly fibrous humified well preserved peat and very occasional fragments of siltstone

44-48.5 very dark greyish brown (10YR 3/2) fibrous slightly sandy peat with small grits and some roots

45-46 2450±30 BP – *585-411 (53.2%), 754-681 (26.7%) and 670-609 (15.5%) cal BC*

48.5-61 very dark brown (10YR 2/2) humified slightly fibrous peat

61-67 very dark greyish brown (10YR 3/2) humified slightly fibrous peat with occasional roundwood and twigs, and roots

67-81 dark brown (7.5YR 3/2) humified fibrous peat with small roundwood and twigs, and roots

72-73 2792±29 BP – *1013-890 (88.6%) and 880-847 (6.6%) cal BC*

81-94 very dark greyish brown (10YR 3/2) organic sandy siltstone gravel with penetrating roots and occasional roundwood and woody roots

Pollen samples taken at 4-92cm at 4cm intervals

The upper part of the sequence is undated but there is no evidence in the deposits for a hiatus. The peats are better preserved than in most of the other sequences, fibrous, with occasional and locally common small roundwood. The core is adjacent to a stream or drain and an associated hedge/shrub and tree line that marks the boundary between two fields. At the base of the sequence are sandy siltstone gravels with organics, wood and woody and herbaceous roots probably reflecting the former stream bed. There is no evidence for a palaeosol. Above this is a sequence of fairly well preserved fibrous peats with occasional small roundwood and grits and small siltstone fragments. The peats become more humified in the upper part of the sequence to 18cm depth, above which they are fibrous and only slightly humified. The junction at 18cm may reflect a change to wetter conditions on the site and perhaps indicate a hiatus, but the sediments immediately below 18cm are not severely humified or oxidised and do not suggest a period of desiccation and humification of the underlying peats.

Pollen analysis *(Rob Scaife and Catherine Langdon)*

This profile comprises solely a highly humified detrital and rootlet peat containing twigs towards the base of the profile. The radiocarbon date at a depth of 72-73cm (2792±29 BP SUERC-60025) places the earliest organic gravels at 94cm as of probably middle to late Bronze Age.

Overall, the pollen spectra in the profile (Fig. 17) are homogeneous from 94cm to *c.* 46cm showing predominantly woodland on and, off-site. Above this phase, there is a change to more open conditions with clearer evidence of human activity. As such, two local pollen assemblage zones have been recognised. These are detailed in Table 7 below.

The majority of the profile (l.p.a.z. TR6: 1/2) is dominated by arboreal and shrub pollen with *Betula*, *Quercus* and *Corylus avellana* type attributed to the terrestrial zone and *Alnus* pollen coming from alder carr growing on and in close proximity to the site. There are small numbers/sporadic occurrences of poorly represented tree taxa including *Tilia, Fraxinus, Fagus, Ilex* and *Sorbus/Crataegus* type (Rowan and Hawthorn). *Hedera helix* (ivy) and *Lonicera* (honeysuckle) are probable lianas/climbing shrubs from the woodland. These latter become more important with the gradual diminution of the woodland. There are relatively few herbs throughout the woodland phase but *Plantago lanceolata* is present throughout in small numbers also with cereal pollen occurring sporadically midway through this phase. The most significant change is at *c.*46cm where tree and shrub pollen values decline and herb pollen assemblages become markedly more important than in the preceding pollen zone. Herb diversity is also greater. Poaceae become dominant also with higher percentages of *Plantago lanceolata* and cereal pollen.

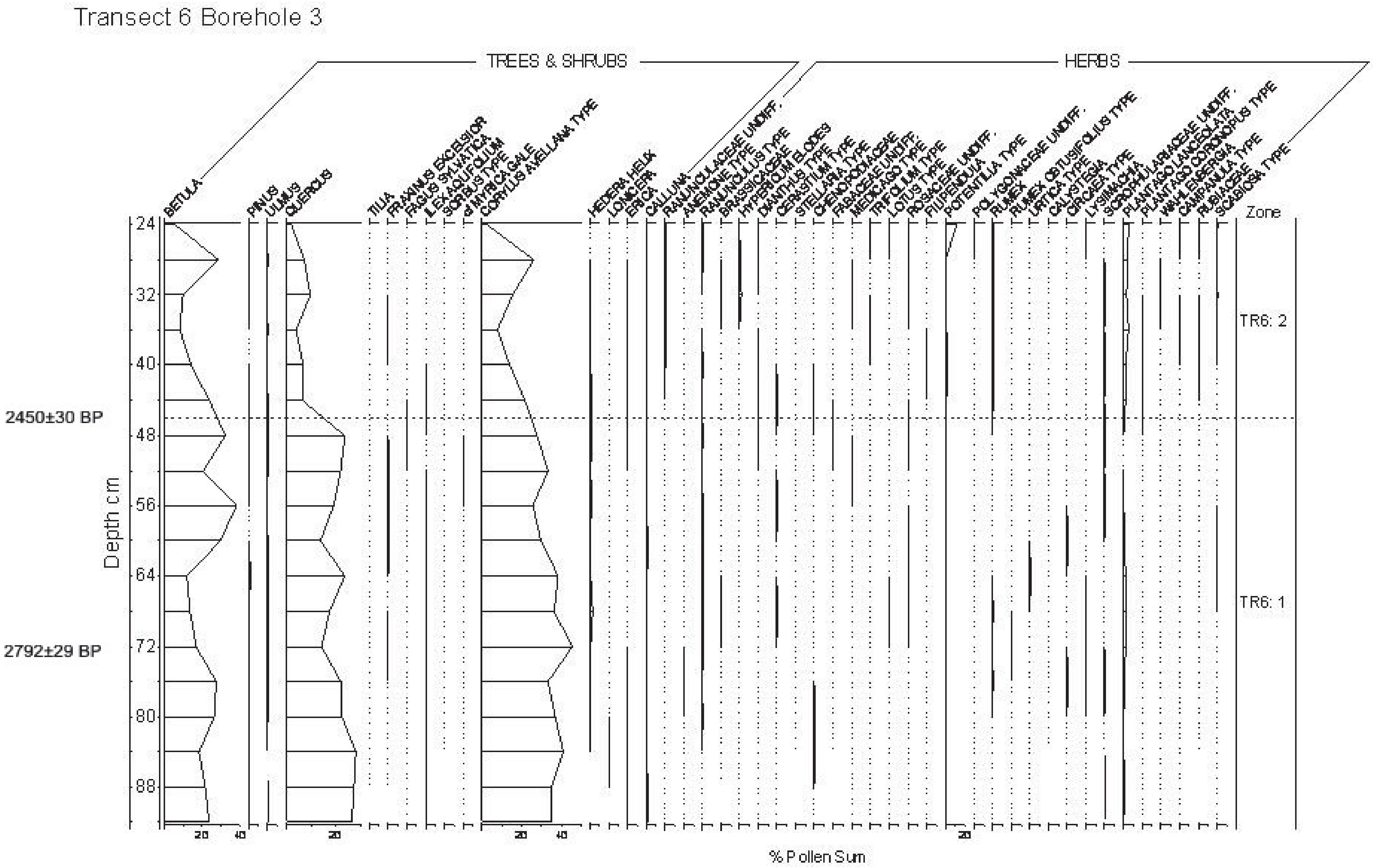
On-site habitat change
Alder carr woodland was dominant throughout most of the time-span represented in this profile (largely in l.p.a.z. TR6: 1), the late Bronze Age and early Iron Age. This community was also characterised by a mature ground flora with *Chysosplenium oppositifolium* (golden saxifrage), *Caltha* type, probably *C. palustris* (marsh marigold), *Typha angustifolia* type (bur reed and/or reed mace) and Cyperaceae (sedges). The transition from l.p.a.z. TR6: 1 to 2 was accompanied by changes in the autochthonous vegetation with *Alnus* declining and a more open grass-sedge fen with higher values of Cyperaceae, *Potentilla* type and some *Sphagnum* also suggesting change to more acid conditions.

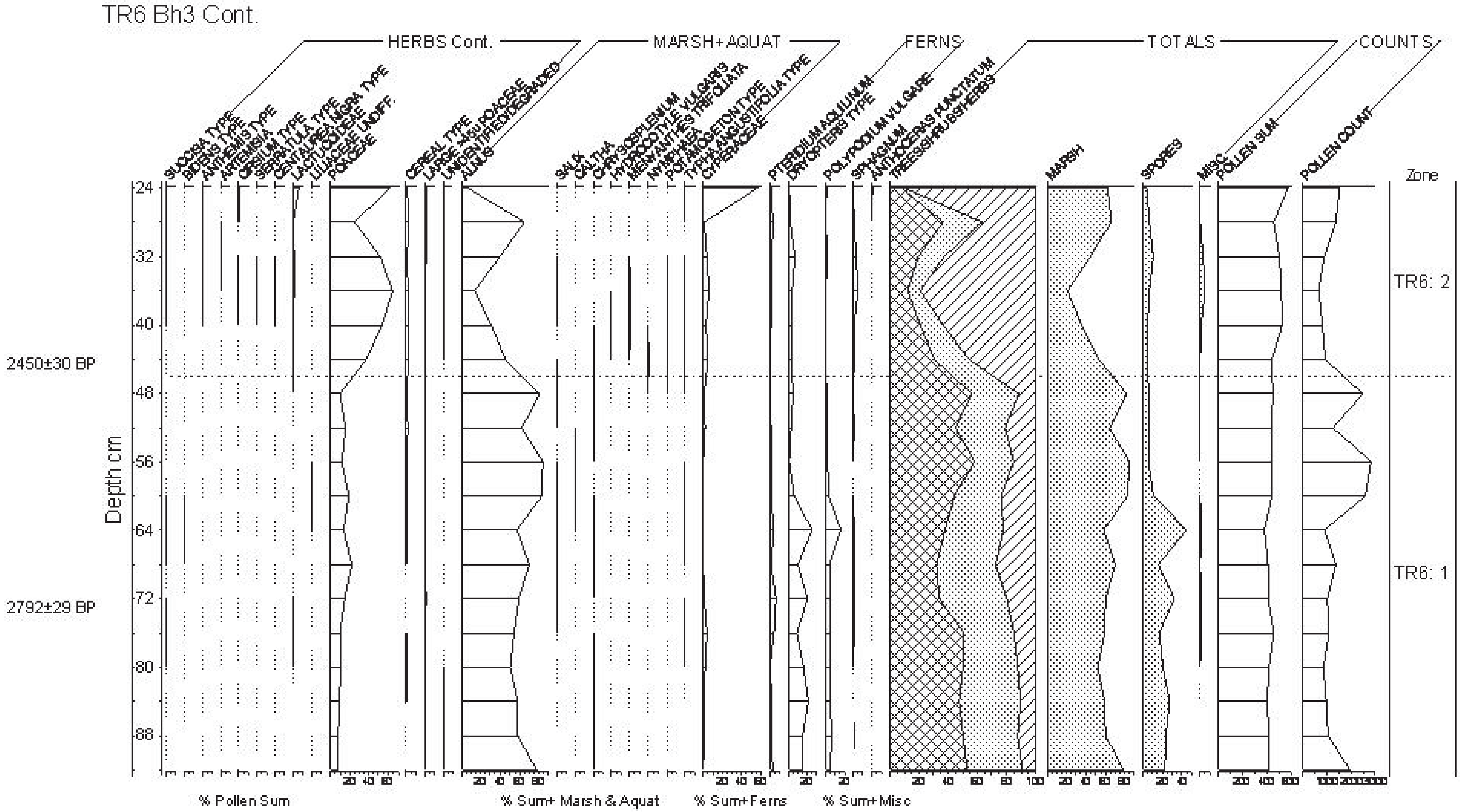
Table 7: Pollen zonation of Transect 6, Borehole 3

Pollen zone	Palynological characteristics
l.p.a.z. TR6: 2 46cm to 24cm	This upper zone is characterised by a sharp increase in the numbers of Poaceae (to 67%), Plantago lanceolata (to 8%). This corresponds with declining values of trees and shrubs noted in l.p.a.z. 1. Betula (declines to 10%), Quercus (to 20%) and Corylus avellana type (to 5% at top of profile). There are ephemeral peaks of Betula and

Pollen zone	Palynological characteristics
Poaceae 44-45cm 2450±30 BP	Corylus type at 28cm.There is also less diversity of sporadically occurring tree and shrub pollen which occurred in l.p.a.z. 1. Herbs are dominated by Poaceae (noted) and with slightly higher values of Cereal pollen type which increase in number towards the top of l.p.a.z. 1. Other principal taxa include Plantago lanceolata, Asteraceae types and Potentilla type in the uppermost studied level (24cm). Alnus remains the dominant marsh taxon for most of the zone but with reduced percentages from l.p.a.z. 1 to a minimum of 5%. However, in the uppermost level Cyperaceae expands to high values (56% sum + marsh & aquatic). In this zone, there are occasional aquatic macrophytes including, Nymphaea and Potamogeton and other fen taxa (Chrysosplenium, Hydrocotyle vulgaris, Menyanthes trifoliata, Caltha type and Typha angustifolia/Sparganium type. Spores of ferns remain at low levels. There is a minor peak of Sphagnum (6%) at 36-28cm.
l.p.a.z. TR6: 1 94cm to 46cm Betula-Quercus-Corylus avellana type-Alnus 72-73cm 2792±29 BP	This basal zone is dominated by tree and shrub pollen (90%). The dominant taxa comprise Betula (to 40%), Quercus (to 28%), Corylus avellana type (peak to 49%) and in the marsh category, Alnus (to 85% sum + marsh and aquatic). There are small numbers of Pinus, Ulmus, Tilia and Ilex and dwarf shrub Ericales (Erica and Calluna). Herbs comprise largely Poaceae (to 25% at 68cm) with sporadic occurrences of a moderately diverse range of other taxa. These include Ranunculus type, Potentilla type, Plantago lanceolata and occasional Cereal type and large Poaceae (>45µm) from c. 80cm. Marsh and aquatic taxa are dominated by Alnus (noted) with occasional occurrences of Salix, Cyperaceae, Caltha type and Chrysosplenium oppositifolium. Fern spores are more important in this zone from 60cm downwards. Taxa include Dryopteris type (to 28%), Polypodium (av. 5%; peak to 20% at 64cm) and small numbers of Pteridium aquilinum (to 6%). These decline to much lower levels upwards from 64cm (intermediate pollen assemblage sub-zone). Sphagnum is present (<1%) from 76cm.

Fig. 17. Transect 6, BH3. Pollen Diagram




TR6 Bh3 Cont.
HERBS Cont.
MARSH+AQUAT
FERNS
TOTALS
COUNTS
SUCCISA TYPE
BIDENS TYPE
ANTHEMIS TYPE
ARTEMISIA
CIRSIUM TYPE
SERRATULA TYPE
CENTAUREA NIGRA TYPE
LACTUCOIDEAE
LILIACEAE UNDIFF.
POACEAE
CEREAL TYPE
LARGE >45u POACEAE
UNIDENTIFIED/DEGRADED
ALNUS
SALIX
CALTHA
CHRYSOSPLENIUM
HYDROCOTYLE VULGARIS
MENYANTHES TRIFOLIATA
NYMPHAEA
POTAMOGETON TYPE
TYPHA ANGUSTIFOLIA TYPE
CYPERACEAE
PTERIDIUM AQUILINUM
DRYOPTERIS TYPE
POLYPODIUM VULGARE
SPHAGNUM
ANTHOCERAS PUNCTATUM
TREES/SHRUBS/HERBS
MARSH
SPORES
MISC.
POLLEN SUM
POLLEN COUNT
Zone
Depth cm
2450±30 BP
2792±29 BP
TR6: 2
TR6: 1
% Pollen Sum
% Sum+ Marsh & Aquat
% Sum+Ferns
% Sum+Misc

The surrounding vegetation

This profile and the associated radiocarbon date of 2792 ±29BP (SUERC-60025) is useful in that it extends back to the late-Bronze Age. This shows that dominant oak, hazel and possibly Betula woodland had remained throughout the late prehistoric period, with no significant clearance until the middle of the first millennium BC. From this date, there is a gradual opening of the woodland as evidenced by the increasing numbers of more light demanding Fraxinus, Fagus and Hedera and also a reduction in woodland ferns (Polypodium) from midway up l.p.a.z. TR6: 1. This similarly applies to cereal and possibly Plantago lanceolata pollen suggesting that we are seeing limited increase/expansion of human activity and agriculture from the early Iron Age. Small numbers of Calluna (ling) throughout this early phase suggests that there were some more acid (depleted) soils in the vicinity.

From a depth of c. 46cm, there was a marked change in the local vegetation habitat with reduction of woodland on the terrestrial zone adjacent to the mire (lower valley slopes?). That is, as at other sites, removal of Betula, Corylus and especially Quercus from drier soils and Alnus from the wet floodplain. Commensurate with this was a sharp expansion of herb pollen dominated by Poaceae but also with higher values of Plantago lanceolata and Cereal pollen. This suggests woodland clearance for expansion of mixed arable and pastoral agriculture from the middle of the first millennium BC. The general rise and fall in grasses, and the associated fall in tree pollen between 48 and 28cm may mark the late Iron Age and Roman periods, with the sample at 28cm perhaps marking the early post-Roman, but these deposits remain technically undated.

Efail Uchaf, Golan, Garndolbenmaen, Gwynedd (Transect 8)

In Field 37 opposite Efail Uchaf Transect 8 revealed a series of organic deposits over a palaeosol on an area of relatively flat rough tussocky pasture (Fig. 18). Four auger holes were sunk down the midline of the easement from just west of the stream (GR 252686.589 342382.555 to GR 252673.092 342388.198 see Rackham 2015) and a location halfway between boreholes BH1 and BH2 selected for coring.

Fig. 18. Core at Transect 8 being extracted, with the field boundary and stream immediately behind. Looking east.

The site lies on silt and mudstones of the Dol-cyn-afon Formation with superficial deposits of peat (http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) overlying Devensian diamicton. The prospection augers showed a sequence with grey clays (diamicton) at the base and a possible surviving palaeosol on the clays (Rackham 2015). A 165cm core was recovered with clay or stones being hit by the nose of the Russian corer at approximately 177cm depth. Clays (diamicton) underlie the site and are capped by dark greyish brown humified organic silts interpreted in the field as a 'palaeosol' (Rackham 2015) but possibly reflecting a slow moving waterlain sediment. The Russian corer failed to recover the base of the sequence because the nose of the corer could not penetrate the silts and clays so the precise character of this deposit has not been established. These earliest deposits were capped by humified organic silts, peaty silts and clayey silts to 80cm depth, before the onset of peat formation in the early Mesolithic (7603-7551 cal BC – see Table 2; Fig. 19). The organic silts recovered at the base of the sequence are interpreted as late glacial in date and indicating a probable stream edge environment.

The top 103cm of the core were collected in a 110mm diameter plastic earth pipe and the subsequent 62cm using a Russian corer.

Fig. 19. Transect 8, BH1.5, core (top at 118.95m OD)

0-2cm rich brown fibrous turf
2-7 dark brown (7.5YR 3/2) fibrous humified peat
7-16 very dark greyish brown (10YR 3/2) humified peaty silt/silty peat

16-32 very dark greyish brown (10YR 3/2) completely humified peats with occasional wood
21-22cm – 3730±30 BP – *2206-2032 (94.8%) and 2266-2261 (0.6%) cal BC*

32-36 very dark brown (10YR 2/2) completely humified peat with traces of wood (roots?)
36-43 very dark brown (10YR 2/2) slightly silty humified peat

43-68 very dark grey (7.5YR 3/1) soft humified peat with occasional wood (poss. roots)

65-66cm – 6930±30 BP – *5883-5737 cal BC*

68-80 black (7.5YR 2/1) soft humified peat

78-79cm – 8566±28 BP – *7603-7551 cal BC (95.4%)*
80-102 brown (10YR 4/2) clayey silt with penetrating roots to 2cm diameter, becoming darker with depth to very dark brown (10YR 2/2)- slightly organic silt

102-122 very dark greyish brown (10YR 3/2) organic clayey silt
122-136 very dark brown (10YR 2/2) humified organic silt.
136-148 very dark brown (10YR 2/2) humified silty peat with reed rhizomes
148-158 very dark greyish brown (10YR 3/2) organic silt
153-156 -
158-165 dark greyish brown (10YR 4/2) slightly organic silt

Nose of Russian corer on clay/stone at 177cm
Pollen samples taken at 4-160cm at 4cm intervals

The peats continue to 16cm depth with peaty silts above. The silt content in these upper sediments may derive from arable activity in fields upslope. The vegetation pattern in Field 32 observed during the fieldwork, three fields west of the core site, suggests rigg and furrow on these 'plateau' lands, and possible traces are visible on one of the Google Earth images. With a late neolithic/early Bronze Age date for humified peat at 21-22cm depth (Table 2; Fig. 17) peat growth over the last four thousand years at this site appears to have been minimal, although there is no marked standstill horizon visible in the section (Fig. 19). The core site sits on the edge of a fairly large area of plateau between 110 and 120m OD, and is probably the only one of the seven sites studied that may have had cultivated land adjacent. About a third of the plateau is at present improved pasture and the remainder rough grazing over peats, but the suggestion of rigg and furrow in the field south of Clawdd Rhos raises the possibility of earlier cultivation in the area. Cereal type pollen occurs in the top 12cms of the sequence (Fig. 18) which includes the silty peats and may reflect medieval cultivation in the area, but with an EBA date at 21-22cm depth this could represent much earlier cultivation. The top 20cm is effectively undated but could represent the last four thousand years.

Pollen analysis *(Rob Scaife and Catherine Langdon)*

The deposits obtained from this borehole lie at 118.95 OD and consist of organic silts, overlain by humified peats, in turn capped by a silty peat and fibrous peaty turf. A date of 8566±28 BP (7603-7551 cal. BC - SUERC-60018) was obtained from the humified peat fraction at 78-79cm. This dates the lower part of the studied sequence to the early post-glacial (Boreal), the early Mesolithic. Twenty five samples were examined for pollen analysis at 4cm sample intervals, the results of which are illustrated in Figure 20. Pollen was generally well preserved and abundant and the diagram has been split into four local pollen assemblage zones which have been described in Table 8 (below). The pollen can be interpreted in terms of the on-site habitat changes (the autochthonous component) and the pollen that is derived from the more regional and extra-regional environment (the allochthonous component).

On-site habitat change

With the long time span represented in this site, as might be expected, there are significant changes in the on-site flora. Initially, in l.p.a.z. TR8: 1, a slow-flowing or lacustrine freshwater environment is indicated, presumably a precursor of the present stream. This habitat supported aquatic macrophytes such as *Myriophyllum spicatum* (water milfoil), *Menyanthes trifoliata* (bogbean, a plant of marginal, shallow water), *Alisma plantago-aquatica* (water plantain) and, more latterly in the zone, increases in *Typha angustifolia* (lesser reedmace) and *Sparganium* (bur-reed). This habitat was probably established as new fluvial systems were instigated following deglaciation and melting of permafrost. *Salix,* a minimal pollen producer, probably grew on-site and values of up to 3% attest to its local growth as floodplain willow carr (Andersen, 1970, 1973). Areas of *Sphagnum* (bog moss) were also important at this time and it is probable that the environment was generally nutrient rich and *Sphagnum* here may have been of the less acid, more mesotrophic to neutral spectrum (*cf. S. subsecundum, S. recurvum, S. palustre*).

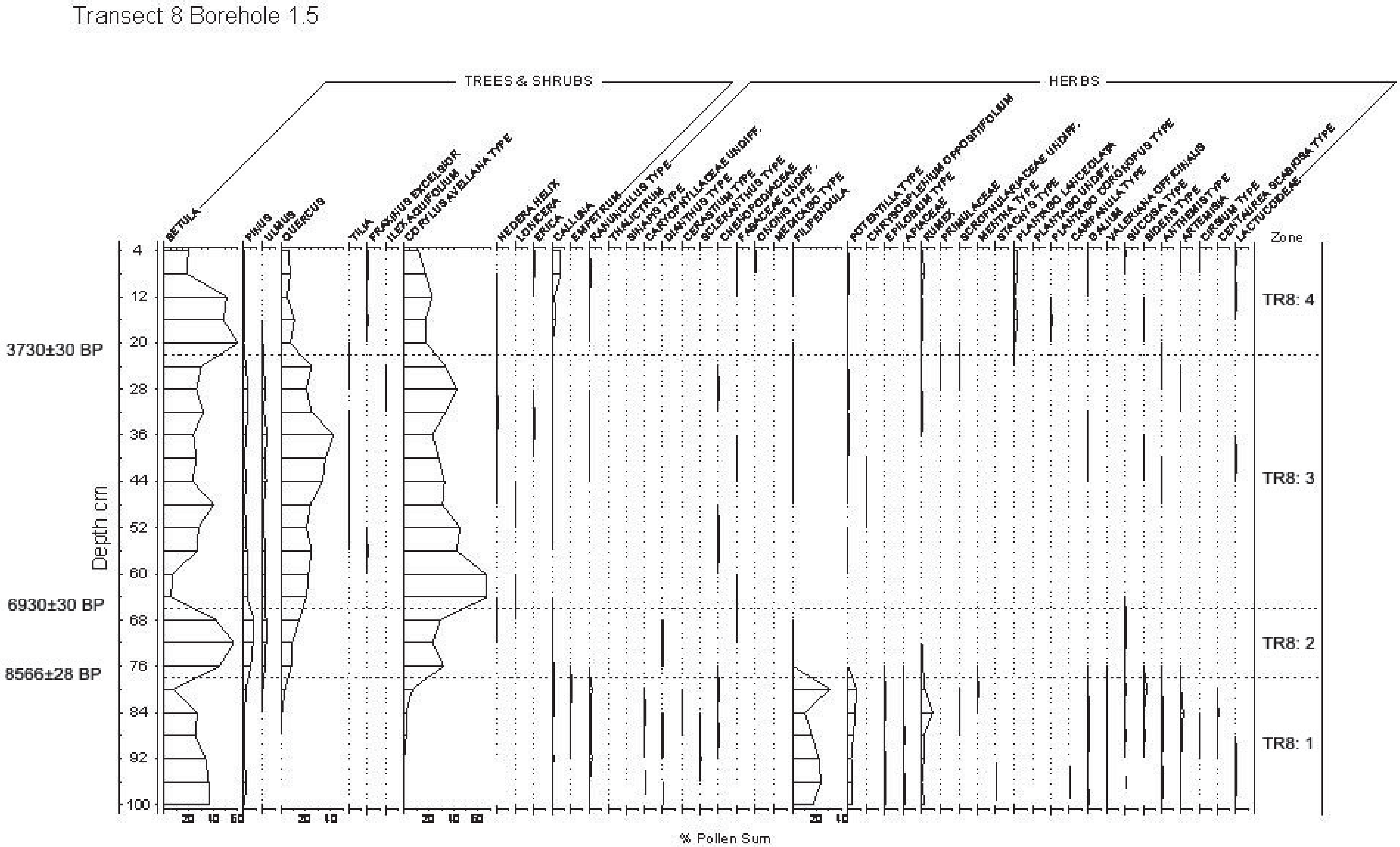
l.p.a.z. TR8: 1 reflects the early colonization of birch as a pioneer tree. This zone shows a typical pre-Boreal to boreal environment with a dominance of birch locally which continued to become established in open areas to form a more open aspect heliophilous woodland that occurred with subsequent oak and elm dominance.

Table 8: Pollen zonation and details Transect 8; Borehole 1.5

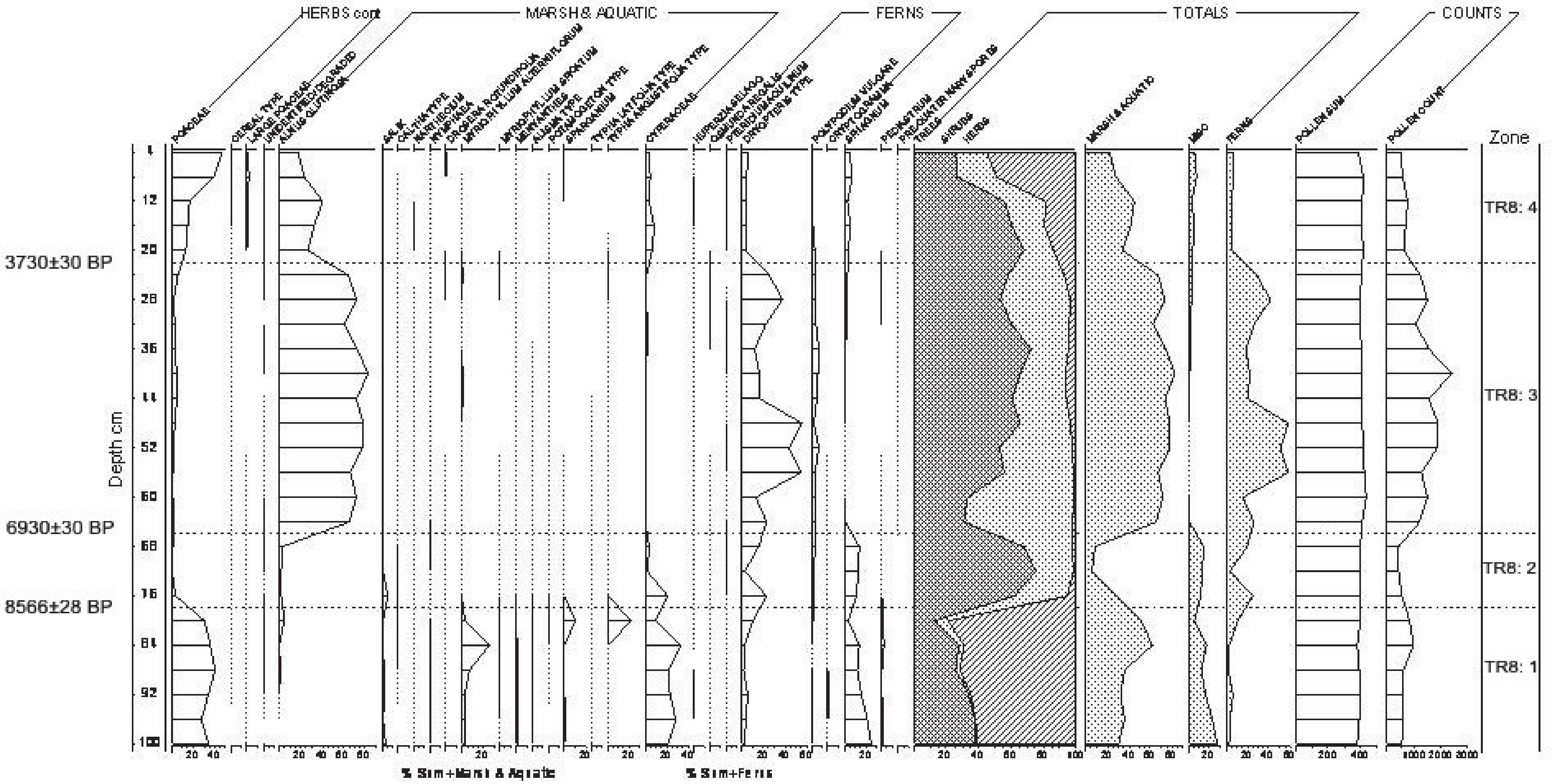
Assemblage Zone	Palynological Characteristics
l.p.a.z.TR8: 4 22cm to 4cm *Betula-Corylus-* Poaceae 21-22cm 3730±30 BP	TR8: 4 is dominated by *Betula* (up to 60%) at the start of the zone and declining to 20% at the end. This is with a corresponding increase in Poaceae pollen values (from 15-45%). *Corylus* remains between 20-30% throughout. Other trees include *Quercus* reducing from 20% to 7%. Some *Fraxinus* and *Ulmus* are also evident with sporadic occurrences. *Calluna vulgaris* rises towards the end of the zone. *Plantago lanceolata* is constantly in evidence as is *Potentilla* type pollen. Other herb taxa include *Ranunculus* type, *Filipendula*, *Rumex* and *Cereal* type. Marsh and aquatic taxa include *Alnus* which exhibits a general decline to *c.* 25% from 80% at the start of TR8: 4. Meanwhile, *Salix*, *Drosera rotundifolia*, *Myriophyllum alterniflorum*, *Sparganium* and Cyperaceae are also recorded at times. The latter remains at between 4-6%. Fern spores remain at relatively low values throughout with *Dryopteris* type declining at the start of the zone.
l.p.a.z. TR8: 3 66cm to 22cm *Alnus-Betula-Quercus-* *Corylus avellana* type 65-66cm 6930±30 BP	Characterised by increasing *Betula* and *Quercus* pollen values, both reaching a maximum of *c.*40%, and a dominance of *Corylus* which reduces from *c.* 70% at the start of the zone to *c.* 50% by the end. *Alnus* reaches its maximum pollen values in the profile during l.p.a.z. TR8: 3 between 70-80%. The dominance of the arboreal and shrub types means that values and incidence of herb pollen types are relatively small with some Poaceae (2-5%), *Filipendula* and *Potentilla* type noted. Also recorded are occasional pollen of *Ranunculus* type, *Rumex*, *Galium*, *Bidens* type and Lactucoideae. *Sphagnum* disappears from the profile for some time and is in relatively low numbers when it is subsequently present. *Dryopteris* spores are, however, more dominant (up to 60%) whilst *Polypodium* remains at levels of between 5-7%.
l.p.a.z TR8: 2 78cm to 66cm *Betula-Pinus-Quercus-* *Corylus avellana* type	l.p.a.z. TR8: 2 is delimited by *Betula* reaching to 60% total of the pollen sum, whilst *Pinus* (10%), *Quercus* (up to 20% at the end of the zone) and *Corylus* (30-40%) are also significant tree pollen types. Herb pollen taxa are relatively few in number and include Poaceae and *Succisa* continuously present at values of <2%, whilst there are occasional incidences of *Rumex* and *Dianthus* type. Cyperaceae declines throughout the zone (from 25% to a low of 3%) whilst *Sphagnum* remains at *c.* 20%. Some *Polypodium* and *Dryopteris* type spores are also recorded.
l.p.a.z. TR8: 1	This zone is delimited by percentages of *Betula* pollen up to 40%, Poaceae (30-40%) and *Filipendula* between 15-30%. Some *Pinus* pollen is present throughout whilst *Ulmus*, *Quercus* and *Corylus* pollen appears towards the end of the zone. Whilst herbs are

Assemblage Zone	**Palynological Characteristics**
100cm to 78cm Poaceae-*Filipendula-Betula* 78-79cm 8566±28 BP	dominated by Poaceae and *Filipendula*, other herb pollen types present include *Potentilla* type (to 5%), *Rumex* (to 7%), *Galium, Artemisia* and *Ranunculus* type, the latter at between 2-3% of the pollen sum. Marsh and aquatic taxa are dominated by *Myriophyllum alterniflorum* and Cyperaceae while *Typha angustifolia*/*Sparganium* type increase markedly at the top of the zone. Other (marginal) aquatic pollen includes *Menyanthes trifoliata* and *Alisma* type. *Sphagnum* reaches 25% in this zone and some *Dryopteris* type is also apparent.

Fig. 20. Pollen diagram for Transect 8, BH1.5



TR8 Borehol 1.5 Cont.



Archaeologically, this is typical of the early Mesolithic period which is concurrent with a radiocarbon date of 8566±28 BP at the top of the zone. The establishment of birch and drying of the site caused a sudden decline in the prevalence of grass and sedge pollen, an overall reduction in diversity of herb pollen coupled with a contraction in areas of freshwater, although areas of *Sphagnum* remained.

A long phase of alder carr woodland dominance is apparent on-site during l.p.a.z. TR8: 3. It was certainly growing on the site and along the valley bottom(s) as floodplain carr woodland with resulting high pollen values (to 80% sum + marsh & aquatic). This expansion of alder is generally thought to be *c.* 7000 BP and is often used as a marker to separate the early Holocene (late Boreal zone VI) from the mid-Holocene (Atlantic zone VIIa) (Godwin, 1956, 1975). However, based on the work of Chambers and Price (1985) it is very probable that the alder expansion from a glacial refugium lying to the west resulted in a much earlier expansion in North Wales than other areas of the country (see section 8.i.b.) below). That is, as early as 8,500 BP during the middle early Holocene, although at this site it dates to 6930±30 BP (Table 2). The continual presence of *Salix* (willow) pollen throughout this phase also suggests that willow co-existed with the alder carr. The site seems to have become increasingly drier during this phase as areas of *Sphagnum* reduce or disappear altogether and ferns become more dominant on areas of drier ground or as an understorey.

Towards the end of the profile (l.p.a.z TR8: 3), although alder carr is still locally prevalent, its growth was probably confined more to the drier edges of the site. The local environment became wetter as evidenced by a decrease in the number of fern spores and the increased number, albeit sporadically, of aquatic pollen types including macrophytes such as *Myriophyllum alterniflorum*, and marginal aquatic, *Sparganium* and/or *Typha angustifolia*. Acidification of the site and development of heathland is also notable as *Sphagnum* makes a recurrence and *Calluna* (ling) increases towards the end of the profile. The considerable opening of the woodland at this time, the late Neolithic/early Bronze Age, and increase in grass pollen suggests that areas close to the site are most likely being anthropogenically cleared, most likely for pasture (as indicated by the presence of *Plantago lanceolata* (ribwort plantain), *Rumex* (docks), *Potentilla* type (cinquefoil) and *Ranunculus* type (buttercups).

The surrounding vegetation

As with the autochthonous vegetation the longevity of this profile shows significant changes in the character of different woodland components and other habitats. More regionally, the profile indicates a relatively open environment in l.p.a.z. TR8: 1 with birch probably growing regionally as small stands or as open aspect woodland on drier developing soils. It was clearly also close to the site although, not as dense woodland. The pollen evidence suggests generally open conditions with heliophilous taxa including *Betula* itself and herbs *Filipendula* (meadowsweet, favouring damp soil), *Potentilla* (cinquefoil) and *Artemisia* (mugwort) and other Asteraceae types being typical of an open pre-boreal environment with remnant late-glacial herb communities remaining in more open, localised areas.

In l.p.a.z. TR8: 2, *Betula* woodland became important (dominant) near the site and possibly also growing in drier zones of the mire. At this time, there were also increasing amounts of other arboreal taxa which included *Pinus* (pine), *Quercus* (oak), *Corylus* (hazel) and *Ulmus* (elm). This phase represents a phase of highly dynamic biogeography with the progressive seral development of woodland during the early Holocene (Flandrian Ia/b; Boreal period) as taxa migrated from earlier refugia (see section discussion 8.2a. below).

Corylus (hazel) peaks at the start of TR8: 3 (64cm) in the later Mesolithic as it out-competes *Betula* to become a principal element of the woodland from 64-60cm. Subsequently, percentages of *Corylus* decline and mixed birch/oak/hazel woodland prevailed until 24cm, which is dated to the early Bronze Age. The incidence of pine pollen declines at the boundary between l.p.a.z. TR8: 2 and 3 which may be taphonomic due to the expansion of other tree pollen types. However, it is known that pine was out-competed at various times during the late Boreal and Atlantic periods and the reduction here is interpreted as an ecological change to greater dominance of broad-leaved tree communities.

L.p.a.z. TR8: 3 represents the maximum extension of Holocene woodland development within the region and is often associated with higher temperatures and greater humidity during the middle Holocene (Atlantic Flandrian II) from *c.* 7,000 to 5,000BP. Typically, for this region, *Quercus, Ulmus* and *Corylus* formed the dominant (?mixed deciduous) woodland. However, *Tilia* (lime/linden) is also present and became established in l.p.a.z. TR8: 3 (56cm) and its shade tolerant seedlings may have allowed it to grow under closed canopy conditions. *Tilia* is poorly represented in pollen spectra and the values here of just 2-3% here suggest that it was probably a constituent of the nearby woodland vegetation even though it was at its ecological limits. Thus, a woodland mosaic diagnostic of the mid-Holocene Atlantic period existed (Flandrian II) (Moore, 1977; Greig, 1982) from the late Mesolithic to the early Bronze Age in the region.

Latterly (l.p.a.z. TR8: 4), an elm decline is noted and in this case it is not suggested to be related to the Neolithic elm decline, traditionally dated to 5,500 to *c.* 5000BP, but to more recent anthropogenic clearance for agriculture, interpolated from the radiocarbon dates that would place the decline in the late Neolithic. In addition to the declining elm, are also reductions of *Quercus* and *Corylus* and increases of *Betula* (scrub regeneration?), *Calluna* (heath?) and herbs (Poaceae) to high values. Opening of the surrounding woodland landscape for agriculture gradually increased as this zone progressed, with evidence for habitats associated with mostly pastoral activity but with some arable elements as noted by the occasional occurrence of *Cereal* type pollen. With potentially the last four thousand years contained within the top 20cm of the profile and just one sample every four centimetres we have insufficient resolution to consider these latter changes within any chronological sequence.

Cefn-coch-isaf, Cwmystradllyn, Garndolbenmaen, Gwynedd

Prospection Transect 10 was laid across an area of wet flush at the base of a tree covered scarp just west of Cefn-coch-isaf (Fig. 21) in Field 54 (McNicol *et al* 2017). A stream runs through the flush and at the time of the survey the ground was wet. Six survey auger holes were laid out between GR 254020.419 342539.945 and GR 253993.907 342524.471 and BH2 was selected for coring (Rackham 2015). The hand auger recorded a 105cm sequence and was stopped by stones at the base, but the 100mm diameter core had recovered only 88cm before it was stopped by stones, but its ground surface was a little lower than the hand auger hole.

Fig. 21. Transect 10 – wet flush and tussocky ground below a small scarp to the right of the picture. The hand auger holes are red flagged and BH2 is the farthest but one.

Fig. 22. Transect 10, BH2, core (top at 139.57m OD)

0-3cm dark brown fibrous peaty turf
3-25 very dark greyish brown (10YR 3/2) fibrous humified peat

25-45 very dark greyish brown (10YR 3/2 patches of 3/1) fibrous humified peat – small stone at 37cm

33-34 1190±30 BP – *766-898 (89%), 924-945 (3.5%) & 722-740 (2.9%) cal AD*

45-88 dark brown (7.5YR 3/2) very moist fibrous humified peat, oxidising on exposure to air
49-50 1780±30 BP – *137-334 cal AD (95.4%)*

85-86 2318±29 BP – *415-357 (90.7%), 284-253 (4%) & 246-236 (0.7%) cal BC*

Pollen samples taken at 4-88cm at 4cm intervals

The ground is very uneven, falling slightly to the north, tussocky and wet at the time of augering, with peats underlying the turf, and only suitable for summer grazing. 0.8 metres of peat were recovered in the core (Fig. 20) at GR 254013.449 342535.894. The site lies on siltstones of the Nant Ffrancon subgroup (http://mapapps.bgs.ac.uk/geologyofbritain/home.html?) with superficial deposits of peats overlying Devensian diamicton (till). The soils are wet slowly permeable acid upland soils with surface peats (http://www.landis.org.uk/soilscapes/). Organic sediment from the base of the sequence (85-86cm depth) has been dated to the middle Iron Age while an early medieval date has been obtained on organic sediment at 33-34cm depth (Table 2; Fig. 22).

The base of the core (85-86cm depth) comprises very moist fibrous humified peats dating to the middle Iron Age (Table 2; Fig. 22), with the sequence of fibrous humified peats above including horizons dated to the Roman and early medieval periods at 49-50cm and 33-34cm respectively (Table1; Fig. 22). The upper 30cm includes the medieval and post-medieval periods.

Pollen analysis *(Rob Scaife and Catherine Langdon)*

The seventeen fibrous peat samples presented for pollen analysis derive from a peat filled stream hollow (139.5 OD) lying below a wooded scarp. A date of 2318±29 BP (SUERC-60015, Table 2) at 85-86cm places the lower peat accumulation in the middle Iron Age. Pollen data are presented in Figure 23 in which a number of palynological changes in the profile are defined as local pollen assemblage zones. These are characterised in Table 9 below. In general pollen was well preserved and abundant. The pollen data can be viewed in terms of the on-site vegetation and pollen representing the surrounding area of the site and in some cases from more regional sources. These aspects are discussed below.

Assemblage Zone	Palynological Characteristics
l.p.a.z. TR10: 3 34cm to 24cm *Betula-Corylus avellana type-Salix* 33-34cm 1190±30 BP	TR10: 3 has been defined by an increase in both *Betula* (35% at 28cm) and *Corylus* (to *c.* 22%). *Salix* also rises to 10% during this zone. Other trees and shrubs present include *Quercus*, *Ulmus*, *Fraxinus*, *Ilex* and *Calluna*, with the occasional occurrences of *Pinus*. Herbs include *Ranunculus* type, (3%), *Plantago lanceolata* (5%) *Filipendula* (2%), *Potentilla* type (2-5%), Apiaceae (2%) and *Rumex* (2-4%). Other herb taxa include *Centaurea nigra* type, *Galium* and *Cirsium*. Poaceae decline to 25% at 28cm but recovers to 45% at the end of the zone. *Alnus* and Cyperaceae remain at 3% and 6-7% respectively whilst fern spores are dominated by *Dryopteris* type (to 20%) with fewer *Pteridium aquilinum* and *Polypodium* spores recorded.
l.p.a.z. TR10: 2 50cm to 34cm Poaceae-*Dryopteris* type 49-50cm 1780±30 BP	Characterised by increased percentages of Poaceae from TR10: 1 (to 60%) and *Dryopteris* type spores rising to 40%. Trees and shrubs remain at relatively low percentages with *Betula* (<5%), *Quercus* (to 10%) and *Corylus* (10%) appearing. *Fraxinus*, *Ulmus*, *Erica* and *Calluna* also feature to a lesser extent. *Potentilla* type and *Plantago lanceolata* reach *c.* 8%, whilst *Cereal* type, *Ranunculus* type, *Filipendula*, *Rumex*, *Myosotis*, *Succisa* and Lactucoideae are a continual low-level presence. Cyperaceae (5%) and *Alnus* (<5%) feature as part of the marsh assemblage with some *Salix* and *Hydrocotyle* also recorded. Some *Pteridium aquilinum* and *Polypodium* is present (<3%) and a very few *Sphagnum* spores.
l.p.a.z. TR10: 1 88cm to 50cm *Calluna*-Poaceae 85-86cm 2318±29 BP	This basal zone is delimited by levels of *Calluna* up to 20%, whilst Poaceae gradually increases from 40-50% as the zone progresses. Trees and shrubs recorded include *Betula* (up to 7%). *Quercus*, (up to 15%), *Ulmus*, *Fraxinus* and *Hedera helix*. *Corylus* percentages decline sharply from 35% at the start of the zone and then remain at *c.* 7% throughout. The most abundant herbs types include *Potentilla* type and *Plantago lanceolata* (both to *c.* 8%). *Rumex*, *Ranunculus* type and *Succisa* (to 7% at the end of the zone) are also significant components of the herb assemblage. Other herbs recorded include *Cereal* type (<2% at 80cm and 52cm) *Myosotis*, *Artemisia* and Lactucoideae amongst others. Cyperaceae dominate the marsh and aquatic taxa but declines from 40% at 64cm to 10% by the end of the zone. Some *Alnus*, *Salix*, *Hydrocotyle vulgaris* and *Typha*/*Sparganium* are also recorded. Small numbers/percentage of fern spores are present, whilst *Sphagnum* spores are variable in number ranging from 5% to 60%.

Table 9: Pollen zonation and details of Transect 10; Borehole 2

The pollen data can be viewed in terms of the on-site vegetation and pollen representing the surrounding area of the site and in some cases from more regional sources. These aspects are discussed below.

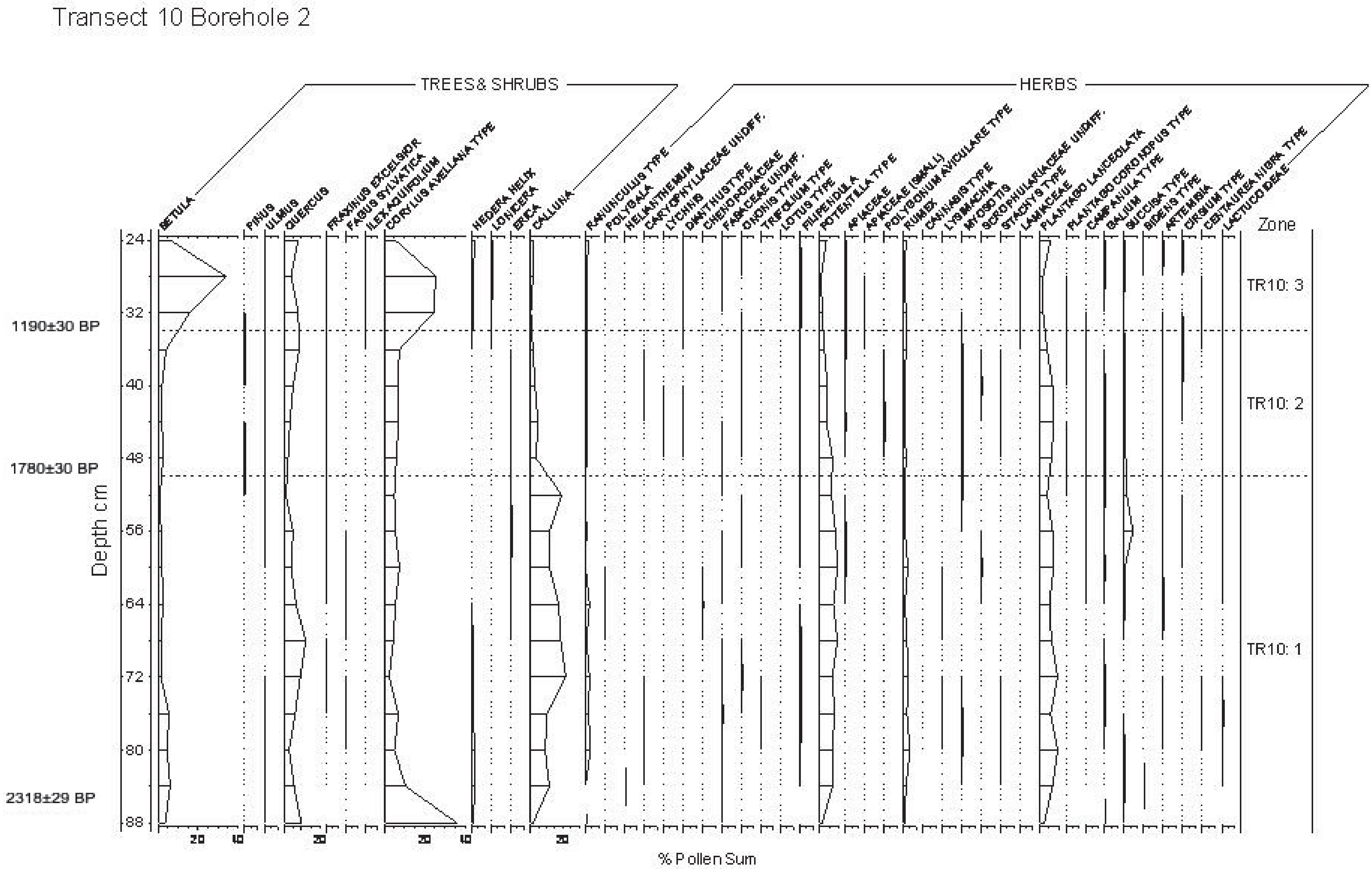
On-site habitat change

The on-site habitat was dominated by Poaceae (grasses), Cyperaceae (sedges) and *Calluna* (ling) in the initial zone with considerable amounts of *Sphagnum* also present; particularly in the initial phases of the zone (from 88-76cm up to 40% and a peak to 60% at 60cm). This suggests that areas of wet of grass/sedge fen were present on-site and that areas of *Sphagnum* were also important in suitable habitats. It is probable that the environment was generally nutrient rich and *Sphagnum* here may have been of the less acid, more mesotrophic to neutral spectrum (*cf. S. subsecundum, S. recurvum, S. palustre*). *Hydrocotyle* (water pennywort) and *Sparganium* (bur-reed) also attest to areas of slow flowing water or those of a lacustrine nature.

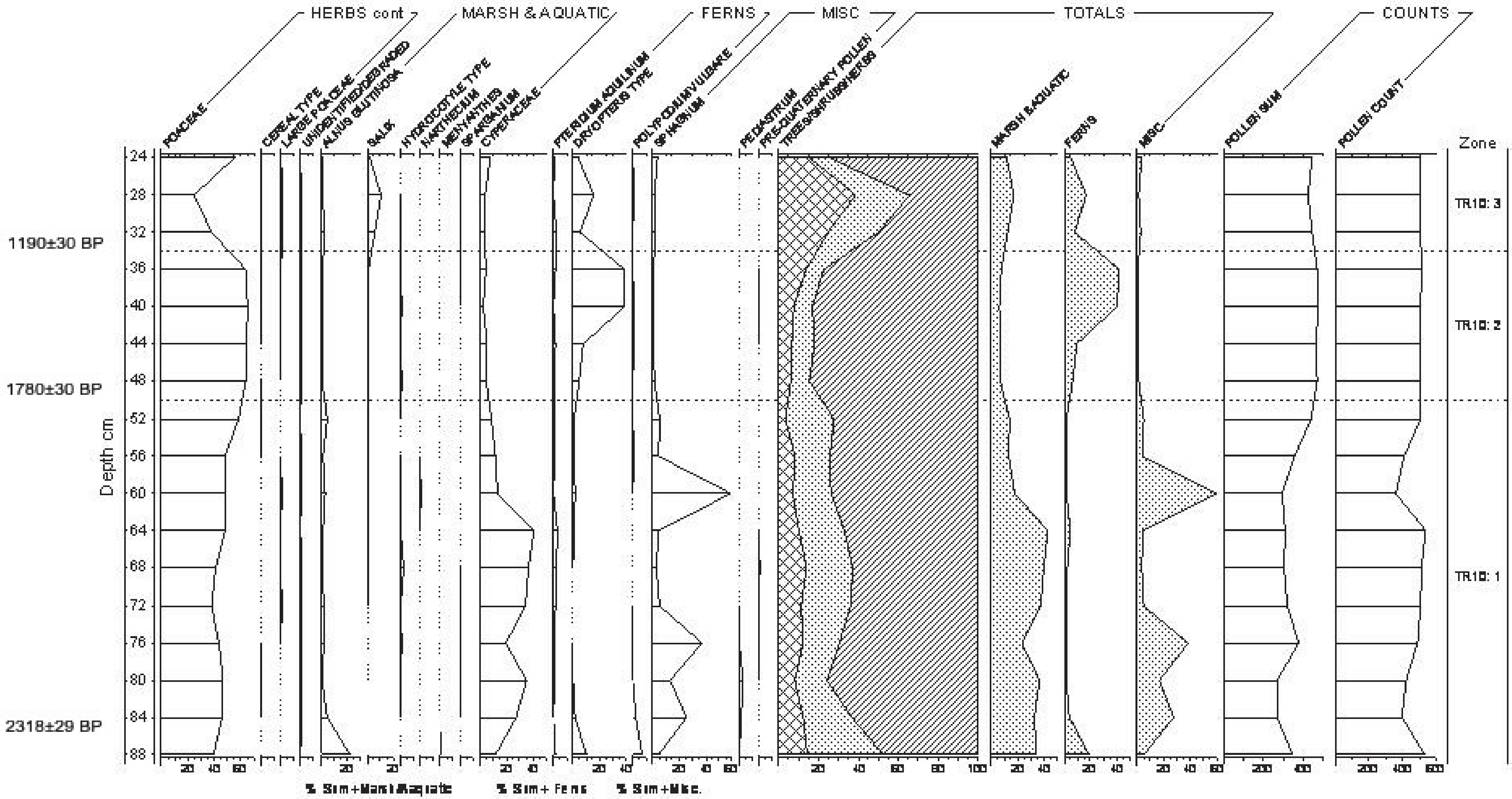
The development of heathland on-site in l.p.a.z TR10: 1 probably occurred following clearance of earlier woodland which resulted in the deterioration and podsolization of soils thus providing ideal edaphic conditions for the expansion of *Calluna*. However, a marked change in the local environment occurred and is apparent in TR10: 2. Here, *Calluna* and Cyperaceae pollen values decline and numbers of *Dryopteris* type spores increase markedly. This appears to indicate drying of the site, although *Hydrocotyle* (water pennywort) and some *Typha*/*Sparganium* type (bur-reed and/or reed mace) at the end of the zone would also indicate some pockets of wetness/damp ground remained at times.

By TR10: 3 trees and shrubs are starting to encroach onto the site. High values of *Salix* would indicate that it was growing *in-situ* perhaps as willow carr/floodplain woodland (Salicetum) and it is most likely that *Corylus* (hazel) and *Betula* (birch) encroached onto, or near the site as drier conditions prevailed. Willow (*Salix*) is a very low pollen producer and even small numbers of its pollen can indicate local presence.

Fig. 23. Pollen diagram for Transect 10, BH2



TR10 Bh2 Cont.



The surrounding vegetation

The pollen record indicates that the area surrounding the borehole was quite open, with high percentages of grass throughout most of the profile. It is likely that mixed birch, oak and hazel woodland was growing more regionally in small pockets of the landscape with a small amount of *Fraxinus* (ash), *Fagus* (beech) and *Hedera* (Ivy) also present. The major phases of woodland clearance had already occurred by the start of the profile, with the tail of the latest phase of clearance perhaps just visible in the middle Iron Age deposits at the base of the sequence (88-76cm). By the mid-late Roman period *Quercus* and *Betula* pollen levels are at their lowest (Fig. 23). Whilst it is clear that grazing was prevalent throughout the time-span covered by this profile, as indicated by *Rumex* (2-4%), *Plantago lanceolata* (10%) and *Ranunculus* type (2-5%) (docks, ribwort plantain and buttercups amongst others), some arable farming was taking place in the surrounding region. This is evidenced from the occasional *Cereal* type pollen grain and large grasses which may derive from cereals. The whole of TR10: 1 has a heath element with *Calluna* which declines in the latter half of the Roman period. The first seven centuries of the 1st millennium AD appear to be characterised by a pastoral landscape, with traces of cereal pollen suggesting some arable.

More latterly in the profile (l.p.a.z. TR10: 3), birch and hazel encroach closer to the site from the 8-9th century AD, inferred from increases in pollen percentages to 30% and 25% respectively, perhaps as a result of decreased anthropogenic activity in the region. Decline in herbs associated with pasture may indicate that there was reduced grazing in the vicinity of the site resulting in the scrub colonisation noted. However, by the end of the zone, pollen types indicative of pastoral activity have again increased somewhat as the landscape started to open up again. That is, perhaps, as a result of a resurgence of human activity in the local area later in the medieval period.`

The Holocene vegetation history from the early Mesolithic to the present.

The pollen assemblages from these borehole sequences have a complex taphonomy with pollen coming from a variety of different sources at different distances from the sample sites. As such, the data at its most fundamental level can be interpreted in terms of the pollen which derives from the on- and near site wetland habitat which has afforded anaerobic conditions and organic accumulation (the autochthonous component) and, that pollen which derives from the drier terrestrial zone both near and far. These aspects are discussed.

Holocene mire development

All of the profiles examined in this project are taken from topogenous mires. As such, these communities/habitats have been largely controlled by the height and fluctuations in the ground water table but have remained waterlogged throughout their history giving anaerobic conditions suited to pollen preservation. Overbank flooding, especially during the winter, may also have played a role in the maintenance of the floodplain habitats. Unlike ombrophilous/ombrogeneous mires and upland blanket peat bogs which are controlled by precipitation and have low nutrient status, the sites here are for the most part fens with higher nutrient status and neutral to alkaline pH. These may be defined as rheophilous/rheotrophic valley fen mires (Moore and Bellamy 1974). The eutrophicated status is reflected by the dominance of rich and dominant alder fen carr woodland in evidence in the majority of analyses undertaken here. This stable, generally linear to rivers and streams flood plain, fen carr existed in balance with stable interfluve woodland such that the ground water table was for the most part stable and within the ecological tolerances of this (carr) community. As a semi terrestrial habitat, being damp and highly biologically active in the growing season, alder will tolerate up to three months of water logging during the winter months, largely caused by overbank flooding from rivers or streams (Tansley 1939). If this is exceeded, such water logging may cause the demise of this vegetation community/habitat and instigate a negative hydroseral succession resulting in change to wet herbaceous grass-sedge fen if local ground water is eutrophic or, if acid, a pathway to a more acid, *Sphagnum* dominated community may occur. The process of change may be complex with the possibility of differing seral stages (Walker 1970). Both circumstances have been observed in this study and, typically, changes in mire status may be attributed to human activity with woodland clearance for agriculture affecting the hydrological status of the sites. Removal of trees from the interfluves was responsible for a raised ground water table through reduction in evapotranspiration and increased surface water run-off to the valley bottoms and topogenic depressions which supported stable carr woodland.

Sites in this study embrace a range of such topogenous basins. Transects TR1, TR2 and TR3 comprise a generally flat upper floodplain (Fig. 2) along the lower valley side of the river Afon Dwyfor and its tributary the Afon Henwy, but at a higher elevation than the lower and active floodplain. These are currently boggy areas existing due to a perched floodplain. Tr5 and Tr6 are a group of peat deposits, which are perched on the side of tributary stream valleys and small basins (Fig. 12). That is, at a higher altitude than the lower floodplain habitats. Tr8 is a peat developed (perched) on the side of a small tributary above a scarp on the valley side to the north (Fig. 18). This is marginal land but flat and in closest proximity to areas of remaining medieval ridge and furrow. Transect 10 is more anomalous being an extremely wet site at the base of a scarp and is probably a stream and spring fed mire of some 100m length/extent (see above Fig. 21).

Rackham (pers. com.) suggests, based on their topographical position, that Transects 1 to 3 and 8 were most likely to have been subject to human interference at an earlier period than the other sites. Followed by Transects 5 to 6 and finally Transect 10. The ecological status of the latter has, however, been found to differ significantly from the other sites. Increased human activity is clearly associated with the changes in mire status and episodes of woodland clearance are recorded in the late Bronze Age, early, middle and late Iron Age, the Roman and medieval periods. These phases of late prehistoric and historic mire change are detailed in Table 10 below.

Early post-glacial mires

At present, only TR8 (BH1.5) provides data pertaining to the early Holocene (pre-Boreal and Boreal; Flandrian Chronozone 1a-c). This clearly shows the effects of climatic change at the close of the Devensian stadial which resulted in increased wet conditions through permafrost melt and, as fluvial systems became established. Whilst *Betula* became dominant on drier and developing soil, *Salix* (willow) colonised the wetter valley bottoms as willow carr/floodplain woodland (Salicetum) became established prior to the later arrival of *Alnus* (alder) (l.p.a.z. TR8: 1) around 7000 years BP. This *Salix* dominated woodland appears to have fringed a slow flowing stream or lacustrine habitat which supported a flora rich in aquatic macrophytes including *Myriophyllum alterniflorum* (water-milfoil), *Nymphaea* (white water lily), *Potamogeton* type (probably pond weed). This was fringed by rooting marginal aquatic taxa with Cyperaceae (sedges), (probably a proportion of) Poaceae (grasses), *Typha angustifolia/Sparganium* type (bur reed and/or reed-mace), *Menyanthes trifoliata* (bog bean), *Alisma plantago-aquatica* (water plantain) and on damp soil by *Filipendula ulmaria* (meadow sweet). The aquatic environment is also evidenced by algal *Pediastrum.* The richness of this aquatic and marginal aquatic flora may be attributed to nutrient rich ground water from springs and overland flow on poorly developed soils. Areas of *Sphagnum* were also important at this time and it is probable that as the environment was generally nutrient rich the *Sphagnum* here may have been of the less acid, more mesotrophic to neutral spectrum (*cf. S. subsecundum, S. recurvum, S. palustre*).

With the establishment of woodland on the interfluves, the habitat (especially the soils) will have become stabilised and evapotranspiration will have increased. Both factors will have had the progressive effect of lowering the ground water table and affecting surface run-off such that the basin became drier. Here, the consequence was the end of the lacustrine habitat. *Salix* (under represented in pollen spectra) and some herbs (*Caltha, Succisa*, Cyperaceae; ferns?) and *Sphagnum* remained in this drier habitat. Due to climatic, eustatic changes and the continued dynamic vegetation/seral succession, *Alnus* arrived and became established and dominant in the valley bottoms, on valley sides and in spring-line situations (8.3 below).

Transect/ Borehole	At Depth	Vegetation character	Date
TR1 BH5	26cm	Extensive heathland development and grassland/pasture. Some (small) Sphagnum increase.	Mid Iron Age
TR1 BH5	46cm	Increase of Sphagnum and Cyperaceae with declining Alnus	Early to mid Bronze Age
TR2 BH3	34 cm	Alnus declined. Expansion of Poaceae and Plantago lanceolata.	Early Iron Age
TR3 BH2	36cm	Change from Cyperaceae fen to Acidophilous Sphagnum	Roman
TR3 BH2	58cm	Alnus to Poaceae-Cyperaceae Fen	Late Iron Age?
TR5 BH1	26cm	Some development of Sphagnum (with Cyperaceae) associated with increased human activity.	Early-middle Iron Age
TR5 BH1	54cm	Some reduction of Alnus and increasing herb fen with Poaceae and Cyperaceae. Increased Salix. Evidence of human activity.	Early Neolithic
TR6 BH3	46cm	Decline of Alnus and some expansion of Poaceae-Cyperaceae fen with minor incursion of acidophilous Sphagnum.	Early Iron Age
TR8 BH1.5	22cm	Declining Alnus and increase of Poaceae, Cyperaceae, Sphagnum and Calluna.	Early Bronze Age
TR8 BH1.5	46cm	Cyperaceae and Sphagnum start to expand. Alnus dominant	Late Mesolithic/early Neolithic?
TR10 BH2	34cm	Woodland regeneration at top of profile. Salix growing on-site.	Early medieval
TR10 BH2	50cm	Little Alnus throughout. Declines of Sphagnum, Cyperaceae and Calluna. Drying out and fern growth.	Roman

Table 10: Depths of changing mire status for sites examined and their date.

The middle Holocene establishment of Alder carr

There is a long history of alder carr woodland (valley fen woods of Tansley 1939) in this region/at a number of these sites. Where alder (*Alnus glutinosa*) remained at these sites, it is probable that we are looking at the last vestiges of a natural habitat which extends back to the beginning of the middle Holocene period; that is, the Atlantic, Flandrian II or earlier. Alnetum was present with various levels of dominance in the pollen record here, being a function of the size/extent of the carr woodland and density due to other factors. Thus, percentages to as high as 90% (of the pollen sum + marsh/aquatic taxa) are recorded for profiles TR1 (l.p.a.z. 1), TR2 (l.p.a.z. 1), TR5 (l.p.a.z. 1), TR6 (l.p.a.z , TR8 (l.p.a.z. 3), reflecting the importance of this habitat in the environment during the late-prehistoric period.

Transect 8, BH1.5 dates back to the early Holocene (late Fl Ia to Fl Ic at *c.* 9,800BP and as such provides a long record of mire change including a major expansion of Alder at the l.p.a.z. TR8: 2/3 transition, dated to about 7000 years BP. Throughout Britain, this event has generally been used to mark the transition from the Boreal (Fl I c) to the Atlantic (Mangerud *et al*. 1974; Fl II) period. This was especially so in Godwin's' dating scheme (Godwin 1940, 1956) (now shown to be asynchronous and superseded by radiocarbon measurement) when it is usually equated to increased rainfall and humidity in response to rising sea level and separation of Britain from continental Europe. This afforded widespread conditions suited to the migration and establishment of alder communities along coastal fringes and extending along valley bottoms, to give ribbons of floodplain carr woodland; the Alnetum glutinosae (Tansley 1939, 460-471; 1953).

In Transect 8 BH1.5, small numbers of alder pollen in l.p.a.z. TR8: 2 reflect the progressive migration of alder along the valleys prior to its arrival within this region and on-site. This is in accord with the very high pollen productivity and anemophily of alder which facilitates its widespread dispersal and representation as a long distance and more regional pollen element in many pollen sequences. This first occurrence of alder in l.p.a.z. TR8: 2 (not growing on-site) occurs before 8600 years BP and its later on-site growth and dominance began around 7000 years BP. It is probable that alder was present in a western refugium during the Devensian, just as *Corylus* was for NorthWest Scotland. This allowed/caused a much earlier expansion into the region than described for most of the British Isles. This appears to be the case at Moel y Gerddi, Ardudwy near Harlech where *Alnus* was present from *c.* 8465 BP (Chambers and Price 1985) and in the Nant Francon Valley at 8450±150 BP (Q-898) (Hibbert and Switsur 1976). The geographical variation and asynchronous *Alnus* expansion has been discussed in detail by Chambers and Price (1985). There has been no subsequent detailed appraisal of this problem/question. The major expansion to dominance (l.p.a.z. TR2/3) in Tr8 occurred at the time often described as the Boreal to Atlantic transition.

Tansley (1939), McVean (1953, 1956) and Bennett and Birks (1990) provide an ecological description and the Holocene history of this community. Due to the high pollen productivity of *Alnus* (Andersen 1970, 1973), absolute numbers of pollen are very high in some samples. This necessitates consideration during interpretation of the pollen spectra because of within sum, statistical skewing of the other pollen percentages (Janssen 1969; see appendix 1). Furthermore, the density of the woodland during the summer creates a still microclimate within the carr community which, along with foliage density, may inhibit pollen from the adjacent terrestrial plant communities/zone (Tauber 1965, 1967a, 1967b).

Once arrived, alder was clearly very important or dominant in topographically suitable areas as discussed above. Transect 5 BH 1 dated at 5656±29BP (l.p.a.z. TR5; 2) along with TR8 BH 1.5 (l.p.a.z. TR8: 3) noted above, demonstrate that alder had become fully established during the middle Holocene (Flandrian II; Atlantic) and subsequently remained during the later prehistoric period as seen in TR1 (BH5) where it remains dominant until the later Neolithic and TR2 (BH3) where it falls during the later Bronze Age. The latter sites have basal dates of 4671±26 BP (Suerc-60022) and 4,930±29 (Suerc-60023) respectively, showing the continued importance of Alder carr through the Neolithic period at these sites and up to the late Bronze Age at Tr 2. This importance existed until decline caused by wetter conditions, probably a function of human activity (and climate?), occurred during the later prehistoric period (see Table 10 above). In most of the sites examined here, the final decline of alder appears to be late prehistoric, although post-Roman in Tr3. However, studies by Chambers and Price (1985) discussed similar alder demise and showed dates at one site of 3715±70BP (CAR-641) and at 1665±60BP (CAR-660).

Other diagnostic taxa associated with the Alnetum have been recorded in the pollen record providing a useful ecological record for these taxa. Small numbers of *Salix* (willow) being a poorly represented pollen taxon (Andersen 1970, 1973) but present in most of the profiles was a constituent of the carr. This may also apply to *Viburnum* (wayfaring-tree) and *Betula* (birch). The latter is enigmatic, as it may have been a woodland constituent of woodland/scrub on adjacent interfluves and/or a major component of drier areas of the floodplain carr. This is thought to be a possibility for pollen zones (TR6: 1) in Transects 6, BH3 which have high *Betula* pollen values.

Other taxa include golden saxifrage (*Chysosplenium oppositifolium*). marsh pennywort (*Hydrocotyle vulgaris*), marsh marigold (*Caltha palustris), Typha angustifolia* and/or *Sparganium* (lesser reedmace and/or bur reed), *Osmunda regalis* (The Royal Fern) and importantly, Cyperaceae (sedges). The latter, although not identifiable to genus or species from pollen may, include the typical tussock sedge, *Carex paniculata* which is common to such habitats/communities.

The transition to Sphagnum and acid conditions

It has been noted that the Alnetum community type represents some stability and equilibrium over a long time period during which the fluves were stabilised by woodland; here, oak (*Quercus*) and hazel (*Corylus*). With human activity, woodland clearance for agriculture, the equilibrium was disturbed resulting in increased wetness and changes in wetland/mire habitats. Six of the seven profiles examined show a marked change from the Alnetum to a more acid, bog environment. Profile TR10 BH2 (Figure 23), however, appears to have had a longer phase of acidophilous vegetation with dry heathland and wet *Sphagnum* bog growing on and in close proximity to the sample site. In the former, the change to more acidophilous vegetation is seen in pollen figures 11, 15, 17 and 20 where there is a clear association with the expansion of anthropogenic pollen indicators which include taxa of arable and pastoral affinity. It is probable that woodland clearance was accompanied by soil deterioration and, on such acid substrates, surface water run-off and ground water will have become important controls. Although this change is seen in all of the profiles, there are differing degrees of change. Thus, for example, there is a clear change in TR3 BH5 (l.p.a.z. TR3: 2/3) and TR8 (l.p.a.z. TR8:3/4) whereas in TR5 BH1 (l.p.a.z. TR5 3/4) and TR6 BH3 (l.p.a.z. TR6: 1/2) although *Sphagnum* peaks, the numbers of this and other taxa are fewer. It is also clear that alder remained important in the areas around the developing *Sphagnum* community. That is, in remaining drier areas outside of the influence of acid ground water and surface run-off. The incidence of *Sphagnum* development is detailed in Table 10 (above). The dating evidence indicates expansion of *Sphagnum* in the Mesolithic in TR8, the Neolithic in TR1 and TR2, the Bronze Age in TR1, TR2 and TR8, the middle Iron Age in TR3, TR5, TR6 and TR10 and Roman and later in TR3. These dates suggest some synchronicity with events in the Neolithic, Bronze Age and particularly the middle of the first millennium BC but whether reflective of climate or an asynchronous series of events caused by increased need for agricultural land is uncertain. Whilst a purely anthropogenic causation has been invoked for these changes, it may also be considered that there may have been a climatic cause. That is, a change to wetter conditions; such as the climate worsening in the Sub-Boreal period. Although the changes described are associated with evidence of agricultural expansion, the more open aspect of the mires would have resulted in taphonomic changes whereby pollen was able to ingress the sites more easily than under closed Alnetum. Anthropogenic causation for the acidification, with possible climatic implications, seems most plausible.

Transect 10 BH2 is interesting and differs from all of the other sites in providing evidence of the longevity of a zone of dry and wet heath with *Sphagnum.* The locality of TR10 is at the floor of a scarp and is a probable spring line bog which today is extremely wet and has woodland growing above. The acidity of this site and it's vegetation is probably due to acid ground water which feeds this mire bog back to at least the middle Iron Age period dated at 2318±29BP (SUERC-60015). As noted in section 7 above, the basal levels at this site have higher values of *Corylus avellana* type, a category which may include bog myrtle (*Myrica*), it is, however, probable that the former represent the last vestiges of woodland which existed on-site. Subsequently (l.p.a.z. TR10: 2), *Calluna*, *Potentilla* and possibly *Rumex* were important locally as dry heathland whilst typically very variable *Sphagnum* shows dominance on-site. Atypically for this study, this phase of acidophilous vegetation shows subsequent woodland regeneration in the early medieval period probably on the areas of previously drier heath.

The changing vegetation of the terrestrial zone

The seven profiles examined span the whole of the Holocene period and possibly back into the Late Devensian stadial (i.e. pre *c*.10,000BP). Thus, a complete picture of the development of the Holocene vegetation and environments is possible (Table 11 – the studied sequences in this report are highlighted). Here, the earliest sequence of Transect 8 BH1.5 dates to the early Holocene Flandrian Chronozone 1a (latter part) at an estimated age of *c.* 9,800-9,500 BP. Subsequently, seral vegetation changes can be seen for the early Holocene (Flandrian Ib an Ic). Transect 5 BH1 probably also has a similar temporal range and the base of Transect 2 BH3 is early Mesolithic. However, Transects 2 and 5 have only been analysed down to the early Neolithic and the late Boreal Flandrian Ic respectively, the latter with a date of 5656±29BP (SUERC-60024) which places this archaeologically in the late Mesolithic. These two profiles (TR5 and TR8) and TR1 BH5 and TR2 BH3 provide data on the character of the subsequent Neolithic and Bronze Age vegetation and environment. In the case of TR5 BH 1, a possible Neolithic Elm decline at *c.* 5,500-5,000 BP (Smith and Pilcher 1973) is seen (38.2c below). All of the sites examined span the last two millennia from which useful data on the land use changes of the historic period can be gleaned, although only TR2 BH3, TR3 BH2 and TR10 BH2 have dated sequences that can be confidently tied to the Roman or medieval periods.

Table 11. Broad periods contained within each core. (studied profiles highlighted)

X- dated part of the sediment sequence; '-' periods potentially contained within the undated top of the sequence

	TR1	TR2	TR3	TR5	TR6	TR8	TR10
Post-med	-	-	-	-	-	-	-
	-	-	-	-	-	-	-
Med	-	X	-	-	-	-	X
	-	X	X	-	-	-	X
Roman	-	X	X	-	-	-	X
	-	X	X	-	-	-	X
LIA	X	X	X	-	-	-	X
	X	X	X	X	X	-	X
MIA	X	X	X	X	X	-	X
	X	X		X	X	-	
EIA	X	X		X	X	-	
	X	X		X	X	-	
LBA	X	X		X	X	-	
	X	X		X		-	
MBA	X	X		X		-	
	X	X		X		-	
EBA	X	X		X		-	
	X	X		X		X	
Neo	X	X		X		X	
	X	X		X		X	
LMeso		X		X		X	
		X		X		X	
Meso		X		X		X	
		X				X	
EMeso		X				X	

The early Holocene (c. 9,800- 7,000 BP)

Transect 8, BH1.5 dates to the early Holocene Flandrian Chronozone Ia at its base (l.p.a.z. TR8: 1). This is confirmed by a radiocarbon date of 8566±28 BP (Suerc-60018) at 78-79cm in the profile. Archaeologically, this equates to the early Mesolithic period. At the base of the profile (l.p.a.z. TR8: 1), there is a phase of important, pioneer and successional birch (Betula) woodland which became established after the close of the last (Devensian) glacial period at c. 10,000BP (Birks 1989). Although not seen in the pollen profile, it is probable that an earlier phase of Juniper (Juniperus) spread occurred as the initial phase of early post-glacial seral changes from pioneer taxa (heliophilous trees/shrubs and remnant herb communities) to woodland trees. However, Filipendula is important here and is diagnostic, often being associated with the Juniperus peak (Iversen 1954, 1960). Such seral changes can be seen here in l.p.a.z. TR8: 2 with the incoming of oak (Quercus), elm (Ulmus) and hazel (Corylus) in Flandrian Ib due to their slower migration rates. Subsequently, they became dominant in Flandrian Ic (upper TR8: 2). Pine (Pinus), is present in this zone dating from c. 8,500BP representing the progressive migration across Britain from the South East of England during the early Holocene (Bennett 1984; Birks 1989). Here, the arrival time appears to have been during the late early Holocene (Fl Ib). This may provide a useful datum for its asynchronous spread across the country and region and is of use to isopollen plots. Overall, the pollen from the lower levels/zones of TR8 reflects the extremely dynamic vegetation and environmental changes occurring at this time; the early post-glacial period. That is, the progressive replacement of open herb communities which remained from the Devensian cold stage to the progressive development of dominant deciduous woodland.

The middle Holocene (c. 7000-5000 BP)

A sharp expansion of alder (Alnus) in TR8 at c. 66cm is a clear indication of its migration and establishment in suitable habitats and dates to around 7000 BP. This was, as noted in section 8.1b above, a function of increased humidity/wetness caused by eustatic changes with rising relative sea level, the separation of Britain from mainland Europe and a coastal fringe in approximately the same position as today. Such dramatic expansions of alder as seen here, were, prior to radiocarbon dating, taken as the typical zone boundary between Godwin's (1940, 1956; 1975) pollen zone VI (late Boreal) and pollen zone VIIa (Atlantic) periods. Whilst this was clearly an asynchronous event in the light of absolute dating/chronology and possibly earlier colonisation in this region (see section 8.1b. above), it never the less remains a useful broad datum event marking the broad start of the middle Holocene. That is, a period of stability and maximum development of natural woodland both geographically and attitudinally prior to the first undisputed evidence of human interference with the natural climax woodland at c. 5,500 to 5000BP; the Neolithic.

Transect 5 BH1 (l.p.a.z. TR5: 2) and TR8 BH1.5 (l.p.a.z. TR8: 3) both illustrate the character of this climax woodland. Oak (Quercus), hazel (Corylus) and elm (Ulmus) were the dominants growing on drier soils, whilst alder (Alnus) a carr woodland occupied the upper floodplain locations of the Afon Dwyfor river and its tributary the Afon Henwy. Pine (Pinus) also remained in the landscape at low levels. The numbers of Pinus pollen in zones TR8: 3 and TR5: 2 are more important than seen in the pollen diagrams (Figures 20 and 15). This is because their numbers are swamped by high values of both Quercus and Corylus. After arrival during the early Holocene, pine probably retained a stronghold on localised areas of acid soils (river terrace gravels?) into the middle Holocene (Atlantic).

Sporadic records/occurrences of lime/linden (Tilia) and ash (Fraxinus) are more enigmatic. The former (Tilia) formed the dominant woodland element of southern and Eastern England during this period (1980, 2003, 2000; Greig 1982; Moore 1977). It is a tree (probably Tilia cordata) of more continental affinity and the region of study falls outside of this and marginal to its ecological range at this time. Pollen here is well preserved and is thus thought to derive from local growth. This is also likely considering the density of the vegetation on and around the peat basin which will have inhibited the pollen input to the mire. Furthermore, Tilia produces small numbers of entomophilous pollen during the summer months when all trees are in full leaf. These factors combine to make its pollen very under-represented in any pollen assemblages unless growth is in close proximity to the sample site (Andersen 1970, 1973) as suggested here.

Archaeologically, the middle Holocene equates with the late Mesolithic. For both the early Holocene post-glacial and the late Mesolithic evidence of any impact of these hunting and foraging, transient communities on such dominant vegetation is not likely to be seen in the lowland zone even though peoples were probably present.

Neolithic influences ? (c. 5,500-5,000BP to 4,000 BP)

The depths of the peat are shallow given the time span involved back to the Neolithic period. Peat cutting is not thought to have occurred which would have truncated the profile. The apparently compacted sequences here are due to the highly humified/detrital nature of the peat which accumulated under the very biologically active alder carr. It can be noted that radiocarbon dating has indicated evidence of the Neolithic at such shallow depths of 64cm in TR2 and TR7 at 48cm (Table 2) and constricted profiles of such character are seen elsewhere (Scaife 1980).

The Neolithic Elm Decline**:** In TR5 BH1 at c. 52-54cm (l.p.a.z. 2/3 boundary), there is a marked decline in elm (Ulmus) pollen from 7-8% to only sporadic occurrences. This decline is accompanied by the first main and consistent occurrences of ribwort plantain (Plantago lanceolata), Cereal type pollen (top of l.p.a.z. TR5: 2) and a greater diversity of herbs and dates to 4860±30 BP, the early Neolithic (Table 2).

These are, of course, attributed to agricultural activity and characteristic of the Neolithic Elm decline. The causes of this broadly synchronous event (Smith and Pilcher 1973) have been much discussed and attributed to many causes. Prior to radiocarbon dating, the decline was a marker for the change from the Atlantic to drier Sub-Boreal period (Godwin's zones VIIa to VIIb) (Godwin 1940, 1956, 1975). Subsequently, suggested causes include the selective felling, ring barking, and use of elm leaves for fodder (Troels-Smith 1960; Hove 1968) as well as climatic change noted (Watts 1961: Heybroek, 1963, Smith 1970, 1981; Scaife 1988; Turner, J. 1970; Simmons and Tooley 1981). With the death of elms from the 1970's, and the work of the late Dr Girling (1988), it is now generally accepted that Neolithic opening of the forest readily allowed the spread of elm bark beetle and an associated fungus which had existed during the preceding middle Holocene. However, at many sites, there appear other environmental changes including locally increased wetness and importantly the evidence of ribwort plantain (Plantago lanceolata) and cereal cropping which was originally detailed by Godwin (1944) and Godwin and Tallantire 1951) at Hockham Mere, Norfolk. Both phenomena are seen at TR5 BH1 from the base of l.p.a.z. 3. Because of the rapid spread of the disease, this event/phenomenon was broadly synchronous across the country and radiocarbon dated to c. 5,500 to 5,000 BP having been obtained at many sites since the first extensive dating by Smith and Pilcher (1973).

The environment of the Neolithic: After the Elm decline, the overall Neolithic environment remained one of dominant woodland, especially in proximity to the sample sites although more extensive activity may have taken place at higher elevations above the dense vegetation of the valley bottoms. Profiles TR1 (l.p.a.z. TR1:1), TR2 (l.p.a.z. TR2: 1) and TR8 (lower l.p.a.z. TR8: 3) all show the dominance of Quercus, Corylus and Betula woodland for the dry-land zone with Alnus (and possibly Betula) on wetter floodplain localities. Transect 5 BH1 shows clearly, the decline in elm and the subsequent, progressive decline of other woodland trees; largely oak but to some extent, hazel. Inversely related to this is the expansion of herbs of anthropochorous character. Increase in grass pollen (Poaceae) is most notable but is also in association with some ribwort plantain (Plantago lanceolata), cinquefoils (Potentilla) and dock (Rumex) which suggest openings of the woodland and establishment of areas of pasture. Cereal pollen is not well represented in pollen spectra and the small numbers recorded again from above the decline of elm suggests some nearby cereal cultivation or, more intensively at some distance. Whichever, this marks the first evidence of human activity/disturbance on the preceding 'natural' woodland habitat. Cereal first appears in TR5 at the top of lpaz TR5:2 just below a level dated to the early Neolithic

(4860±30 BP - Table 2) but does not appear until much later in the other diagrams (see below).

Whilst the Elm decline event is a common and broadly synchronous event, there are circumstances where there were no apparent effects and vegetation remained largely the same until later woodland clearance/deforestation. That is, sequences without an apparent Elm Decline as discussed for TR5. This is the case with TR8 BH1.5. where elm pollen is consistently at levels of 5-6% after earlier higher values during the late Boreal (Flandrian Ic) and only dies out at a much later date in the early Bronze Age (3730±30 BP – Table 2) at the l.p.a.z. TR8 3-4 boundary. It is also noted, that unlike the TR5 profile, there are no occurrences of cereal pollen or ribwort plantain possibly indicating less human (Neolithic) impact in the region of this site (TR8). Sites at TR1 BH5 and TR2 BH3 both have basal radiocarbon dates which place the lower profiles within the Neolithic at 4671±26 (Suerc-60022) in the former and 4930±29 (Suerc-60023) for the latter. These post-date the normal dates of 5,500-500BP for the Elm decline although small values of Ulmus in these profiles suggest that this had indeed occurred earlier at these localities. TR1:1 shows a fall in oak in the latter part of the Neolithic accompanied by a rise in birch suggesting clearance and subsequent scrub colonisation of the cleared areas. As with TR8, however, there is little evidence of herb pollen indicating any local Neolithic agricultural activity. Occasional Plantago lanceolata, Potentilla type and some Poaceae are incoming in what might be extrapolated as middle or late-Neolithic in TR2 and some increases in Poaceae and Potentilla type in TR1 similarly from the middle Neolithic.

It is interesting that associated with the decline in elm and the rise of herbs, there is a change in the status of the sample site at Tr5 BH1 with evidence of increasing wetness as shown by increasing numbers of sedge (Cyperaceae) pollen and other herbs of grass-sedge fen affinity in the early neolithic. As discussed in section 8.1c above, it is probable that woodland clearance and general human disturbance affected (raised) the local ground water table.

The late-prehistoric; Bronze Age

Pollen data relating to the vegetation and environment of the Bronze Age is present in lpaz TR1:2/3, TR2:1, TR5:3, TR6:1 and TR8:3/4 although in TR8 the Bronze Age is mainly within the undated top 20cm of the core. These profiles appear to show the continuation/maintenance of the oak and hazel woodland, which existed throughout the Neolithic with limited evidence of human activity and no major changes. TR1:2-3 shows an expansion of grasses accompanied by the appearance of Plantago lanceolata and increasing Potentilla in the mid Bronze Age; traces of Calluna (ling) in l.p.a.z. TR1: 2 may be attributed to soil deterioration through human activity during the late Neolithic and Bronze Age which subsequently became more extensive in the Iron Age. TR5:3 shows a continuing reduction in oak with expanding Poaceae, increasing herb diversity and rising Plantago lanceolata throughout the Bronze Age, with the re-appearance of cereal type pollen indicating some agricultural activity in the landscape. The base of TR6 falls into the late Bronze Age and although traces of cereal type pollen appear and the herb flora is diverse with consistent Potentilla and Plantago lanceolata with a slow increase in Poaceae there is no major change to the woodland elements suggesting little change in woodland cover. There is evidence for an episode of woodland clearance at the transition of lpaz TR8:3-4 associated with an early Bronze Age date but with potentially a thousand years between each pollen sample at this point in the sequence it is impossible to relate this change confidently to the Bronze Age, although it is perhaps probable that this clearance phase fell within the Bronze Age. The first appearance of cereal type pollen in TR8:4 and the expansion of Poaceae occur higher in the profile, probably post-dating the Bronze Age.

The continuation of oak, hazel and probably Betula woodland into the 1st millennium BC is to some extent, confirmed from the lowest levels/pollen samples from profiles TR3 (BH5), TR6 (BH3) and TR10 (BH 2). These profiles have radiocarbon dates that extend back into the late Bronze Age and early Iron Age (Table 2). With the exception of TR10, these pollen sequences show the continued importance of Betula, Quercus and Corylus through to the late Bronze Age, the early Iron Age and later while alder floodplain woodland (carr) remained the dominant wetland mire community. TR10 dates to the Iron Age at the base of the peat and differs from the other profiles in showing a markedly more open environment by c. 2,300BP, the middle Iron Age. It appears that at some time prior to this date, woodland had been cleared with resultant soil deterioration, soil acidification and the establishment of dry heathland and acid, Sphagnum bog along a flush/spring line. The lowest sample level of TR10 does, however, contain high values of Corylus avellana type and subsequently declining. It is tempting to suggest that this represents a phase of colonisation by hazel scrub after early deforestation, edaphic depletion and woodland/scrub regeneration. This, however, remains tenuous without additional analyses which extend further back in time to the Bronze Age.

The Iron Age and Roman periods (c. 2,500 to 1500 BP)

The upper levels of the pollen diagrams show significant changes in the environment. These changes are related to woodland clearance for agriculture, although woodland remained important. With deforestation, there were also edaphic changes with acidification of the soils and changing mire status. It is possible that these changes may also be a human response to climate change. That is, Sub-Boreal to Sub-Atlantic change for the Iron-Age and later, the Little Ice Age or medieval warm period.

All the cores contain deposits that fall within the Iron Age and Roman period but some are more informative than others. Well dated Iron Age deposits have been identified in lpaz TR1:3 and 4, TR2:2, TR3:1 and 2, TR5:3 and 4, TR6:1 and 2, and TR10:1.

The vegetation of the Iron Age (which here extends into the Romano-British of England) is well represented in the profiles examined. These data, in general, show that the terrestrial habitat had remained wooded in large areas. For example, both TR3 BH5 and TR6 BH3 show the dominance of birch (Betula) although this may also be associated with the mire vegetation and, ubiquitous for this region, oak (Quercus) and hazel (Corylus). However, other taxa include less well-represented elm (Ulmus), lime/linden (Tilia), holly (Ilex), beech (Fagus) and ash (Fraxinus) which were also present and were certainly growing in proximity to the sample site. Holly (Ilex) suggests open canopy woodland. Small numbers of pine are considered to be of longer distance origin although occasional growth maintained from earlier periods on suitable soils/habitats cannot be ruled out. TR2 and TR6 have evidence for woodland clearance in the early Iron Age at the TR2:1/2 and TR6:1/2 boundaries, while TR1 suggests a final clearance phase in the late Iron Age (the TR1:3/4 boundary). TR3 has a last phase of woodland clearance in the Roman period. In TR5 the pollen data suggest some clearance of oak woodland through the early Iron Age, with an associated expansion of birch, but the chronological resolution fails in the top 20cm of the profile and an expansion of pasture and cereal cultivation in lpaz TR5:4 may include the later Iron Age or be Roman and/or medieval.

Arable cultivation is shown by some increases in cereal pollen and associated weeds of arable and disturbed ground. These include obvious cereal pollen and also possible weeds of Brassicaceae (charlocks), Spergula (spurrey), Chenopodiaceae (goosefoot and orache), Polygonaceae (knotgrass) and Artemisia (mugwort). Pastoral activity is more clearly seen in the pollen record with the associated weeds of pasture tending to be anemophilous. Grassland/pasture is evidenced in the upper pollen zone (s) by the increased pollen numbers of Poaceae (non-cultivated grasses), Plantago lanceolata (ribwort plantain) and other herbs which are not so easily assigned to this habitat. These latter include Ranunculus type (buttercups), Fabaceae types (medicks, clovers, vetches), Rumex (dock), Asteraceae types (especially Lactucoideae-Dandelion types and Centaurea spp. knapweed). However, given the importance of trees noted, it is interesting that these lowland zones appear to have remained heavily wooded until at least the very late historic period. This picture of mixed farming is evident in lpaz TR1:4 in the Roman and post-Roman periods, with indications of pastoral expansion earlier in the Iron Age. It is present in the Iron Age and Roman periods in TR2:2, TR3:2 and 3, to a lesser degree in TR5:3 and 4, although the expansion in TR5:4 may be Roman in date; also in TR6:1 and 2, where an expansion of pasture and cereal cultivation may be associated with the late Iron Age and/or Roman period. Finally the sequence in TR10 shows a landscape already largely cleared in the middle Iron Age with significant evidence for pasture and some heathland, but only transient evidence for cereal cultivation. This continues through the Roman period, although the evidence for heathland falls. This site lies at a slightly higher altitude than the others, towards the more marginal uplands, and both the evidence for woodland clearance and limited cereal cultivation may indicate its marginality in the Iron Age and Roman periods.

Where human activity/woodland clearance and agriculture had taken place on more acid soils, it appears that soil depletion occurred (leaching?). This produced areas of acid, probably podzolic or micropodzolic soil suited to acidophilous flora. This also influenced the wetland hydrology/habitat with creation of acid bog dominated by Sphagnum with typical bog flora of Cyperaceae, Narthecium ossifragum and Drosera rotundifolia and possibly Menyanthes trifoliata (bog bean) noted. Drier acid soil areas saw the development of Calluna (ling) and Erica (heather) along with typical heathland herbs especially including Potentilla type.

The post-Roman periods (1500 BP to present)

Owing to the humification and compression of the upper peats below the fibrous turf layer the most recent 1500 years are in most of the profiles contained within the top 20cm and their chronological resolution is almost impossible, and the limited number of pollen samples studied across this depth (five samples), makes the ‘story’ very unclear. This discussion relies on the upper dated horizon and evidence for potential post-medieval plantations (pine) or exotic species (fir and spruce) to define the periods represented.

Only TR2:2-3 and TR102-3 clearly cover the medieval period. The latter shows a period of expansion of hazel and birch in the early medieval period, at the expense of Poaceae and pastoral indicators but no increase in arable indicators. This is followed by a reversal at the top of the studied profile, probably a little later in the medieval period. At TR2 a progressive reduction in woodland appears to take place from the Roman period up until the late medieval (TR2:3), accompanied by increasing Poaceae, Plantago lanceolata, Potentilla and Lactucoideae. The Tudor and post-medieval periods mark the greatest expansion of pasture and arable activity in this profile (TR2).

Discussion

The results from these analyses give some indication of the extent and impact of human activity on the landscape along the route of the pipeline and its surrounding area. We know from previous archaeological assessment of the route (Richards and Smith 2013) that archaeological sites occur in the area from the Neolithic to the post-medieval period with the density increasing slightly from the Iron Age onwards, particularly in the post-medieval period. The excavations along the route uncovered features of Neolithic, Iron Age, Roman, early and later medieval date, with additional evidence of Mesolithic activity in the form of charred hazelnut shells (McNicol *et al* 2017).

It is evident from the palynological results that the Mesolithic period made little impact upon the vegetation and landscape. However such impacts might be expected to be small and would not be picked up by the resolution of these analyses where the time gap between individual pollen samples could be as much as several hundred years. To target whether Mesolithic people left a signature in these palaeoenvironmental sequences of their small scale woodland clearances and settlement fires the pollen analysis would need to be conducted at much closer intervals (i.e. millimetres not centimetres) and detailed micro-charcoal analyses undertaken at a similar scale. Commercial archaeology rarely allows this level of analysis but it is clear that the sites and sequences exist in this landscape zone, and the work could be undertaken on the cores recovered during this project.

By the Neolithic period there is evidence in the pollen profiles of human activity. Indications of woodland clearance begins in the early Neolithic period at Ynys Pandy and by the middle Neolithic at Tyddyn Madyn, and probably by the late Neolithic at Efail Uchaf. These clearances are followed by a rise in birch, perhaps indicating colonisation of the clearances by birch after acidification of the soils which could indicate repeated abandonment of the cleared areas, rather than sustained use. These clearances do not appear to lead to a permanent opening up of the landscape, which remains largely wooded, although the character has changed with birch woodland more important than earlier, probably with some regenerating woodland across the whole of the studied landscape. The damp areas and river valleys were dominated by alder woodland which also shows a local reduction in the middle to later Neolithic, but continued to be dominant right up to the late Iron Age at Ynys Pandy. These differences clearly reflect very local conditions and may be due to environmental and climate changes rather than direct felling and clearance of the alder carr by humans.

Evidence for cereals first appears in the early Neolithic at Ynys Pandy (TR5) along with pastoral indicators but the farming is of small scale and has little impact on the landscape. During the Bronze Age the picture continues but it is not until the end of the Bronze Age that the changes become pronounced. At Tyddyn Madyn there is an extended period of clearance in the later Bronze Age at TR1 and a little later in the beginning of the 1st millennium BC at TR2. The clearances at Ynys Pandy continue through the Bronze Age and into the Iron Age, with possible regeneration of birch in the cleared areas continuing through the Iron Age. By the middle Iron Age there has been a significant reduction in woodland at all sites, although this was most marked at Cefn-coch-isaf where all woodland, including birch had been reduced to levels typical of the medieval period in the other profiles. Cefn-coch-isaf lies closest to the margin of the uplands which may have been permanently de-forested much earlier than the lowland areas.

Evidence for cereal cultivation and pasture is present throughout this period but becomes a bit more marked in the later Iron Age and Roman periods. A pastoral landscape is clearly dominant at Cefn-coch-isaf from the middle Iron Age, but is much less marked with woodland still a major element of the landscape in the other profiles. It is the middle of 1st millennium BC which sees the first really major changes in the vegetation and indicates that the landscape is now well populated and beginning to open up. Up until this time the evidence for clearance and woodland regeneration, with limited pasture and just traces of cereal type pollen suggest a relatively small population, perhaps still moving about the landscape (at least at a generational scale?). From the latter half of the 1st millennium BC the diagrams begin to consistently show a more cleared landscape and pastoral and arable indicators reflective of mixed farming, although the eastern end of the route remains pastoral and the west still fairly extensively wooded.

In the Roman period at Tyddyn Madyn woodlands are still important, with pastoral indicators becoming more evident but still fairly limited cereal pollen frequency. At Ynys Pandy TR5 while still showing a predominantly wooded landscape has an episode of clearance accompanied by both pastoral and arable indicators. Unfortunately we cannot be confident as to whether this is Roman or medieval in date or perhaps both. In contemporary deposits at Cefn-coch-isaf the woodland is much reduced and the landscape is largely pastoral, although traces of cereal type pollen suggest possibly some cultivated fields. There is an episode of woodland regeneration at this site in the early medieval period starting around the 8-9th century, although it does not appear to be very long-lived. At Tyddyn Madyn TR2 has a medieval sequence. There is still substantial hazel woodland around the site in the early medieval period, which is cleared in late medieval or Tudor times, after which pasture and arable become much more important.

The profiles lack sufficient chronological resolution to consider the last few hundred years in any more detail but it would appear that the final woodland clearances in the western end of the pipeline route do not take place until towards the very end of the medieval period, and that woodland still covered significant tracts of the landscape during the Iron Age and Roman periods.

Summary and conclusions

The following principal points have been made in this study.

- Seven pollen sequences have been examined, all of which produced well-preserved and abundant pollen and spores. This has enabled detailed pollen diagrams to be produced from which interpretation of the past vegetation and environments have been made.

- The pollen profiles show the character and changes of vegetation and environment extending from the early Holocene, early post-glacial period at *c.* 8,500BP to the post-medieval period.

- Early Holocene seral woodland colonisation has been described with colonisation by birch followed by pine, oak, elm and hazel. That is, archaeologically during the early Mesolithic (Flandrian late Ia to Ic).

- The Middle Holocene (Flandrian II; Atlantic) is described. This shows the maximum development and the typically stable woodland of the middle Holocene, late Mesolithic period. This consisted of dominant oak, hazel, elm and hazel with some lime and ash. After arrival of alder, at about 7000 BP, dense alder carr woodland colonised the valley bottoms and sides. This remained important through to the historical period.

- A Neolithic Elm decline is described which dates to c. 5,500-5,000 BP and represents the opening of forest by incoming Neolithic woodland clearance which exacerbated the spread of elm disease.

- At the point of the Elm Decline, there occurs the first evidence of human impact on the natural woodland. This is attributed to Neolithic woodland clearance for agriculture, both arable and pastoral but is small scale and localised.

- From this period, there is evidence of continued but largely minor impact on the woodland which remained dominant with oak and hazel growing on the interfluves and dense floodplain alder carr in the wetter valley bottoms. Local episodes of clearance are suggested in the late Neolithic, Bronze Age, Iron Age, Roman and even into the medieval period.

- The upper sequences of all but one of the sites examined show a substantial change from dominant woodland to more open agricultural land. This change is most marked from the middle Iron Age onwards, but was continuing into the medieval period, the latter possibly associated with the extension of ridge and furrow cultivation.

- These significant changes in the woodland were responsible for a change in the status of the wetland flora from largely stable alder carr woodland to wetter grass-sedge fens and the acidification and development or expansion of *Sphagnum* bog. Accompanying the latter is evidence of some heathland development on depleted (?agricultural) soils from as early as the middle Iron Age.

- In the surface levels, there are some records of recently planted spruce and pine.

- Overall, this study has produced pollen data from the lowland zone of North Wales where little such information exists; earlier studies having concentrated on more typical upland peat and lacustrine sites.

- Of particular note from this study appears to be the importance and the longevity of woodland in the lowland zone extending into the historic period.

- The results illustrate well the individuality of the core sites and indicate that these small 'basins' contain a more local picture of the landscape than the larger upland bogs, mires and blanket peat that have historically been the focus for palynological studies. This can allow some interpretation of patterns of landuse across the sampled landscape.
- In the light of the importance of the results from these sequences some additional samples have been analysed to extend the study and will be incorporated into the publication of the results.

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Appendix XI.1: Pollen method

Core samples were obtained using a Russian (Jowsey 1966) peat corer. Sub-sampling and stratigraphical description of the core was carried out in the laboratory. Pollen sub-samples of 1 to 1.5ml volume were taken at 4cm intervals and processed using standard techniques for the extraction of the sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al.* 1992). The pollen and spores were identified and counted using an Nikon and Olympus biological research microscopes at magnifications of x400 and x1000. A pollen sum of 400 to 500 or more grains plus all marsh and aquatic taxa (including *Alnus*) was counted for each sample level. Pollen totals thus extended to several thousand grains in some samples where *Alnus* was dominant. Fern spores and miscellaneous elements (*Pediastrum*) were also counted outside of the basic pollen sum. Standard pollen diagrams (figures 1 to 7) were plotted using Tilia and Tilia View. Percentages have been calculated in a standard way, as follows:

Sum =	% total dry land pollen (tdlp).
Alnus and *Salix* =	% tdlp + *Alnus* and *Salix*.
Marsh/aquatic =	% tdlp + sum of marsh/aquatics.
Spores =	% tdlp + sum of spores.
Misc. =	*% tdlp + misc. Sphagnum, Pediastrum etc.*

Because of the very high pollen productivity of *Alnus* (Andersen 1970, 1973) which was growing on and adjacent to all but one of the sites, *Alnus* (also with *Salix*) have been incorporated into the marsh and aquatic sum. That is, because the high percentages of the former, if included in the pollen sum may cause problems with the percentage representations of allochthonous (off-site) pollen taxa (Janssen 1969). Dealing with *Alnus* in this way also shows more clearly, the changing status of the fen mire and interaction with grass sedge fen and *Sphagnum* bog.

Pollen taxonomy, in general, follows that of Moore and Webb (1978) modified according to Bennett *et al.* (1994) and Stace (1992). These procedures were carried out in the Palaeoecology Laboratory of the School of Geography, University of Southampton. An extensive pollen reference/comparative collection was available for identification of some taxa encountered.

Appendix XI.2: Radiocarbon results

BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.7 o/oo)

Laboratory number **Beta-465762**

Conventional radiocarbon age **2120 ± 30 BP**

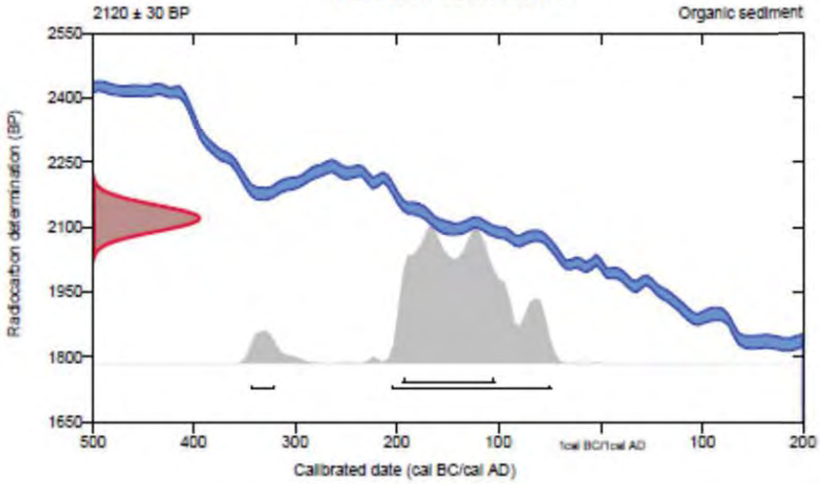
95.4% probability

(91.2%)	206 - 50 cal BC	(2155 - 1999 cal BP)
(4.2%)	345 - 322 cal BC	(2294 - 2271 cal BP)

68.2% probability

(68.2%)	196 - 106 cal BC	(2145 - 2055 cal BP)

G2231/Tr1/BH5/25-26



Database used
INTCAL13

References
References to Probability Method
Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.
References to Database INTCAL13
Reimer, et.al., 2013, Radiocarbon55(4).

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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.6 o/oo)

Laboratory number **Beta-465763**

Conventional radiocarbon age **3380 ± 30 BP**

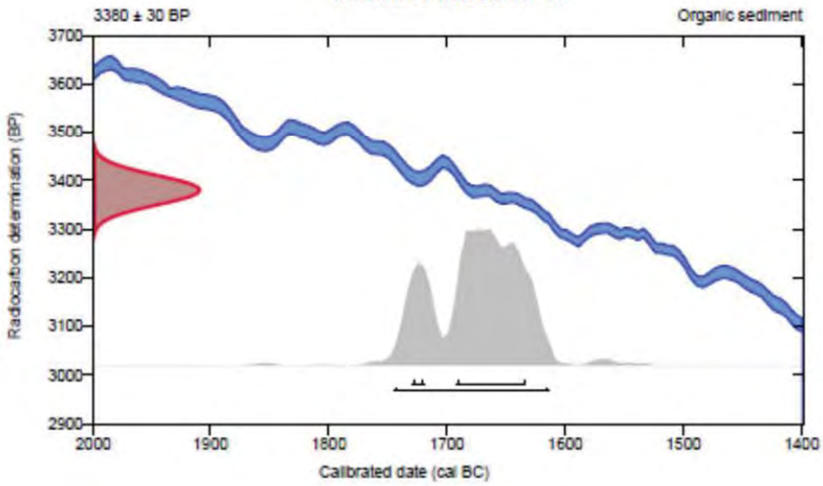
95.4% probability

(95.4%)	1746 - 1616 cal BC	(3695 - 3565 cal BP)

68.2% probability

(59.5%)	1693 - 1636 cal BC	(3642 - 3585 cal BP)
(8.7%)	1731 - 1721 cal BC	(3680 - 3670 cal BP)

G2231/Tr1/BH5/45-46



Database used
INTCAL13

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References to Database INTCAL13
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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.7 o/oo)

Laboratory number **Beta-465764**

Conventional radiocarbon age **4230 ± 30 BP**

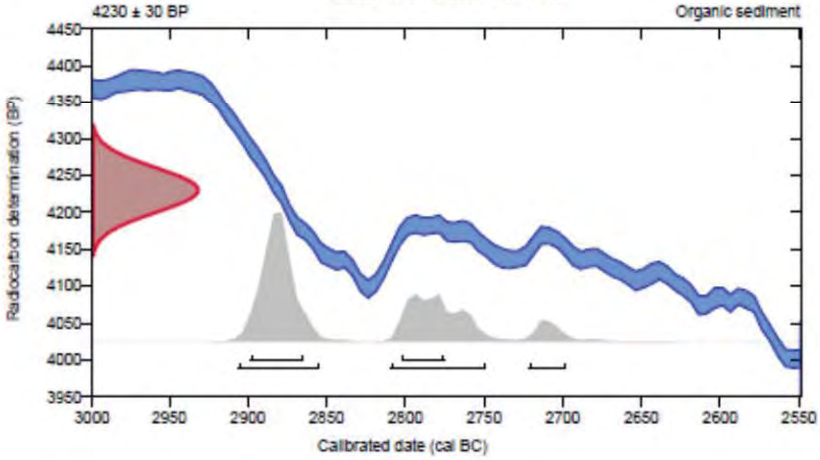
95.4% probability

(54.8%)	2908 - 2857 cal BC	(4857 - 4806 cal BP)
(34.3%)	2811 - 2751 cal BC	(4760 - 4700 cal BP)
(6.3%)	2723 - 2700 cal BC	(4672 - 4649 cal BP)

68.2% probability

(47.8%)	2900 - 2867 cal BC	(4849 - 4816 cal BP)
(20.4%)	2804 - 2777 cal BC	(4753 - 4726 cal BP)

G2231/Tr1/BH5/69-70



Database used

INTCAL13

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Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.6 o/oo)

Laboratory number **Beta-465765**

Conventional radiocarbon age **400 ± 30 BP**

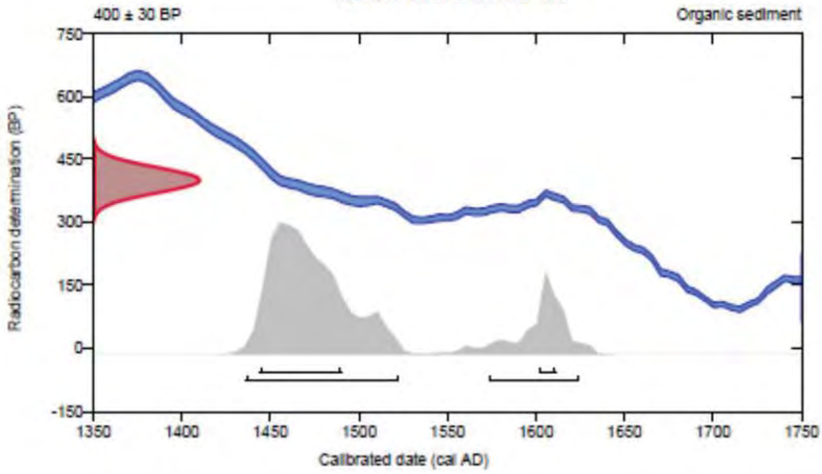
95.4% probability

(76.4%)	1436 - 1522 cal AD	(514 - 428 cal BP)
(19%)	1574 - 1624 cal AD	(376 - 326 cal BP)

68.2% probability

(60.8%)	1444 - 1490 cal AD	(506 - 460 cal BP)
(7.4%)	1602 - 1611 cal AD	(348 - 339 cal BP)

G2231/Tr2/BH3/17-18



Database used

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Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.7 o/oo)

Laboratory number **Beta-465766**

Conventional radiocarbon age **2620 ± 30 BP**

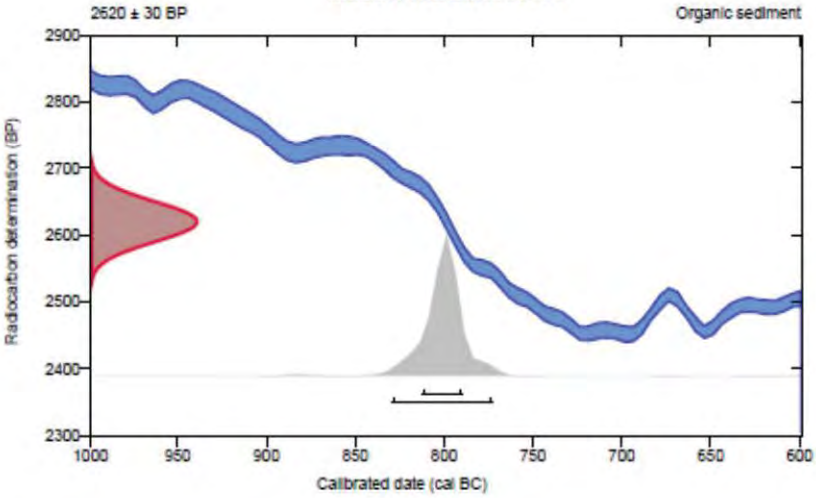
95.4% probability

(95.4%) 831 - 775 cal BC (2780 - 2724 cal BP)

68.2% probability

(68.2%) 814 - 792 cal BC (2763 - 2741 cal BP)

G2231/Tr2/BH3/33-34



Database used

INTCAL13

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Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.1 o/oo)

Laboratory number **Beta-465767**

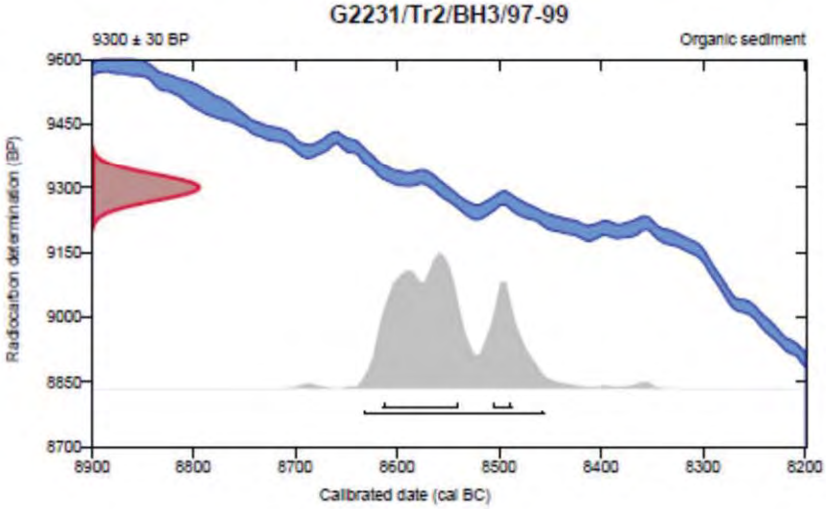
Conventional radiocarbon age **9300 ± 30 BP**

95.4% probability

(95.4%) 8634 - 8458 cal BC (10583 - 10407 cal BP)

68.2% probability

(56.9%) 8615 - 8542 cal BC (10564 - 10491 cal BP)
(11.3%) 8507 - 8490 cal BC (10456 - 10439 cal BP)



Database used

INTCAL13

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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.5 o/oo)

Laboratory number **Beta-465768**

Conventional radiocarbon age **1910 ± 30 BP**

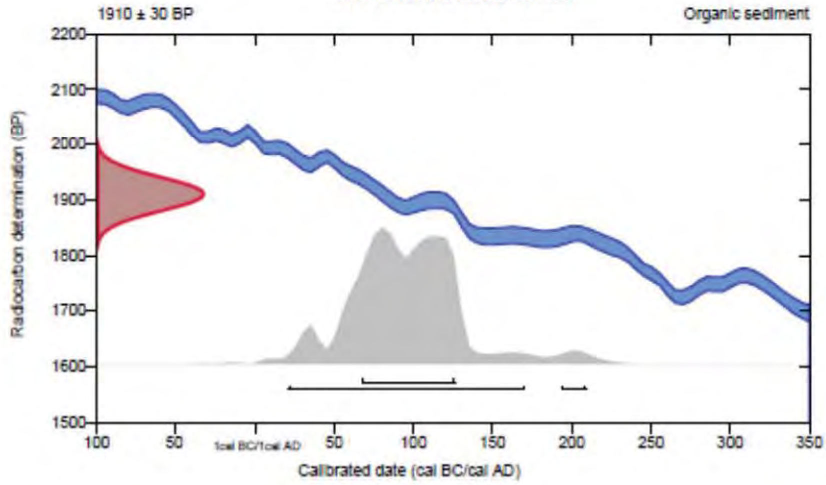
95.4% probability

(93.6%)	21 - 170 cal AD	(1929 - 1780 cal BP)
(1.8%)	194 - 209 cal AD	(1756 - 1741 cal BP)

68.2% probability

(68.2%)	68 - 126 cal AD	(1882 - 1824 cal BP)

G2231/Tr3/BH2/37-38



Database used
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Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.1 o/oo)

Laboratory number **Beta-465769**

Conventional radiocarbon age **2400 ± 30 BP**

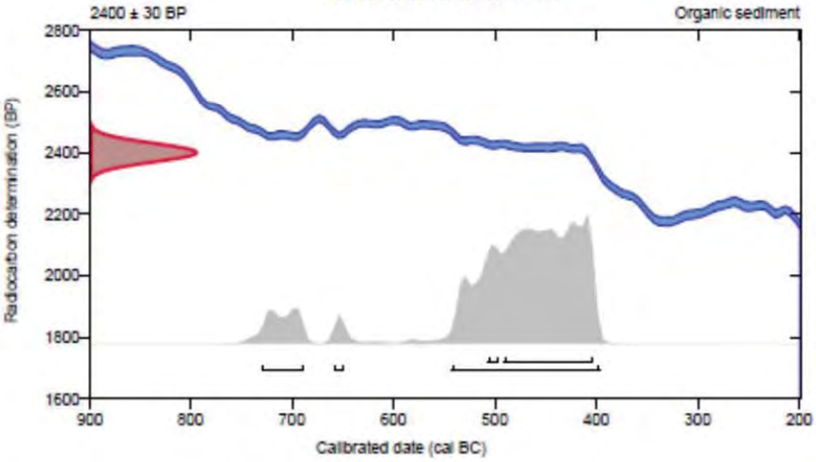
95.4% probability

(86.6%)	544 - 399 cal BC	(2493 - 2348 cal BP)
(7.4%)	731 - 691 cal BC	(2680 - 2640 cal BP)
(1.4%)	660 - 651 cal BC	(2609 - 2600 cal BP)

68.2% probability

(62.4%)	493 - 406 cal BC	(2442 - 2355 cal BP)
(5.8%)	508 - 499 cal BC	(2457 - 2448 cal BP)

G2231/Tr5/BH1/25-26



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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.2 o/oo)

Laboratory number **Beta-465770**

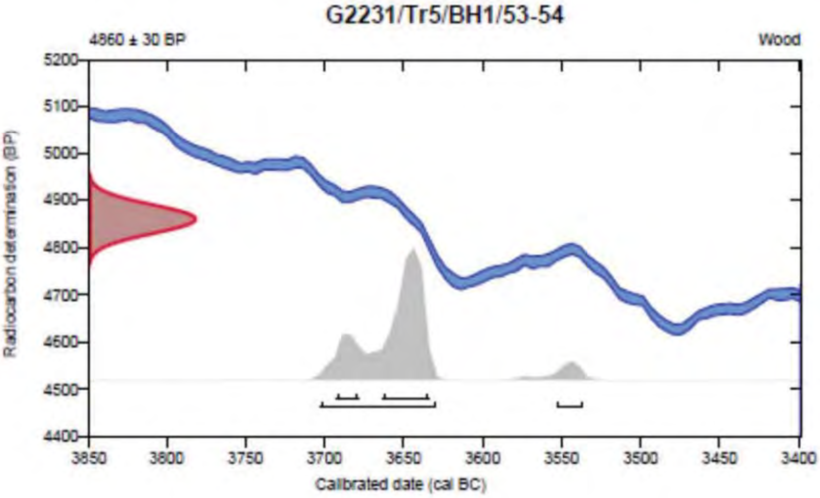
Conventional radiocarbon age **4860 ± 30 BP**

95.4% probability

(90%)	3704 - 3632 cal BC	(5653 - 5581 cal BP)
(5.4%)	3555 - 3539 cal BC	(5504 - 5488 cal BP)

68.2% probability

(56.6%)	3665 - 3636 cal BC	(5614 - 5585 cal BP)
(11.6%)	3694 - 3681 cal BC	(5643 - 5630 cal BP)



Database used
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Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.
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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.2 o/oo)

Laboratory number **Beta-465771**

Conventional radiocarbon age **5390 ± 40 BP**

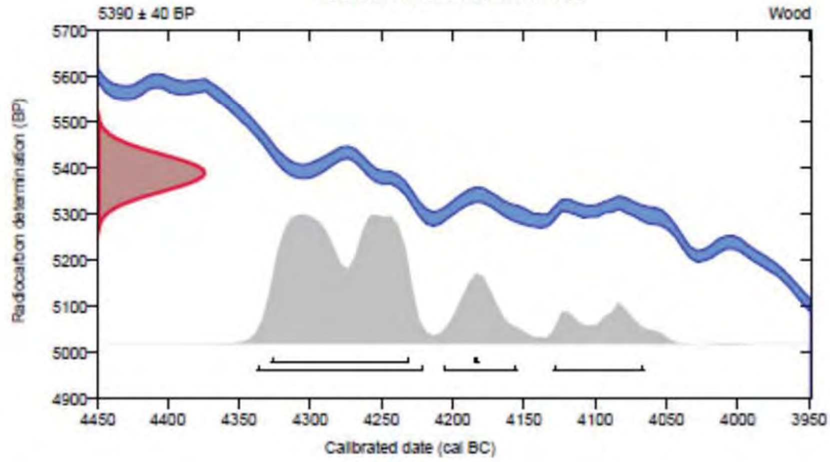
95.4% probability

(71.5%)	4339 - 4223 cal BC	(6288 - 6172 cal BP)
(13.5%)	4208 - 4157 cal BC	(6157 - 6106 cal BP)
(10.4%)	4131 - 4068 cal BC	(6080 - 6017 cal BP)

68.2% probability

(66.7%)	4329 - 4233 cal BC	(6278 - 6182 cal BP)
(1.5%)	4187 - 4184 cal BC	(6136 - 6133 cal BP)

G2231/Tr5/BH1/144-145



Database used
INTCAL13

References
References to Probability Method
Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.
References to Database INTCAL13
Reimer, et.al., 2013, Radiocarbon55(4).

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Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -28.8 o/oo)

Laboratory number **Beta-465772**

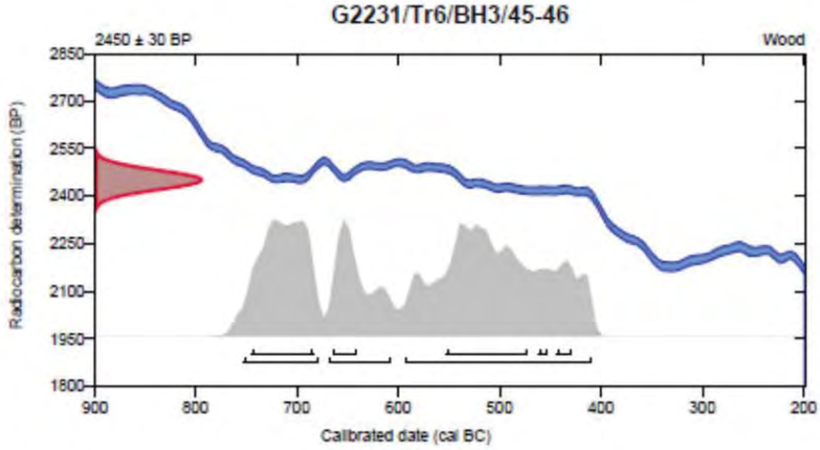
Conventional radiocarbon age **2450 ± 30 BP**

95.4% probability

(53.2%)	595 - 411 cal BC	(2544 - 2360 cal BP)
(26.7%)	754 - 681 cal BC	(2703 - 2630 cal BP)
(15.5%)	670 - 609 cal BC	(2619 - 2558 cal BP)

68.2% probability

(28.8%)	554 - 475 cal BC	(2503 - 2424 cal BP)
(24.6%)	746 - 686 cal BC	(2695 - 2635 cal BP)
(8.6%)	666 - 643 cal BC	(2615 - 2592 cal BP)
(4.1%)	445 - 431 cal BC	(2394 - 2380 cal BP)
(2.1%)	463 - 455 cal BC	(2412 - 2404 cal BP)



Database used

INTCAL13

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Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.4 o/oo)

Laboratory number **Beta-465773**

Conventional radiocarbon age **3730 ± 30 BP**

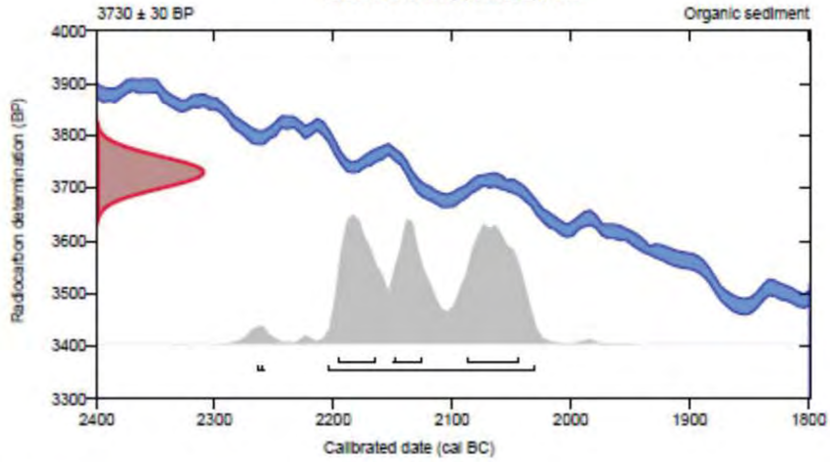
95.4% probability

(94.8%)	2206 - 2032 cal BC	(4155 - 3981 cal BP)
(0.6%)	2266 - 2261 cal BC	(4215 - 4210 cal BP)

68.2% probability

(29.7%)	2089 - 2046 cal BC	(4038 - 3995 cal BP)
(22.5%)	2198 - 2166 cal BC	(4147 - 4115 cal BP)
(16%)	2151 - 2127 cal BC	(4100 - 4076 cal BP)

G2231/Tr8/BH1.5/21-22



Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.4 o/oo)

Laboratory number **Beta-465774**

Conventional radiocarbon age **6930 ± 30 BP**

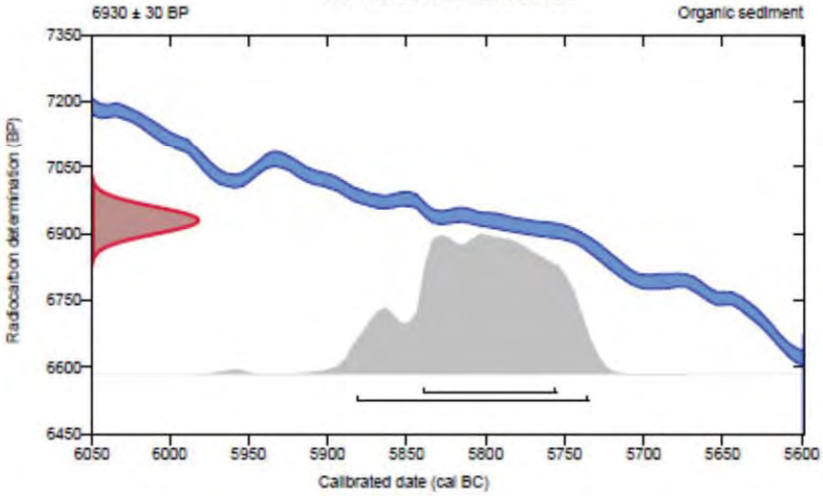
95.4% probability

(95.4%) 5883 - 5737 cal BC (7832 - 7686 cal BP)

68.2% probability

(68.2%) 5841 - 5757 cal BC (7790 - 7706 cal BP)

G2231/Tr8/BH1.5/65-66



Database used
INTCAL13

References
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BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.3 o/oo)

Laboratory number **Beta-465776**

Conventional radiocarbon age **1190 ± 30 BP**

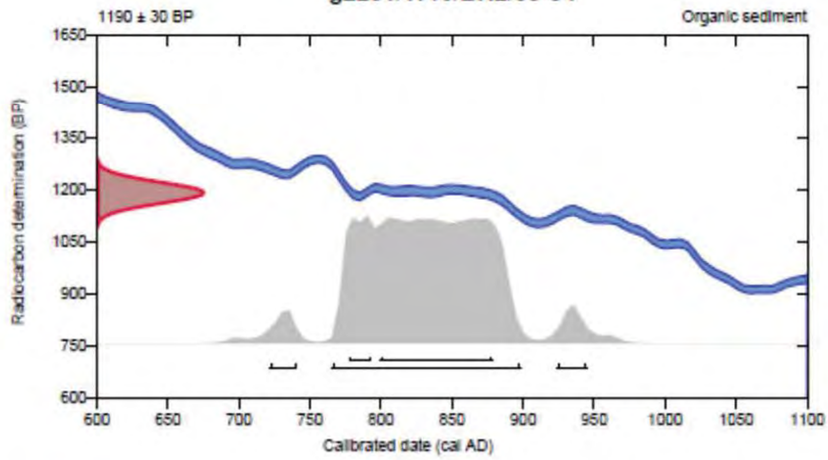
95.4% probability

(89%)	766 - 898 cal AD	(1184 - 1052 cal BP)
(3.5%)	924 - 945 cal AD	(1026 - 1005 cal BP)
(2.9%)	722 - 740 cal AD	(1228 - 1210 cal BP)

68.2% probability

(57.2%)	800 - 878 cal AD	(1150 - 1072 cal BP)
(11%)	778 - 793 cal AD	(1172 - 1157 cal BP)

g2231/Tr10/BH2/33-34



Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, Radiocarbon55(4).

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -29.0 o/oo)

Laboratory number **Beta-465777**

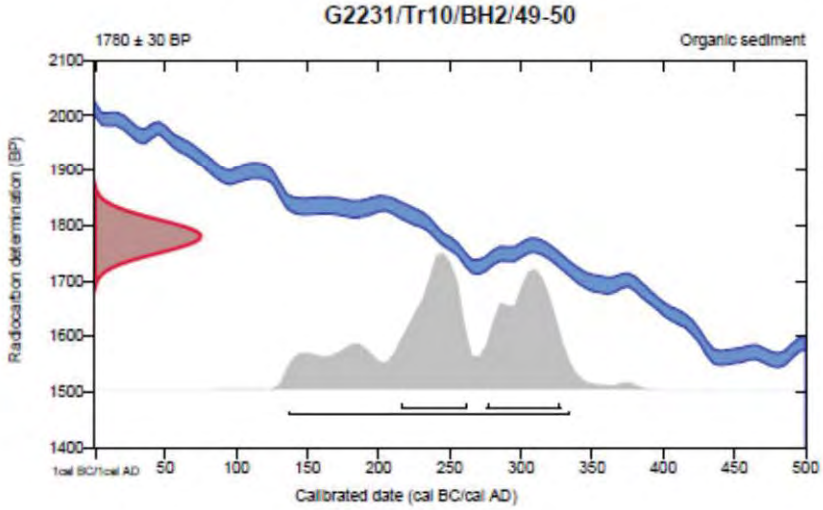
Conventional radiocarbon age **1780 ± 30 BP**

95.4% probability

(95.4%)	137 - 334 cal AD	(1813 - 1616 cal BP)

68.2% probability

(34.6%)	276 - 328 cal AD	(1674 - 1622 cal BP)
(33.6%)	216 - 262 cal AD	(1734 - 1688 cal BP)



Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, Radiocarbon55(4).

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25 APPENDIX XII: RADIOCARBON DATING REPORT AND BAYESIAN ANALYSIS

Dolbenmaen to Cwmystradllyn Pipeline (G2231: Radiocarbon dating and Bayesian modelling

Derek Hamilton (SUERC)

Ten samples of charcoal and charred plant remains were submitted to the Scottish Universities Environmental Research Centre (SUERC) for radiocarbon dating by accelerator mass spectrometry (AMS). The samples were single-entities (Ashmore 1999) and were pretreated following the methods described in Dunbar et al. (2016) and dated by AMS following Naysmith et al. (2010). The radiocarbon results are given in Table 1. These are conventional radiocarbon ages (Stuiver and Polach 1977), quoted according to the international standard set at the Trondheim Convention (Stuiver and Kra 1986). The dates are calibrated following the maximum intercept method (Stuiver and Reimer 1986) with the internationally agreed curve of Reimer et al. (2013) using OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009), and rounded outward to 10 years. The probability distributions seen in App XII Figures 1–3 were obtained by the probability method (Stuiver and Reimer 1993).

The ten samples come from five contexts. The pairing of samples for dating, or duplication, is one way to assess the security of contexts. If the context formed rapidly and did not suffer much in the way of post-depositional disturbance, then the expectation is that the two samples will have statistically consistent radiocarbon measurements. App XII Table 2 shows the T-values for the paired samples, following the test of Ward and Wilson (1978), and only one of the duplicates is not statistically consistent. The pair from context 01031 do pass the test at 3σ (T_{crit}=8.81), and is discussed in further detail below.

The samples

There are two archaeological sites dated along the Dolbenmaen to Cwmystradllyn Pipeline, an Iron Age settlement and a burnt mound. All five features from these two sites were dated with paired samples (App XII Fig. 2). In only one instance are the paired measurements statistically inconsistent (Context 01031; App XII Table 2), but in that case the two measurements are consistent at 3σ. In all five cases, the later date provides the best estimate for the date of formation of the deposit.

The burnt mound was dated by two deposits. Single fragments of birch and hazel charcoal from the basal fill (39023) of pit [39019] were dated (SUERC-68357 and -68358). This pit dates to the Late Neolithic Period (2880–2570 cal BC; 95% confidence; SUERC-68358). Covering this pit was burnt spread (39015), from which two fragments of hazel roundwood charcoal were dated (SUERC-68362 and -68363). This spread is Late Neolithic, and dates to 2890–2630 cal BC (95% confidence; SUERC-68363).

From the Iron Age settlement there are two results (SUERC-68348 and -68352) on wheat grains in the fill (01031) of posthole [01017]. SUERC-68348 provides the best estimate for the date of the feature (cal AD 1–140; 95% confidence). Another two grains of wheat were dated (SUERC-68353 and -68354) from the fill (01041) of pit [01040]. This feature dates to 50 cal BC–cal AD 130 (95% confidence; SUERC-68353). These postholes, were two of four that were enclosed by ditch [01001]. Two fragments of oak roundwood were dated (SUERC-68355 and -68356) from the basal fill (01066) of ditch [01001]. The latest date suggests the ditch was open and beginning to fill in by 380–170 cal BC (95% confidence; SUERC-68356).

Bayesian chronological modelling

A Bayesian approach has been adopted for the interpretation of the chronology for some of the activity dated along the Dolbenmaen to Cwmystradllyn Pipeline (Buck et al. 1996). The methodology allows the combination of different types of information (e.g. radiocarbon dates, phasing, and stratigraphy) explicitly, to produce realistic estimates of the dates of archaeological interest. It should be emphasised that the *posterior density estimates* produced by this modelling are not absolute. They are interpretative *estimates*, which can and will change as further data become available and as other researchers choose to model the existing data from different perspectives. The technique used is a form of Markov Chain Monte Carlo sampling, and has been applied using the program OxCal v4.2. Details of the algorithms employed by this program are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001; 2009). The algorithm used in the model described below can be derived directly from the model structure shown in Figures 2–3.

Burnt mound activity in Field 39

While there is observed stratigraphy in the burnt mound, with the burnt spread (39015) overlying the dated pit [39019], the redeposited/mixed nature of many of these burnt mound deposits makes modelling the stratigraphy directly unreliable. Therefore, the two dated features have been modelled as representative of a single phase of continuous activity with the assumption that the material was deposited at a relatively uniform rate across the phase.

The model has good agreement between the dates and the model assumption (Amodel=84). The burnt mound activity began in *3145–2690 cal BC* (*95% probability*; Fig. 2; *start: G2231 burnt mound*), and probably in *2935–2765 cal BC* (*68% probability*). The activity ended in *2870–2400 cal BC* (*95% probability*; Fig. 2; *end: G2231 burnt mound*). The overall period of burnt mound use could have been up to *670 years* (*95% probability*; Fig. 4; *span: G2231 burnt mound*), and probably *1–250 years* (*68% probability*).

Iron Age activity in Field 1

The two postholes ([01017] and [01040]) and surrounding ditch [01001] with Iron Age dates in Field 1, were initially modelled as representative of a single phase of continuous activity with the assumption that the material was deposited at a relatively uniform rate across the phase. However, the oak roundwood in the basal fill of the enclosure ditch is considerably earlier than the material recovered from the postholes. Either the postholes and ditch are not contemporary, or else the oak roundwood is residual. The model considers the basal ditch dates to provide a *terminus post quem* for the filling of the ditch, which is how the material would be modelled if the charcoal fragments were residual. If one wishes to interpret the enclosure ditch and postholes as relating to two separate phases of activity, then the later date in the ditch (see above) provides the best estimate for the beginning of its infilling.

The model presented in App XII Figure 3, with the postholes representative of the Iron Age under study, and the enclosure dates providing a *tpq* for this activity, has good agreement between the dates and the model assumption (Amodel=99). The model estimates that the activity associated with the postholes began in *200 cal BC–cal AD 60* (*95% probability*; Fig. 3; *start: G2231 Iron Age*), and probably in *60 cal BC–cal AD 40* (*68% probability*). The activity in this area ended in *20 cal BC–cal AD 255* (*95% probability*; Fig. 3; *end: G2231 Iron Age*), and probably in *cal AD 20–120* (*68% probability*). The overall span of the activity was *1–410 years* (*95% probability*; Fig. 4; *span: G2231 Iron Age*), and probably *1–155 years* (*68% probability*).

Discussion

The low number of dates, given the length of some of the modelled activity, has resulted in a lower level of overall model precision than might otherwise have been expected (Steier and Rom 2000). The decreased precision should not be misinterpreted as a decrease in accuracy. The result can be that the 95% probability for the date of a modelled event has an especially long tail (i.e. start and end dates). In many instances, the 68% probability is likely to provide a more realistic estimate for the date of the event.

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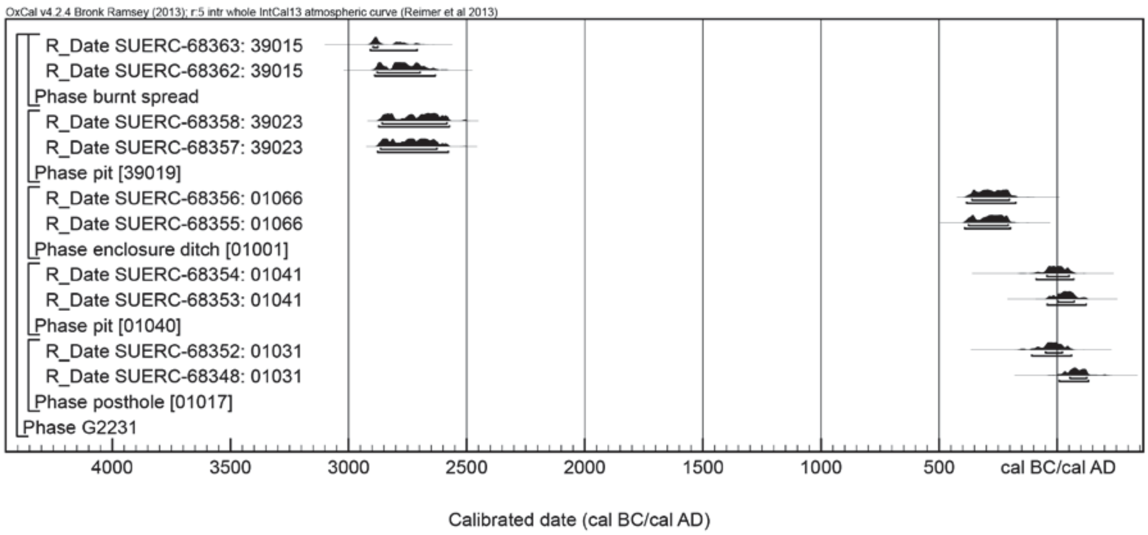
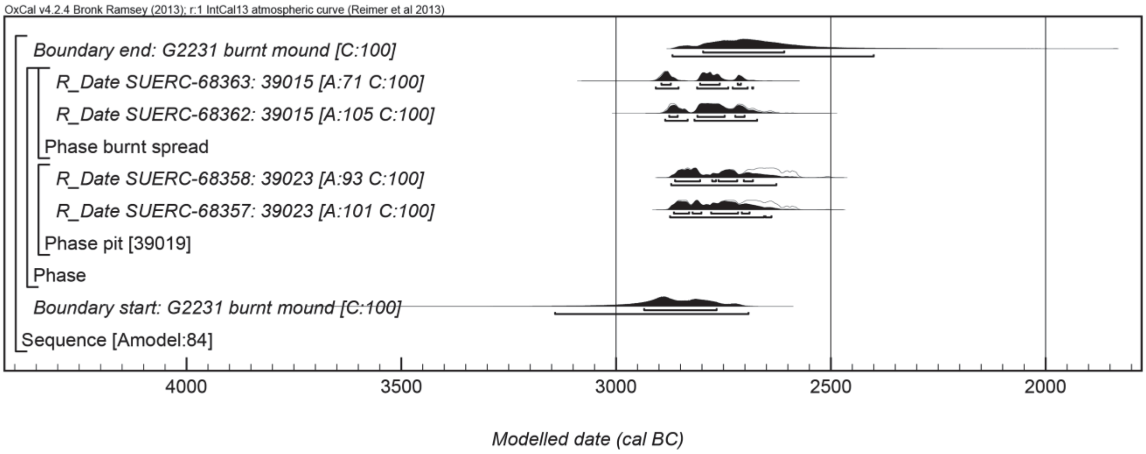
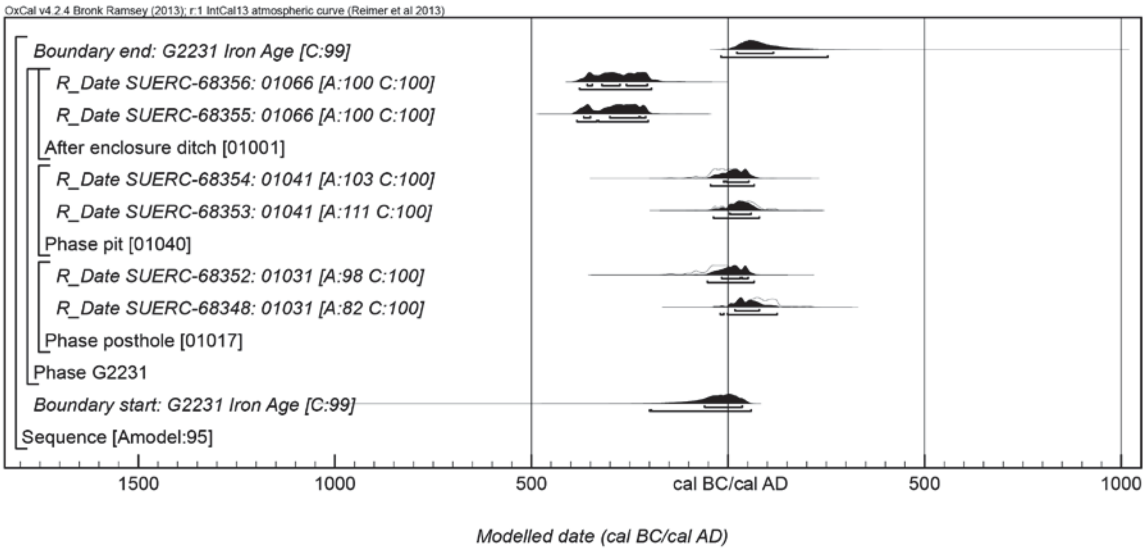
Figures



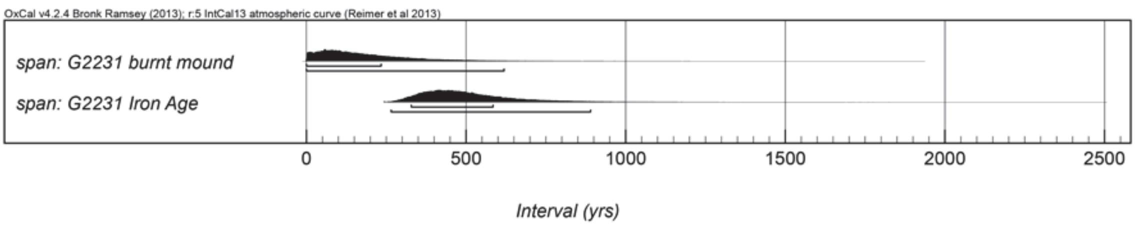
App XII Figure 1: Calibrated radiocarbon dates from the Dolbenmaen to Cwmystradllyn Pipeline (G2231)



App XII Figure 2: Chronological model for the burnt mound activity from Field 39. Each distribution represents the relative probability of an archaeological event. The distributions in outline show the calibration of each result by the probability method (Stuiver and Reimer 1993). The solid distributions are *posterior density estimates* derived from the chronological model. This model is exactly defined by the square brackets and OxCal keywords at the left of the diagram.



App XII Figure 3: Chronological model for the Iron Age activity from Field 1. The model is as described in the text and App XII Figure 2.



App XII Figure 4: Spans for the modelled activity on the Dolbenmaen to Cwmystradllyn Pipeline**.** The spans are based on the models shown in App XII Figures 2–3.

Tables

App XII Table 1: Radiocarbon results from Dolbenmaen to Cwmystradllyn Pipeline (G2231), Wales

Lab No	Sample ID	Context No	Context Description	Material/species	Radiocarbon Age (BP)	δ^{13}C (‰)	Calibrated date (95% confidence)
SUERC-68348	**7A**	**01031**	**Fill of posthole [01017]**	**charred grain: *Triticum* cf. *dicoccum* (emmer wheat)**	**1921 ± 34**	**−22.2**	**cal AD 1–140**
SUERC-68352	**7B**	**01031**	**Fill of posthole [01017]**	**charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)**	**2019 ± 34**	**−23.5**	**110 cal BC–cal AD 60**
SUERC-68353	**11A**	**01041**	**Fill of pit [01040]**	**charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)**	**1963 ± 34**	**−23.1**	**50 cal BC–cal AD 130**
SUERC-68354	**11B**	**01041**	**Fill of pit [01040]**	**charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)**	**2003 ± 34**	**−23.5**	**90 cal BC–cal AD 70**
SUERC-68355	**20A**	**01066**	**Basal fill of enclosure ditch [01001]**	**charcoal: *Quercus* sp.; roundwood**	**2230 ± 34**	**−25.2**	**400–190 cal BC**
SUERC-68356	**20B**	**01066**	**Basal fill of enclosure ditch [01001]**	**charcoal: *Quercus* sp.; roundwood**	**2209 ± 34**	**−25.4**	**390–170 cal BC**
SUERC-68357	**27A**	**39023**	**Basal fill of pit [39019]**	**charcoal: *Betula* sp.**	**4136 ± 34**	**−24.2**	**2880–2570 cal BC**
SUERC-68358	**27B**	**39023**	**Basal fill of pit [39019]**	**charcoal: *Corylus* sp.**	**4116 ± 34**	**−26.6**	**2880–2570 cal BC**
SUERC-68362	**28A**	**39015**	**Burnt spread**	**charcoal: *Corylus* sp.**	**4181 ± 34**	**−25.5**	**2890–2630 cal BC**
SUERC-68363	**28B**	**39015**	**Burnt spread**	**charcoal: *Corylus* sp.**	**4238 ± 34**	**−26.2**	**2910–2710 cal BC**

App XII Table 2: Chi-square test results (Ward and Wilson 1978) for paired measurements from dated contexts from the Dolbenmaen to Cwmystradllyn Pipeline (G2231), Wales. The T_{crit} (5%) value for all pairs (df=1) is 3.8

Context	Chi-square result	Pass/Fail
01031	T'=4.2	Fail
01041	T'=0.7	Pass
01066	T'=0.2	Pass
39023	T'=0.2	Pass
39015	T'=1.4	Pass

26 APPENDIX XIII: RADIOCARBON DATING CERTIFICATES

Scottish Universities Environmental Research Centre

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RADIOCARBON DATING CERTIFICATE
29 July 2016

Laboratory Code	SUERC-68348 (GU41303)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	1031
Sample Reference	7A
Material	Cereal grain : Triticum cf. dicoccum
$\delta\,^{13}C$ relative to VPDB	-22.2 ‰
Radiocarbon Age BP	1921 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

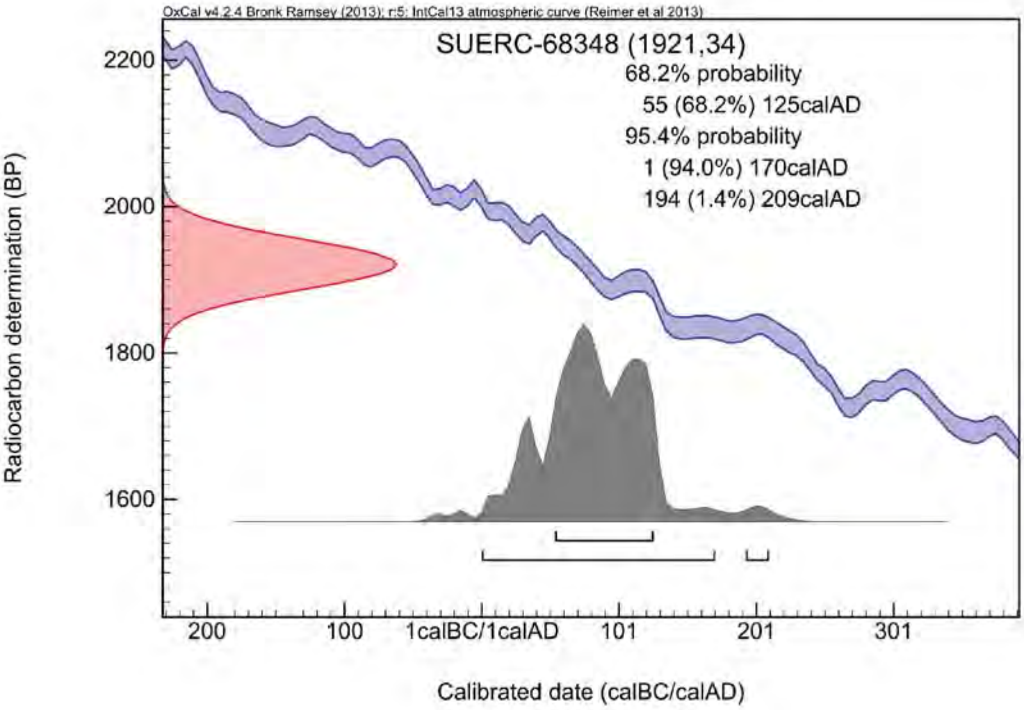
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

THE UNIVERSITY OF EDINBURGH

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68352 (GU41304)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	1031
Sample Reference	7B
Material	Cereal grain : Triticum dicoccum/spelta
$\delta\,^{13}C$ relative to VPDB	-23.5 ‰
Radiocarbon Age BP	2019 ± 34

N.B. 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.

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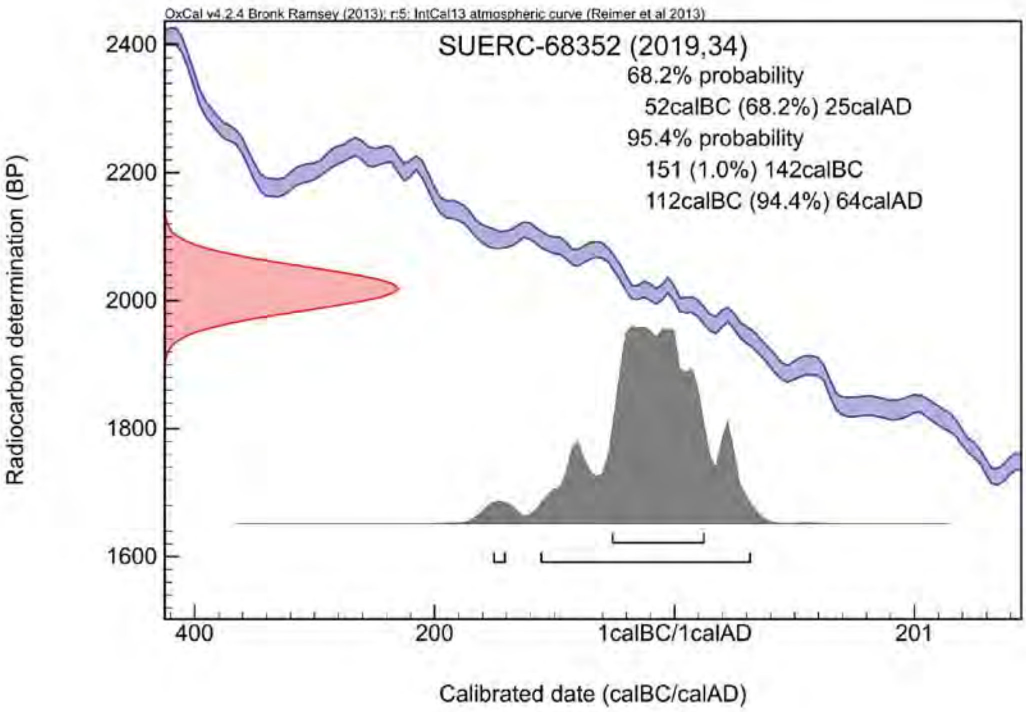
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



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Laboratory Code SUERC-68353 (GU41305)

Submitter John Roberts
Gwynedd Archaeological Trust
Craig Beuno
Garth Road
Bangor
Gwynedd, LL57 2RT

Site Reference G2231
Context Reference 1041
Sample Reference 11A

Material Cereal grain : Triticum dicoccum/spelta

δ ^{13}C relative to VPDB -23.1 ‰

Radiocarbon Age BP 1963 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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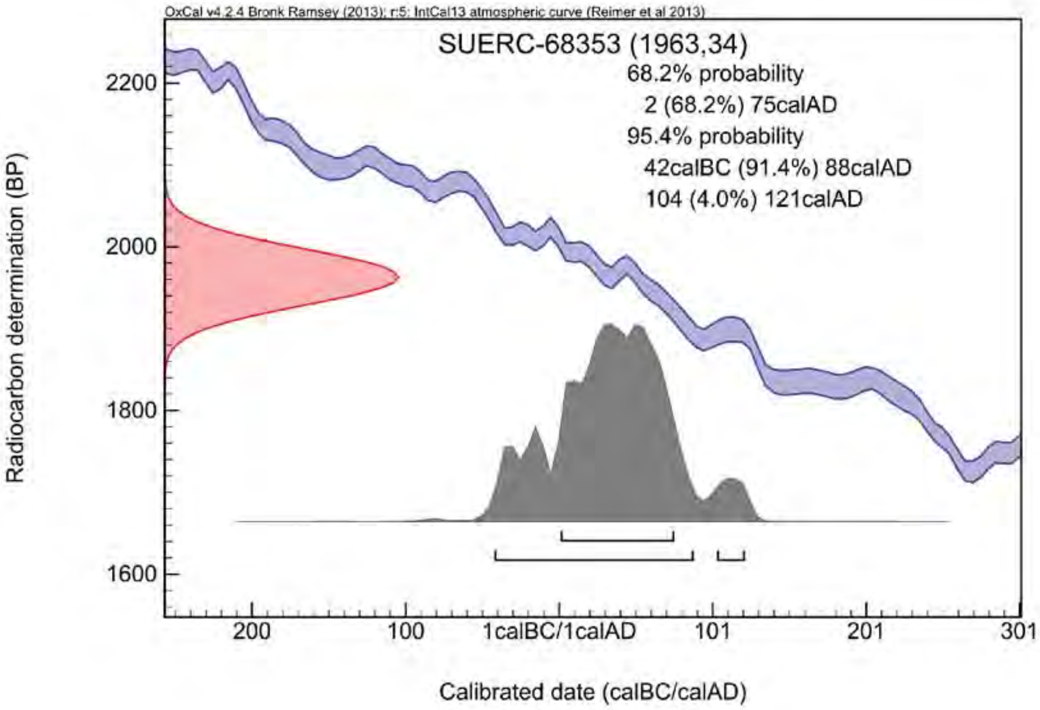
Calibration Plot



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Laboratory Code	SUERC-68354 (GU41306)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	1041
Sample Reference	11B
Material	Cereal grain : Triticum dicoccum/spelta
δ ^{13}C relative to VPDB	-23.5 ‰
Radiocarbon Age BP	2003 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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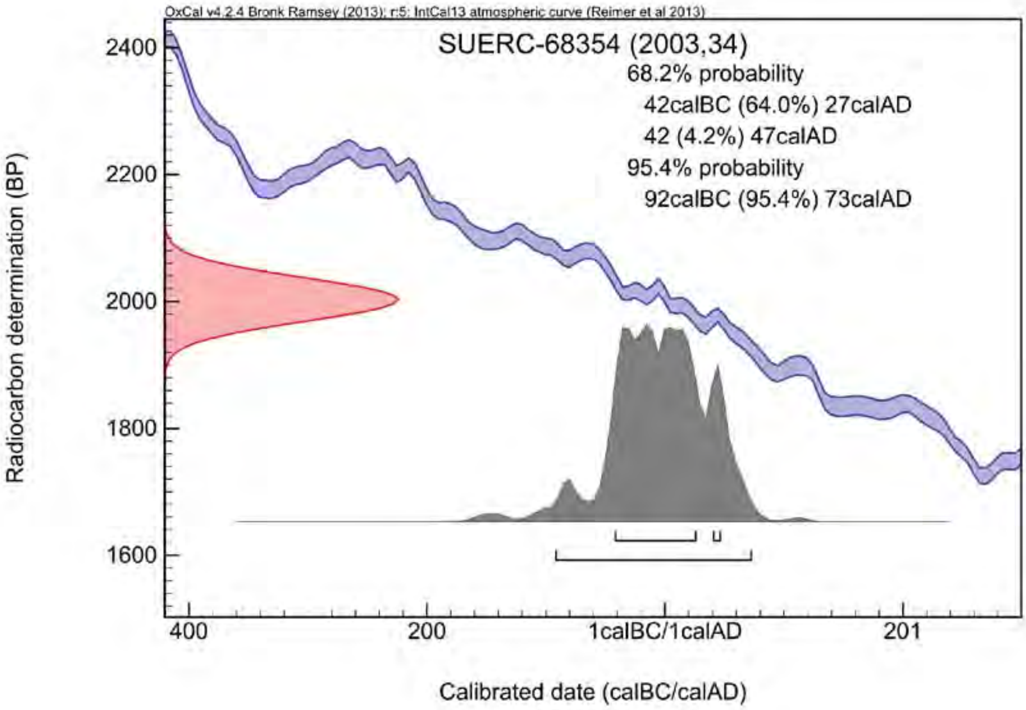
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- Date :- 29/07/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

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Laboratory Code	SUERC-68355 (GU41307)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	1066
Sample Reference	20A
Material	Charcoal : Quercus sp.
$\delta^{13}C$ relative to VPDB	-25.2 ‰
Radiocarbon Age BP	2230 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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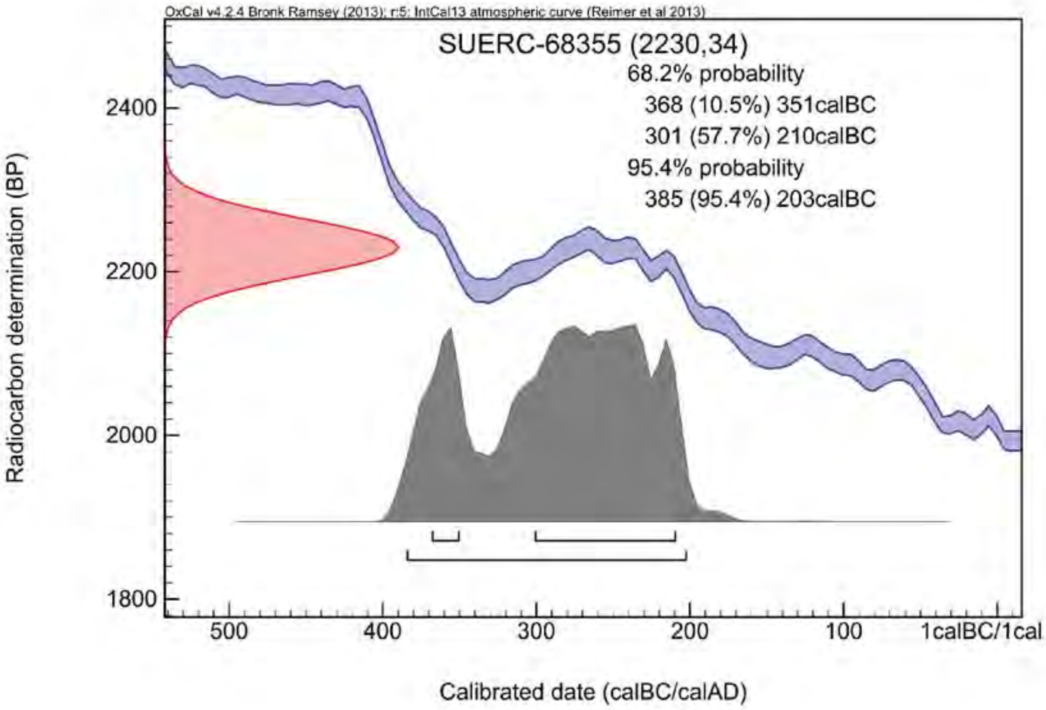
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68356 (GU41308)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	1066
Sample Reference	20B
Material	Charcoal : Quercus sp.
δ^{13}C relative to VPDB	-25.4 ‰
Radiocarbon Age BP	2209 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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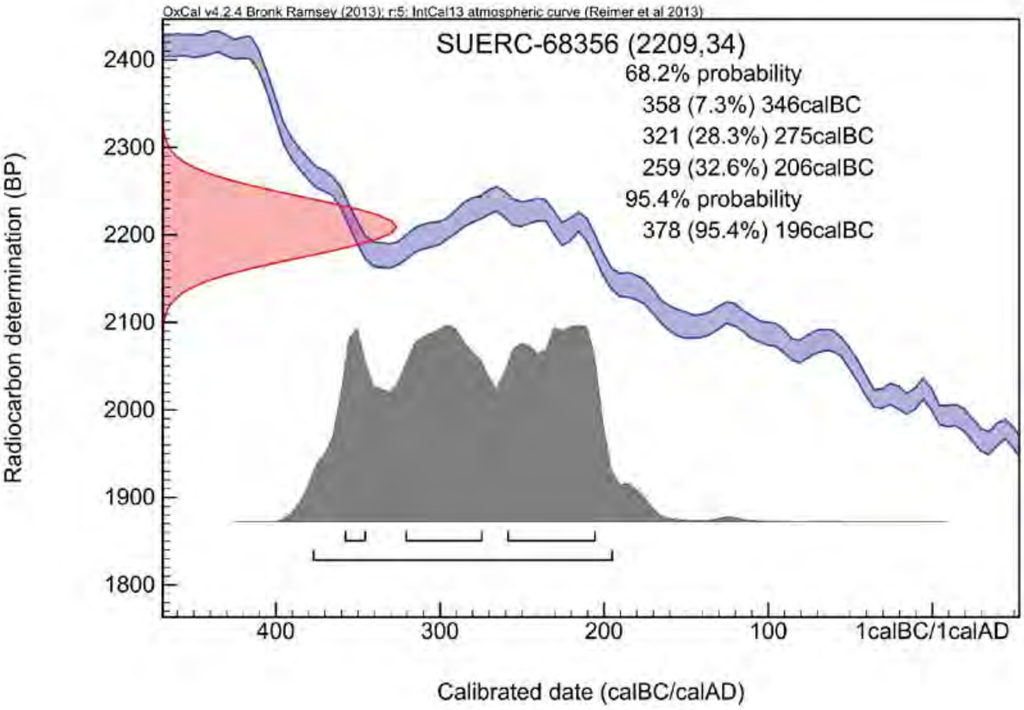
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



Scottish Universities Environmental Research Centre

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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68357 (GU41309)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	39023
Sample Reference	27A
Material	Charcoal : Betula sp.
$\delta^{13}C$ relative to VPDB	-24.2 ‰
Radiocarbon Age BP	4136 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

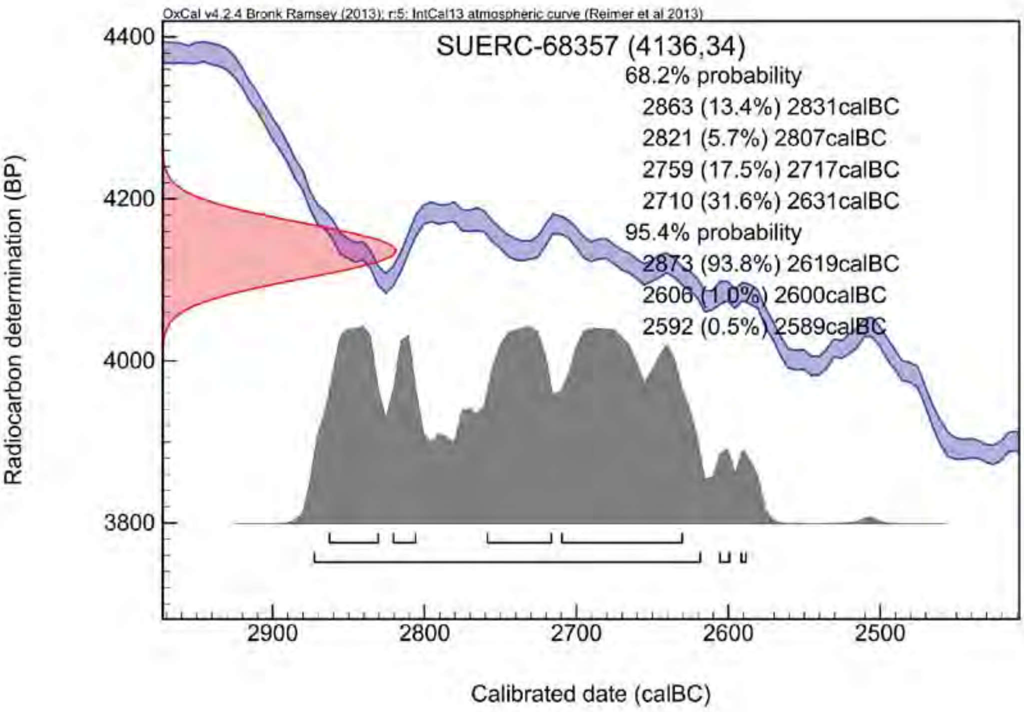
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- P. Naysmith   Date :- 29/07/2016

Checked and signed off by :- B Tagney   Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68358 (GU41310)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	39023
Sample Reference	27B
Material	Charcoal : Corylus sp.
$\delta\ ^{13}C$ relative to VPDB	-26.6 ‰
Radiocarbon Age BP	4116 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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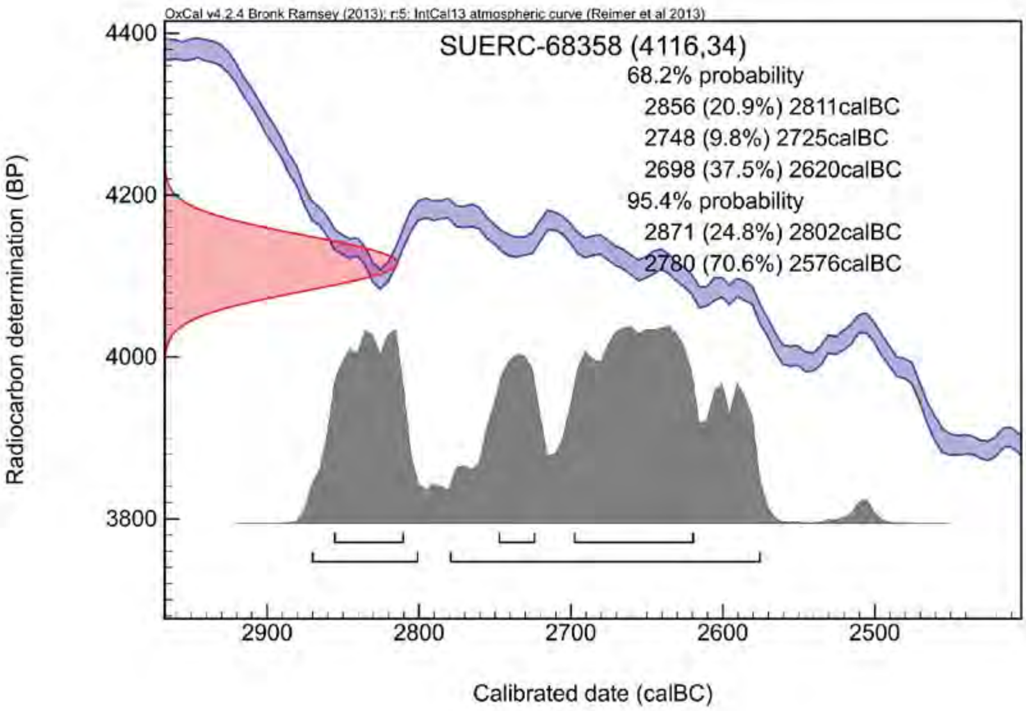

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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code SUERC-68362 (GU41311)

Submitter John Roberts
Gwynedd Archaeological Trust
Craig Beuno
Garth Road
Bangor
Gwynedd, LL57 2RT

Site Reference G2231
Context Reference 39015
Sample Reference 28A

Material Charcoal : Corylus sp.

δ ^{13}C relative to VPDB -25.5 ‰

Radiocarbon Age BP 4181 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

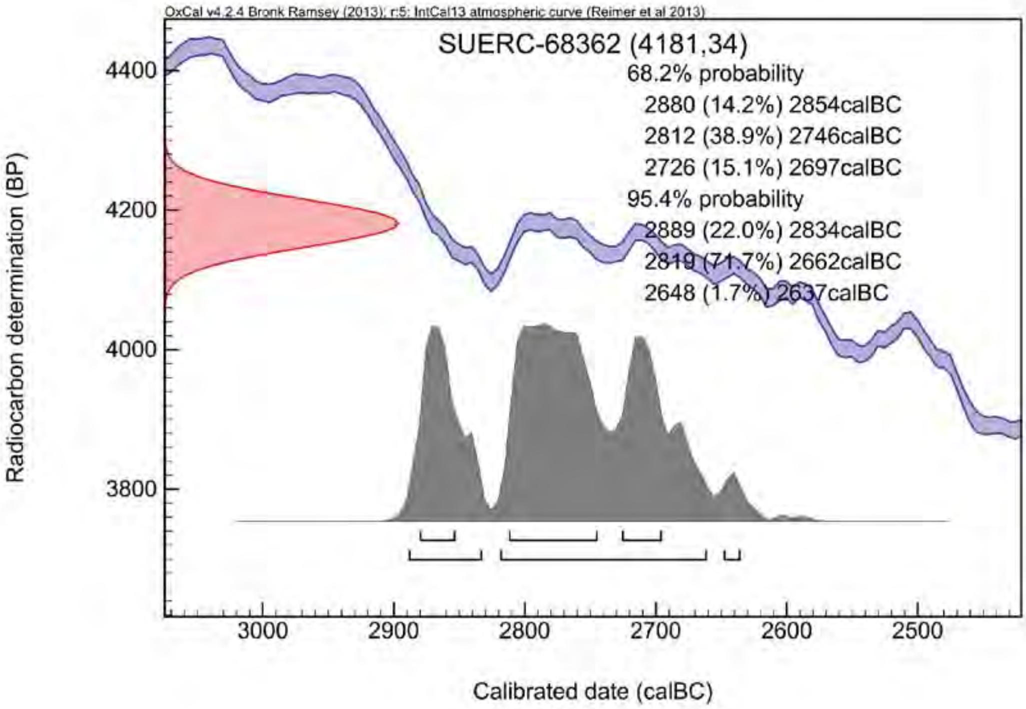
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68363 (GU41312)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2231
Context Reference	39015
Sample Reference	28B
Material	Charcoal : Corylus sp.
δ ^{13}C relative to VPDB	-26.2 ‰
Radiocarbon Age BP	4238 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

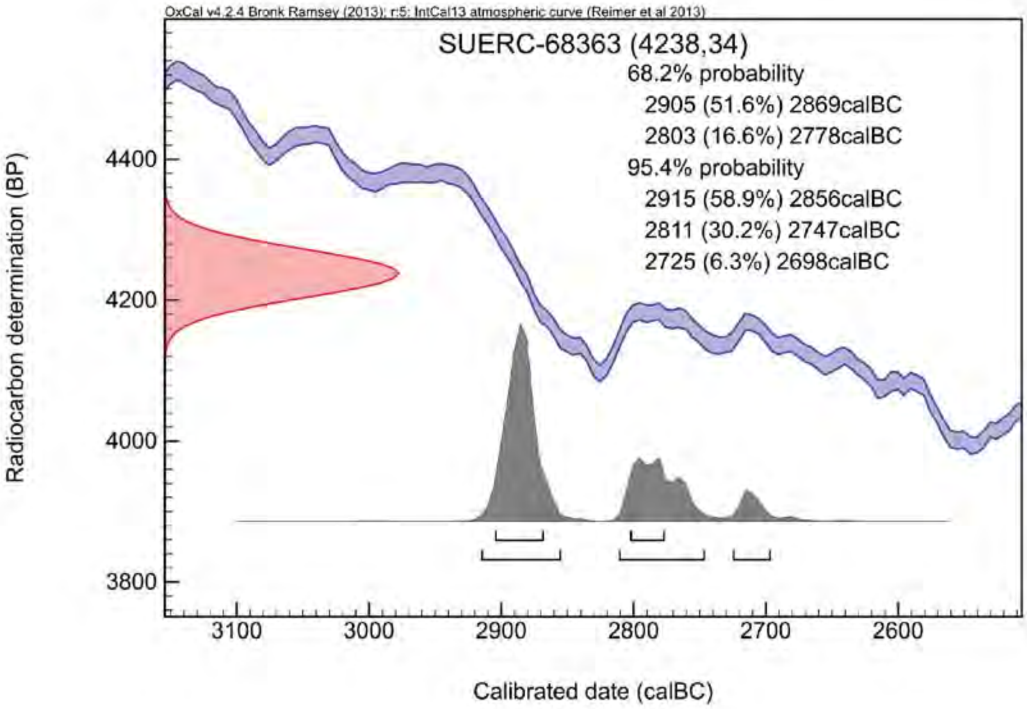
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



27 Appendix XIV: Project Design

Project Design for Archaeological Mitigation at Dolbenmaen Water Treatment Works

Prepared for Black & Veatch Limited, May 2012

Introduction

Gwynedd Archaeological Trust (GAT) has been asked by *Black & Veatch Limited* to provide a project design for completing a programme of archaeological mitigation during the main ground works stage at the location of the proposed Dolbenmaen Water Treatment Works (WTW); centred on NGR **SH49634290**.

According to *Black and Veatch Ltd* amended drawing **174357-30-9114** (reproduced as Figure 1), the proposed WTW site is located across three irregular shaped enclosed fields and will comprise:

- the main WTW area within the central field (39,110m^2)
- Zone A (6,890m^2) - main site compound;
- Zone B (6,055m^2) - main soil storage area.

The groundworks will be completed in two main stages:

- Stage 1 – enabling works: this will include the establishment of the main site compound in Zone A and the soil storage area in Zone B, as well as the removal of topsoil across the entire site.
- Stage 2 – main works: the construction of the water treatment works and associated landscaping, which includes two earth bunds.

GAT has already completed a staged programme of archaeological works (cf. para. 2.0 for a detailed summary). This has included an archaeological assessment of the proposed works (GAT Report **1092**), a watching brief during the client ground investigation works (GAT Report **1098**), a geophysical survey of the proposed WTW zone (*Stratascan* report **J3297**) and an archaeological evaluation of the WTW zone targeting the geophysical survey results (GAT Report **1123**). *It is recommended that all of these reports are reviewed in tandem with this project design.*

Based on these results and the client programme and methodology, the GAT archaeological mitigation will include:

- A basic record of GAT Report **1092** features 3 and 4;

- An archaeological watching brief of Stage 1 enabling works, monitoring all topsoil removal within the development zone.
- An archaeological controlled strip of the main WTW area prior to Stage 2.
- An archaeological controlled strip of Zone B prior to Stage 2.

(cf. para. 3.0 for a detailed methodology)

Note: a haul road is required at the start of the enabling works to connect Zones A and B, crossing the main WTW site; this will require a controlled strip before the haul road is established and before the main controlled strip.

The site contractor working for *Black and Veatch Ltd* on Stage 1 will be *GT Williams Ltd*. who will be responsible for topsoil strip across the scheme, the haul road and the main site compound. GAT will also be contracting *GT Williams Ltd*. to undertake the controlled strip in tandem with the GAT team. The enabling works are currently scheduled from **29/05/13** to **18/07/13**. The GAT works will in tandem with this schedule.

A detailed brief has not been prepared for this stage by Gwynedd Archaeological Planning Service (GAPS). However GAPS has monitored all archaeological phases for this scheme. Based on those results and the known and suspected archaeological activity, GAPS has requested an archaeological watching brief in the location of Zone A and a controlled strip for the main WTW zone and Zone B. GAPS must approve this and any future project designs and output related to this scheme. The controlled strip areas must be approved by GAPS prior to the undertaking of the main works and all opportunities afforded to GAPS to visit and monitor the scheme.

Reference will also be made to the guidelines specified in *Standard and Guidance for Archaeological Watching Brief* (Institute for Archaeologists, 1994, rev. 2001 & 2008) and *Standard and Guidance for Archaeological Excavation* (Institute for Archaeologists, 1994, rev. 2001 & 2008)

Background

GAT has completed an archaeological assessment report and ground investigation watching brief report in advance of the proposed works (Reports **1092** and **1098** respectively), along with a magnetometer geophysical survey of the area, completed by *Stratascan* for GAT (report forthcoming). The assessment identified characterised a study area within a rich archaeological landscape with thirty known sites of archaeological significance within a 500m radial zone. A large rock outcrop was identified in the Zone B field (cf. Figure 01), which appears from a combination of place name evidence and historic literature to have been used as an early medieval assembly mound. The remainder of the area was characterised by improved pasture separated by cloddiau (field boundaries) of post-medieval date. The archaeological and historical background is reproduced from report **1092** below. The ground investigation watching brief results and the magnetometer geophysical survey results are discussed below (paras. 2.4 and 2.5 respectively)

Prehistoric and Roman sites

The evidence for prehistoric occupation within the vicinity of the proposed development area is slight. The nearest confirmed prehistoric sites are the hut groups (PRN 145 SH 4994

4345) and (PRN 170 SH 5019 4276) 450m NE and 450m SE respectively. The Scheduled Ancient Monument of Craig-y-Tyddyn Camp (CN 046; SH 50594271) lies approximately 715m to the south east of the assessment area. It is possible; therefore that evidence of prehistoric activity may survive below ground in the vicinity of the proposed development, occupying as it does the lower ground between these two hut groups, the later agricultural improvement of this land may well have truncated or obscured the evidence for earlier occupation of the landscape. The line of the proposed Roman Road from Segontium - Pen Llystyn - Tomen y Mur may lie under the present A487 (T) although there is no direct evidence of occupation from the Roman period within the vicinity of the proposed development area. The nearest confirmed Roman site is Pen Llystyn fort (PRN 144 SH 4809 4492), approximately 2.3 km to the NW. The sparseness of the evidence may reflect a lack of investigation rather than a lack of settlement activity relating to these periods.

Medieval

Scheduled Ancient Monument (CN 063; SH50654307) castle earthwork which marks the site of the medieval llys of Dolbenmaen is approximately 830m to the west of the proposed development area (PRN 161 SH 50654037). The western boundary of the land which made up the llys complex comes within 350m of the eastern boundary of the proposed development (GAT Report 790: 09). The geological outcrop and associated earth mound known as Pen Bryn yr Orsedd which is situated in Field 02 may have served as an assembly mound for the retinue of a peripatetic early medieval court. Pen Bryn yr Orsedd translates as 'The Seat on top of the Hill', and assembly mounds which have similar characteristics are known from England, Scotland, Ireland and the Isle of Man (GAT Report 790: 09). An assembly mound near Llangollen is currently subject to a programme of archaeological work as part of 'Project Eliseg'. In the case of 'Project Eliseg', the mound is topped by the remains of a stone cross, and academic work on the social context for the mound and the cross has recently been published (GAT Report 790: 09). The place name 'Dol Pen Maen' is mentioned in the medieval story of 'Math and Mathonwy' as a point where hostages were exchanged between two high – status families (GAT Report 790: 09). Dolbenmaen / Dol Pen Maen translates as 'The Meadow with the Rock at the Head', and the rock in this instance may be Pen Bryn yr Orsedd.

Post-Medieval and Modern

An Exchequer survey dated 1589-90 shows that the boundary of the township of Dolbenmaen was almost exactly the same as the parish as given of the Tithe Map of 1838 (GAT Report 790: 09). The assessment area is recorded by the 17th century as being part of a farm known as Tyddyn Rhwng y Ddwyryd. In 1637 the lands were demised to John Griffith of Cefn Amlwch by his father in law Sir Richard Trevor, by which time, or shortly after, the lands were purchased from the Crown. John Griffith's heir and brother sold the township in 1719 to Williams Brynker, son of James Brynker of Brynkir. A rental of 1721 includes the farm of Plas Dolbenmaen, which is the earliest found reference of the farm under this name. William ran into financial problems, and the lands with the exception of Dolwgan, were sold to William Owen of Clenennau and Brogyntyn in 1736, and so passed by marriage to the Ormesby (later Ormesby-Gore) family (GAT Report 790: 09).

Between the production of the Tithe Map in 1839 (GAT Report 790: Figure 03) and the 3rd Edition of the Ordnance Survey Map in 1915 (GAT Report 790: Figure 06), the field system within the assessment area saw several changes through the planting and grubbing up of field boundaries. The name Pen Bryn yr Orsedd in reference to the rock outcrop is not recorded on the 1st Edition O.S. map but does appear on the 2nd Edition.

Environmental Remains and Soil Morphology: Ground Investigation Stage

The topsoil within the assessment area is well drained, with some limited areas of waterlogging. GAT attended a Ground Investigation (GI) stage for Black and Veatch Ltd on the 10th and 11th of December 2012 and monitored the excavation of 12No trial pits (GAT Report **1098**). All 12 trial pits revealed a clay silt topsoil, more humic in character in TPD02, TPD04, TPD08, TPD11 and TPD12 and varying in depth between 0.10m (TPD03 and TPD06) and 0.30m (TPD09). TPD02, cut into the southern side of Pen Bryn yr Orsedd revealed that this side of the mound had not been modified and was entirely natural, composed of a grey silt over a very clean orange brown sandy clay. TPD01, TPD05, TPD07 and TPD11 revealed river gravel below their respective sub-soils of sandy clay (TPD01); orange-brown till derived material (TPD05); grey-brown through red-orange clay (TPD07) and orange-brown clay-silt (TPD11). TPD03, TPD04, TPD05, TPD08, TPD09 and TPD10 came down immediately below the topsoil onto a till or till derived material Individual unabraded sherds of Post-Medieval pottery were recovered from the topsoil of TPD06 and TPD09.

Archaeological Evaluation – geophysical survey and trial trenching

The archaeological evaluation (trial trenching) of the main WTW and Zones A and B was completed by GAT in March 2013 (GAT Report **1123**) and revealed a range of features spread throughout the development site showing evidence of land use and settlement in the area. The 14No evaluation trenches targeted anomalies identified during the preceding geophysical survey (*Stratascan* report **J3297**), which identified features interpreted as former field boundaries throughout the site and anomalies possibly indicative of prehistoric farmstead activity in the central region where the main WTW is proposed. The trial trenching uncovered a number of features which showed that settlement of the site had taken place, most likely dating to the prehistoric period.

The two sets of parallel boundary ditches (**502** and **504**, and **1102** and **1104**) show that division of the land has occurred at some point, with the V-shaped nature of ditch **1104** tentatively suggesting that this may date to the prehistoric period.

Further use of the land was visible from the platforms revealed in Trenches 06 (**603**) and 10 (**1002**). These platforms, located within the same area to the east of the current water treatment works, suggest that the natural slope of the ground in this area was modified so as to provide flatter areas for the growing of crops. There is also the possibility that these platforms were used for settlement, although no evidence for this was uncovered during the evaluation. However settlements on south facing platforms are not uncommon, and evidence for this may survive outwith the evaluation area.

Directly to the north of the water treatment works settlement evidence was revealed in the form of a roundhouse ditch (**103**), a small pit (**203**), and a linear ditch (**1402**). The roundhouse is likely to be prehistoric in date, and carbon dating of charcoal recovered from the lower fill of the ditch (**107**) is recommended so that a definitive date can be assigned. It is possible that the ditch and pit are contemporary with the roundhouse, and form part of the same settlement, although no dating evidence was uncovered within any of the features. Given the roundhouse's ideal location close to a river it is likely that this is not an isolated feature, but rather it is part of a larger settlement, further evidence of which may still survive in this area in the form or further roundhouses, enclosures, and/ or associated features.

The anomalies that were recorded by the geophysical survey but not targeted by the evaluation may represent archaeological features given that evidence of activity throughout the site has been uncovered. However, given the amorphous nature of some of these anomalies (such as those in the southeastern and southwestern corners of the site), it is also possible that they represent natural features such as bioturbation or animal burrows.

Given the evidence for settlement activity uncovered during the evaluation, it is likely that further archaeological features may survive in the areas that showed no anomalies on the geophysical survey and were therefore not targeted by the evaluation. The absence of any anomalies may be a result of any remains being un-magnetic; the truncation of any features by ploughing (such as Pit **203**); the destruction of features by the building of the compound for the construction of the water treatment plant in this area (The concentration of stones located within the topsoil of Trench 02, similar as they are to those within the uppermost fill of the roundhouse ditch, may represent such destruction); or by the masking of features by the magnetic disturbance of nearby metal objects, such as in the areas directly to the west and north of the roundhouse (**103**).

Due to the unknown size of the settlement uncovered during the evaluation, and with archaeological features uncovered towards both the eastern and western extents of the development, it was recommended in the report that a programme of controlled stripping of the entire development site was carried out to allow for the full extent and nature of the settlement on the site to be known, as well as providing evidence for any truncation or destruction.

It is currently understood that GAT Report **1092** Feature 5: Pen Bryn yr Orsedd Rock Outcrop and Earthen Mound, which is currently interpreted as a medieval meeting place, is not directly affected by either the Stage 1 or Stage 2 works and will not be mitigated at this time. There is still potential for associated activity to be identified within the surrounding areas including the controlled strip zones.

Method Statement

Black & Veatch/GT Williams Enabling Works Programme

Based on current information *G T Williams Ltd* will complete the enabling works across Zones A, B and the main WTW between **29/05/13** to **18/07/13**. *Black and Veatch Ltd* drawing **174357-30-9114** (reproduced as Figure 1), identifies the location of the site compound (Zone A), the main WTW to the north of the existing WTW and the soil storage area (Zone B).

Zone A will be undertaken from 29/05/13, with the topsoil stripped to a mean depth of 140mm (Russell Brown *Black & Veatch pers comm.*) and then sealed with geotextile membrane; infrastructure, including below ground services, will be established between 12/06/13 and 17/07/13.

Preparation work for Zone B will be completed between 13/06/13 and 20/06/13 and will include topsoil removal and the breaching of Feature 4. The programme also lists the installation of geotextile membrane and stone. No underground services are listed here on the programme.

The main WTW area will include the removal of all topsoil and Feature 3 boundary wall breach. Geotextile membrane and then stone will be laid within the area, according to the current programme, between 03/07/13 and 10/07/13. Electrical services and lighting will be established on site between 11/07/13 and 16/07/13.

The haul road that is located on *Black and Veatch Ltd* amended drawing **174357-30-9114** is not listed on the programme but will form part of the main works area.

Please note: these timings are as currently as determined by the site contractor and are subject to change. The identification of archaeological activity in any of the zones can affect this programme.

Archaeological watching brief

(Reproduced from *Institute for Archaeologists 1994 rev. 2001 and 2008 Standard and Guidance for an archaeological watching brief)*

The definition of an archaeological watching brief is a formal programme of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.

This definition and *Standard* do not cover chance observations, which should lead to an appropriate archaeological project being designed and implemented, nor do they apply to monitoring for preservation of remains *in situ.*

An archaeological watching brief is divided in to four categories according to the *Institute for Archaeologists Standard and Guidance for an archaeological watching brief:*

- comprehensive (present during all ground disturbance)
- intensive (present during sensitive ground disturbance)
- intermittent (viewing the trenches after machining)
- partial (as and when seems appropriate).

GAT recommends the following mitigation strategy, to be approved by GAPS.

- An **intensive watching brief** within Zone A during topsoil stripping scheduled from 30/07/13. Based on current client information, the mean topsoil strip depth will be 140mm (Russell Brown *Black & Veatch pers comm.*). GAT will monitor this depth across the zone to determine if this will be exceeded and whether further archaeological mitigation will be required were this to happen and/or any archaeological activity identified. Based on received service information, Zone A is

dominated by two underground water mains that cross the site on a southwest-northeast orientation (also visible in *Stratascan* report **J3297** Figure 3).
NOTE: bulldozer style machines fitted with blades cannot be monitored in a safe and effective way by the archaeological mitigation team and it is recommended that only tracked excavators fitted with toothless buckets are used for topsoil removal.

- An **intensive watching brief** within Zone B during topsoil stripping scheduled from 13/06/13. This area will be subsequently targeted by an archaeological controlled strip (cf. para. 3.3).
NOTE: bulldozer style machines fitted with blades cannot be monitored in a safe and effective way by the archaeological mitigation team and it is recommended that only tracked excavators fitted with toothless buckets are used for topsoil removal.

- An **intensive watching brief** within the main WTW zone identified on *Black and Veatch Ltd* drawing **174357-30-9114**, incorporating the main footprint of the WTW as well as the two landscaping bunds and haul road located on *Black and Veatch Ltd* drawing **174357-30-9114**. This area will be subsequently targeted by an archaeological controlled strip (cf. para. 3.3).
NOTE: bulldozer style machines fitted with blades cannot be monitored in a safe and effective way by the archaeological mitigation team and it is recommended that only tracked excavators fitted with toothless buckets are used for topsoil removal.

- **The watching brief will be undertaken in a manner that allows for the immediate cessation of the main contractor groundworks for the recording of archaeological evidence. This will involve close liaison between the archaeologist and the site agent and the instigation of a further archaeological works mitigation programme (cf. para. 4.0)**

- A photographic record will be maintained throughout, using a digital SLR camera set to maximum resolution.

- Any subsurface remains will be recorded photographically, with detailed notations and a measured survey.
- Any further mitigation required will be subject to an additional Further Archaeological Works Design (FAWD) to be approved by GAPS.

The archive will then be held by GAT under an appropriate project number (**G2293**)

Archaeological Controlled Strip

GAT has recommended an archaeological **controlled strip** for the main WTW zone and Zone B.

This will be completed in the following sequence:

- Controlled strip of the haul road in the main WTW zone;
- Controlled strip of Zone B;
- Controlled strip of the main WTW zone

This sequence is required to allow the haul road linking Zone A to Zone B to be completed at the start of the works.

Please note in all instances that GAPS must approve all archaeological works within the controlled strip zones and sign-off the relevant areas prior to the start of any contractor works, including the haul road.

In general the controlled strip will involve the GAT mitigation team working with the *G T Williams Ltd* plant operator and banksman to strip the footprint of the designated areas to the glacial horizon and mitigate any archaeological activity identified within the footprint. Any areas of archaeological potential will be cleaned by hand. Where complex archaeological deposits are identified during stripping, these will be identified at an early stage in order to formulate a defined area of work. This technique relies upon the recognition of features by plan; excavation of features will be kept to the minimum required to assess the nature and importance of the remains and to allow a suitable archaeological mitigation strategy. The mitigation strategy may require the production of a further works design (FAWD) generated by GAT and reviewed and approved by GAPS and the client (cf. para. 4.0).

Controlled strip of the haul road in the main WTW zone

Removal of the remaining topsoil and the subsoil horizons will be undertaken by a 360º tracked excavator with a toothless bucket of suitable size. The soil will be removed in thin spits down to either the top of significant archaeological deposits or to the initial glacial horizon. The stripping will be constantly monitored by an archaeologist to ensure that the right level is reached and to identify finds or layers that appear during stripping.

The precise length and width of the haul road is not currently understood, but the location is partly indicated on *Black and Veatch Ltd* drawing **174357-30-9114** as parallel to the northern boundary of the existing WTW. Two service pipes are known to run parallel to Feature 03 (Boundary Wall), from a service chamber to the existing WTW. The haul road will partly cross this location and will run in very close proximity to Feature 103, a curvilinear ditch of possible prehistoric date, identified both during the geophysical survey and subsequently in GAT trial trench 01 (GAT Report **1123**). *The feature was not fully exposed during the trial trench and it is possible that this feature or activity associated with it could be identified during the controlled strip.* ***Please note that the subsequent investigation of archaeological features could delay the completion of the haul road at this location and along the route as a whole.***

The archaeologist will not act as a banksman. GAT will work under *Black and Veatch Ltd* CDM throughout.

All identified archaeological contexts within the controlled strip locations will be excavated manually unless otherwise agreed with the curator in advance. All archaeological contexts subsequently located must be adequately sampled in order to define their function, date, and relationship to adjacent features.

- The site will be planned to scale and a digital survey completed using a Total Station or survey quality Global Positioning System (if required).

- A written record of the trench content and all identified features will be completed via pro-forma sheets
- All subsurface features will be recorded photographically using a digital SLR camera set to high resolution.
- Features and layers will be excavated only enough to establish their depth, character and if possible their date. The assumption is that excavation will be kept to a minimum. Any artefacts found during these investigations will be collected and where charcoal-rich deposits are found or other deposits likely to contain palaeoenvironmental information these will be sampled as appropriate.

Controlled strip of Zone B

The controlled strip will be completed after an initial topsoil strip.

The archaeological evaluation of Zone B (GAT Report **1123**), identified two parallel linear ditches (Contexts **1102** and **1104**), 1.8m apart and aligned north-south, within Trench 11 cutting into the natural geology (**1101**) towards the middle of Trench 11 (Figure 9). Ditch **1102** measured 1.4m in width, with a depth of 0.2m. It had a concave base with a steep sloping side to the single silted up deposit of greyish brown gravelly clayey silt (**1103**). No finds were recovered from either of the ditches, and no other features were uncovered within the trench, but they were interpreted as earlier field systems of currently unknown date, although the V-shaped nature of ditch **1104** tentatively suggested that this may date to the prehistoric period. It is expected that further evidence for the ditches will be identified during the controlled strip.

Removal of any remaining topsoil and the subsoil horizons will be undertaken by a 360º tracked excavator with a toothless bucket of suitable size. The soil will be removed in thin spits down to either the top of significant archaeological deposits or to the initial glacial horizon. The stripping will be constantly monitored by an archaeologist to ensure that the right level is reached and to identify finds or layers that appear during stripping.

As indicated on *Black and Veatch Ltd* drawing **174357-30-9114**, an initial topsoil bund will be deposited along the northern boundary of Zone B, parallel to the A487 trunk road. This bound will be placed on top of an existing main (visible in *Stratascan* report **J3297** Figure 3). GAT is recommending that this bund area is not subject to a controlled strip due to the presence of the main beneath and associate ground disturbance. The remainder of the zone will be controlled stripped. As Zone B will be used for storing all topsoil and subsoil removed from Zone A and the WTW, it will not be possible to remove the controlled strip material from Zone B to an alternate location. GAT's current proposal is to strip the zone in portions, stripping a selected area and storing to the side, signing that area off under GAPS authorisation, backfilling and stripping the next portion until the entire area is completed. *Note: this will require approval by GAPS prior to instigation*.

The archaeologist will not act as a banksman. GAT will work under *Black and Veatch Ltd* CDM throughout.

All identified archaeological contexts within the controlled strip locations will be excavated manually unless otherwise agreed with the curator in advance. All archaeological contexts subsequently located must be adequately sampled in order to define their function, date, and relationship to adjacent features.

- The site will be planned to scale and a digital survey completed using a Total Station or survey quality Global Positioning System (if required).
- A written record of the trench content and all identified features will be completed via pro-forma sheets
- All subsurface features will be recorded photographically using a digital SLR camera set to high resolution.
- Features and layers will be excavated only enough to establish their depth, character and if possible their date. The assumption is that excavation will be kept to a minimum. Any artefacts found during these investigations will be collected and where charcoal-rich deposits are found or other deposits likely to contain palaeoenvironmental information these will be sampled as appropriate.

Controlled strip of main WTW

The controlled strip will be completed after an initial topsoil strip and will incorporate the footprint of the proposed WTW as well as the landscaping bunds indicated on *Black and Veatch Ltd* drawing **174357-30-9114**. The haul road portion will be completed in advance (as discussed in para. 3.3.1)

The main WTW was the location for GAT Report **1123 Trenches 1** to **10** and **12** (cf. Figure 2). Five of the trenches, nos. 03-04, 08-09, and 12) revealed no evidence of any archaeological activity, while Trench 07 only revealed an animal burrow. Archaeological activity was identified in Trenches 01, 02, 05, 06 and 10.

Trench 01

Trench 01 measured 20m by 2m with a 2m by 2m extension on its western side. A curvilinear ditch (**103**) was revealed cutting into the natural geology (**102**), an orangey grey silty sand, along the western side of the trench. The ditch measured 1m in width with a maximum depth of 0.25m, and had steep sloping sides with a concave base. The basal fill of the ditch (**107**) consisted of a 0.04m thick layer of greyish brown clayey silt and charcoal which was sealed by a light whitish grey sandy clay, 0.03m thick. This in turn was sealed by a silted up layer of greyish brown clayey silt (**105**), 0.05m thick. The uppermost fill of the ditch consisted of a 0.15m thick concentration of sub-rounded stones within a greyish brown clayey silt (**104**) similar to (**105**). No finds were recovered from the fills of this ditch, and no other features were revealed within the trench. This was interpreted as a circular ditch for a roundhouse structure, indicating at least small scale settlement in this area.

Trench 02

A shallow circular pit (**203**), measuring approximately 0.9m in diameter and 0.1m in depth was uncovered within Trench 02 cutting into the natural geology (**202**). It had shallow sides with a fairly flat base and was filled with a single silted up deposit consisting of a greyish brown clayey silt (**204**). No finds were recovered from this feature.

Trench 05

Two parallel linear ditches (**502** and **504**), 1.5m apart and aligned ENE-WSW, were uncovered cutting into the natural geology (**501**) towards the middle of Trench 05. Ditch **502** measured 1m in width, with a depth of 0.3m and had steep sloping sides and a concave base (. It was filled with a single silted up deposit of greyish brown stony silt (**503**).

Ditch **504** measured 0.6m in width with a depth of 0.1m and had uneven sides and an uneven base. It was filled with a single silted up deposit (**505**) comprising of greyish brown stony silt. No finds were recovered from either of the ditches, and no other features were uncovered within the trench. As with the ditches in Zone B, but they were interpreted as earlier field systems of currently unknown date.

Trench 06

An approximately 2.1m wide linear feature (**603**), aligned NNW-SSE, was uncovered towards the middle of Trench 06. The WSW side of the feature had a steeply sloping, 0.2m deep side which gave way to the natural slope of the natural geology (**602**). The ENE side was very ephemeral, which may have been due to plough damage or that there was no other side and that the feature represents a platform, formed by cutting into the natural on one side and creating a levelled off area. No finds were recovered from this feature. No datable artefacts were recovered but it is thought possible that further evidence could be found during the controlled strip.

Trench 10

Trench 10 measured 20m by 2m, with a 5m by 5m extension on its northeastern side at its northwestern end. A large, stepped, linear feature (**1002**) was uncovered at the northwestern end of the trench, aligned northeast-southwest. It measured approximately 3.7m in width and consisted of two fairly steep cuts into the natural geology, forming two fairly flat platforms. The uppermost platform measured approximately 2.2m in width and had a depth of 0.32m, while the lower platform measured 1.5m in width with a depth of 0.2m. The upper platform was filled with a silted up deposit of greyish brown clayey silt (**1003**) similar to the subsoil (**1000**). A concentration of sub-rounded stones (**1004**) filled the lower platform, which may have been used as a border for the upper platform. No finds were recovered from the fills of either platform.

<u>In all cases, further activity associated with these features is expected during the controlled strip.</u>

Removal of any remaining topsoil and the subsoil horizons will be undertaken by a 360º tracked excavator with a <u>toothless</u> bucket of suitable size. The soil will be removed in thin spits down to either the top of significant archaeological deposits or to the initial glacial horizon. The stripping will be constantly monitored by an archaeologist to ensure that the right level is reached and to identify finds or layers that appear during stripping.

<u>The archaeologist will not act as a banksman. GAT will work under *Black and Veatch Ltd* CDM throughout.</u>

All identified archaeological contexts within the controlled strip locations will be excavated manually unless otherwise agreed with the curator in advance. All archaeological contexts subsequently located must be adequately sampled in order to define their function, date, and relationship to adjacent features.

- The site will be planned to scale and a digital survey completed using a Total Station or survey quality Global Positioning System (if required).

- A written record of the trench content and all identified features will be completed via pro-forma sheets

- All subsurface features will be recorded photographically using a digital SLR camera set to high resolution.

- Features and layers will be excavated only enough to establish their depth, character and if possible their date. The assumption is that excavation will be kept to a minimum. Any artefacts found during these investigations will be collected and where charcoal-rich deposits are found or other deposits likely to contain palaeoenvironmental information these will be sampled as appropriate.

Paleoenvironmental Assessment/Mitigation

If palaeoenvironmental activity of note is identified within any of the mitigation zones, then recourse to the specialist for advice is recommended both on recovering any samples and any further mitigation (including assessment and analysis) resulting from this.

Further Archaeological Works

- **<u>The identification of significant archaeological features during the groundworks/archaeological watching brief may necessitate further archaeological works. This may require the submission of new cost estimates to the contractor.</u> Any further mitigation required will be subject to an additional Further Archaeological Works Design (FAWD) to be approved by GAPS.**
- **This design does not include a methodology or cost for examination of, conservation of, or archiving of finds discovered during the watching brief, nor of any radiocarbon dates required, nor of examination of palaeoenvironmental samples. The need for these will be identified in the post-fieldwork programme (if required), and a new design will be issued for approval by the GAPS Archaeologist.**

Human Remains

Any finds of human remains will be left *in-situ*, covered and protected, and both the coroner and the GAPS Archaeologist informed. If removal is necessary it will take place under appropriate regulations and with due regard for health and safety issues. In order to excavate human remains, a licence is required under Section *25* of the Burials Act 1857 http://www.legislation.gov.uk/ukpga/Vict/20-21/81/introduction for the removal of any body or remains of any body from any place of burial. This will be applied for should human remains need to be investigated or moved.

Small Finds

The vast majority of finds recovered from archaeological excavations comprise pottery fragments, bone, environmental and charcoal samples, and non-valuable metal items such as nails. Often many of these finds become unstable (i.e. they begin to disintegrate) when removed from the ground. All finds are the property of the landowner, however, it is Trust policy to recommend that all finds are donated to an appropriate museum where they can be stored and made available for future study. Access to finds must be granted to the Trust for a reasonable period to allow for analysis and for study and publication as necessary. All finds would be treated according to advice provided within *First Aid for Finds* (Rescue 1999). Trust staff will undertake initial identification, but any additional advice would be sought from a wide range of consultants used by the Trust.

Unexpected Discoveries: Treasure Trove

Treasure Trove law has been amended by the Treasure Act 1996. http://www.legislation.gov.uk/ukpga/1996/24/contents

The following are Treasure under the Act:

- *Objects other than coins* any object other than a coin provided that it contains at least 10% gold or silver and is at least 300 years old when found.
- *Coins* all coins from the same find provided they are at least 300 years old when found (if the coins contain less than 10% gold or silver there must be at least 10). Any object or coin is part of the same find as another object or coin, if it is found in the same place as, or had previously been left together with, the other object. Finds may have become scattered since they were originally deposited in the ground. Single coin finds of gold or silver are not classed as treasure under the 1996 Treasure Act.
- *Associated objects* any object whatever it is made of, that is found in the same place as, or that had previously been together with, another object that is treasure.
- *Objects that would have been treasure trove* any object that would previously have been treasure trove, but does not fall within the specific categories given above. These objects have to be made substantially of gold or silver, they have to be buried with the intention of recovery and their owner or his heirs cannot be traced.

The following types of finds are not treasure:

- Objects whose owners can be traced.
- Unworked natural objects, including human and animal remains, even if they are found in association with treasure.
- Objects from the foreshore which are not wreck.

All finds of treasure must be reported to the coroner for the district within fourteen days of discovery or identification of the items. Items declared Treasure Trove become the property of the Crown, on whose behalf the National Museums and Galleries of Wales acts as advisor on technical matters, and may be the recipient body for the objects.

The National Museums and Galleries of Wales will decide whether they or any other museum may wish to acquire the object. If no museum wishes to acquire the object, then the Secretary of State will be able to disclaim it. When this happens, the coroner will notify the occupier and landowner that he intends to return the object to the finder after 28 days unless he receives no objection. If the coroner receives an objection, the find will be retained until the dispute has been settled.

Post-excavation Phase

Introduction

The management of this phase will follow guidelines specified in Management of Archaeological Projects (English Heritage, 1991), and relevant guidelines from Management of Research Projects in the Historic Environment (English Heritage 2006). Five stages are specified:

- Phase 1: project planning
- Phase 2: fieldwork
- Phase 3: assessment of potential for analysis
- Phase 4: analysis and report preparation
- Phase 5: dissemination

The post-excavation stage for the project will include Phases 3 to 5.

Phase 3 involves an objective assessment of the results of the fieldwork phases (Phases 1 and 2) in order to ascertain the appropriate level of post-excavation analysis and reporting. This phase culminates in the production of a post-excavation assessment report. The second involves carrying out the work identified within the post-excavation assessment report, and culminates in a final report and project archive (Phases 4 and 5).

<u>NOTE: any outstanding post-excavation material from the evaluation phase (GAT Report **1123**), will also be included as part of this stage.</u>

Post-excavation assessment

The level of post-excavation analysis and reporting for the purposes of the evaluation will be sufficient to establish the character, scale, date range, artefactual and palaeo-environmental potential and overall significance of the remains.

Style and format of the report will include as a minimum the following:

- A location plan of trenches and/or other fieldwork
- Plans and sections of features located at an appropriate scale
- A section drawing showing depth of deposits including the present ground level with Ordnance Datum, vertical and horizontal scale.
- A summary statement of the results.
- A table summarising per trench the features, classes and numbers of artefacts contained within, spot dating of significant finds and an interpretation.
- An interpretation of the archaeological findings both within the site and within their wider landscape setting.

Artefact analysis will be sufficient to establish date ranges of archaeological deposits, a general assessment of the types of pottery and other artefacts to assist in characterising the archaeology, and to establish the potential for all categories of artefacts should further archaeological work be necessary.

Analysis and report preparation

The work undertaken during this phase of the project will be carried out according to the recommendations contained within the post-excavation assessment report.

Production of site archive

A full archive including plans, photographs, written material and any other material resulting from the project will be prepared. All plans, photographs and descriptions will be labelled and cross-referenced, and lodged in an appropriate place (to be decided in consultation with the regional Sites and Monuments Record) within six months of the completion of the project. All digital data will be written to CD-ROM and stored with the paper archive.

Processing Data, Illustration, Report and Archiving

Following completion of the watching brief as outlined above, a report will be produced incorporating the following:

- Non-technical summary
- Introduction
- Specification and Project Design
- Methods and techniques
- Archaeological Background
- Description of the results of the mitigation
- Summary and conclusions
- Bibliography of sources consulted.

Illustrations, including plans and photographs, will be incorporated within the report.

A full archive including plans, photographs, written material and any other material resulting from the project will be prepared. All plans, photographs and descriptions will be labelled and cross-referenced, and lodged in an appropriate place (to be decided in consultation with the regional Historic Environment Record) within six months of the completion of the project. All digital data will be written to CD-ROM and stored with the paper archive.

- one or more copies (as required) will be sent to the client

- one or more copies (as required) will be sent to GAPS

- one or two copies (as required) sent to the Historic Environment Record Archaeologist for the area (HER, Gwynedd Archaeological Trust, Craig Beuno, Bangor, Gwynedd LL57 2RT);

- copies of all key digital files on optical media should be provided to GAPS and the Regional HER, including report, photographs, scans of maps etc.

- a copy of the report and/or digital files on optical media should be provided to the National Monument Record (Royal Commission on the Ancient and Historic Monuments of Wales, Aberystwyth, SY23 1NJ) dependent upon their requirements.

Staff

The project will be supervised by a Senior Archaeologist at GAT Contracts Section. The work will be carried out by fully trained Project Archaeologists who are experienced in conducting watching briefs and working with contractors and earth moving machinery. (Full CV's are available upon request).

Health & Safety

The Trust subscribes to the SCAUM (Standing Conference of Archaeological Unit Managers) Health and Safety Policy as defined in **Health and Safety in Field Archaeology** (1999).

Insurance

Liability Insurance - Aviva Policy 24765101CHC/00045

- Employers' Liability: Limit of Indemnity £10m in any one occurrence
- Public Liability: Limit of Indemnity £5m in any one occurrence
- Hire-in Plant Insurance: £50,000.00 any one item;
  £250,000.00 any one claim

The current period expires 21/06/13

Professional Indemnity Insurance – RSA Insurance Plc P8531NAECE/1028

- Limit of Indemnity £5,000,000 any one claim

The current period expires 22/07/13

Bibliography

Black & Veatch Ltd drawing number **174357-30-9000**

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Institute for Archaeologists, 1994, rev. 2001 & 2008 *Standard and Guidance for Archaeological Evaluation*

Institute for Archaeologists, 1994, rev. 2001 & 2008 *Standard and Guidance for Archaeological Watching Brief*

McNicol, D. 2013. Gwynedd Archaeological Trust Report **1123** Dolbenmaen Water Treatment Works, Dolbenmaen - Archaeological Evaluation

Smith, S. 2012. Gwynedd Archaeological Trust Report **1092**: *Garndolbenmaen Water Treatment Works - Archaeological Assessment (G2293)*

Smith, S. 2012. Gwynedd Archaeological Trust Report **1098**: *Garndolbenmaen Water Treatment Works - Archaeological Watching Brief: Ground Investigation Works (G2293)*

28 APPENDIX XV: LIST OF FINDS FROM G2293

Find No	Context No	Material	Period	No of items	Weight (g)	Description	Discarded?
1	1511	stone	Natural	1	0	Broken unworked stone initially thought to be possible quern	Discarded
2	1511	stone	Natural	1	0	Natural cobble collected as possible grinding stone	Discarded
3	1538	stone	Natural	1	0	Natural cobble collected as possible hammerstone	Discarded
4	1585	stone	Unknown	1	730	Fire-shattered burnt cobble fragment	
5	1611	Cu alloy	15th century AD	1	4	Thimble	
6	1611	stone	15th century AD?	1	231	Polished stone	
7	1649	bone	Unknown	0	15	Fragments of burnt bone, includes some sheep bone (from sample 36)	
8	1549	bone	Early medieval	0	2	Fragments of burnt bone (from sample 13)	
9	1585	bone	Bronze Age??	0	1	Fragments of burnt bone (from sample 16)	
10	1603	bone	Late medieval	0	1	Fragments of burnt bone, includes medium-sized mammal bone frags (from sample 17)	
11	1591	bone	Unknown	0	1	Fragments of burnt bone (from sample 18)	
12	1601	bone	Unknown	0	1	Fragments of burnt bone (from sample 24)	
13	1605	bone	Unknown	0	1	Fragment of burnt bone (from sample 25)	
14	1609	bone	Unknown	0	1	Fragments of burnt bone, includes some sheep bone (from sample 27)	
15	1612	bone	Unknown	0	4	Fragments of burnt bone, includes cattle-sized metapodia frags (from sample 29)	
16	1620	bone	Unknown	0	1	Fragments of burnt bone (from sample 47)	
17	1631	bone	Post medieval?	0	1	2 tiny fragments of burnt bone (from sample 51)	
18	1638	bone	Post medieval?	0	1	Fragments of burnt bone (from sample 52)	
19	1645	bone	medieval?	0	1	Fragments of burnt bone (from sample 39)	
20	1647	bone	Unknown	0	1	Fragments of burnt bone (from sample 34)	
21	1650	bone	Unknown	0	1	Fragments of burnt bone (from sample 37)	
22	1651	bone	Unknown	0	1	Fragments of burnt bone (from sample 35)	
23	1665	bone	medieval?	0	1	Fragments of burnt bone (from sample 54)	
24	1667	bone	medieval	0	11	Fragments of burnt bone, includes some sheep bone (from sample 55)	
25	1669	bone	medieval	0	4	Fragments of burnt bone, includes medium-sized mammal bone frags (from sample 56)	
26	1506	glass	Modern	1	348	Whole cast glass bottle, labelled "Masons OK Sauce"	Discarded
27	1531	pot	Post medieval	2	7	Two small sherds of post med pot	
28	1551	glass	Modern	1	55	Base of cast glass bottle	Discarded
29	1557	glass	Post medieval	2	11	Sherd of glass and sherd of post med pot	Discarded
30	1583	pot	15th century AD	2	29	One sherd of brown glazed pottery broken into two	
31	1550	pot	Post medieval	1	14	Sherd of post med pot	

29 APPENDIX XVI: LIST OF CONTEXTS

Context No	Type	Description
100	Topsoil	Dark greyish brown sandy silt, 0.15m deep
101	Subsoil	Brownish grey sandy silt, 0.3m deep
102	Natural	Reddish brown sandy clay
103	Ring Ditch	Ring Ditch, 1m wide, 0.25m deep
104	Fill	Stone fill of ditch [103]
105	Fill	Greyish brown clayey silt fill of [103]
106	Fill	Light whitish grey sandy clay fill of [103]
107	Fill	Greyish brown clayey silt fill of [103]
200	Topsoil	Dark greyish brown sandy silt, 0.2 - 0.45m deep
201	Subsoil	Brownish grey sandy silt, 0.2 - 0.25m deep
202	Natural	Reddish brown sandy clay
203	Pit	Circular pit, 0.9m in diameter, 0.1m deep
204	Fill	Greyish brown clayey silt fill of [203]
300	Topsoil	Dark greyish brown sandy silt, 0.35m deep
301	Subsoil	Greyish brown sandy silt, 0.2m deep
302	Natural	Dark yellowish brown sandy clay
400	Topsoil	Dark greyish brown sandy silt, 0.3m deep
401	Natural	Mottled, grey, brown, reddish brown and yellowish brown sandy clay
500	Topsoil	Dark greyish brown sandy silt, 0.3m deep
501	Natural	Mottled sandy gravel and light yellowish brown sandy clay
502	Ditch	Linear Ditch, 1m wide, 0.3m deep
503	Fill	Greyish brown stony silt fill of [502]
504	Ditch	Linear Ditch, 0.6m wide, 0.1m deep
505	Fill	Greyish brown stony silt fill of [504]
600	Topsoil	Dark greyish brown sandy silt, 0.4m deep
601	Subsoil	Greyish brown sandy silt, 0.25m deep
602	Natural	Sandy gravel at ENE end, yellowish brown sandy clay at WSW
603	Platform?	Possible Platform, 2.1m wide, 0.2m deep
604	Fill	Greyish brown clayey silt fill of [603]
700	Topsoil	Dark greyish brown sandy silt, 0.3m deep
701	Subsoil	Greyish brown sandy silt, 0.25m deep
702	Natural	Yellowish brown sandy clay
703	Animal Burrow	Animal Burrow
800	Topsoil	Dark greyish brown sandy silt, 0.2m deep
801	Natural	Sandy gravel
900	Topsoil	Dark greyish brown sandy silt, 0.2 - 0.4m deep
901	Natural	Mottled gravelly sandy clay
1000	Topsoil	Dark greyish brown sandy silt, 0.6m deep
1001	Natural	Sandy gravel at NNW end, rest yellowish brown sandy clay
1002	Platform?	Possible Platform, 3.7m wide, 0.32m deep
1003	Fill	Greyish brown clayey silt and gravel fill of [1002]
1004	Fill	Greyish brown clayey silt and gravel fill of [1002]
1100	Topsoil	Dark greyish brown sandy silt, 0.2m deep
1101	Natural	Sandy gravel
1102	Ditch	Linear Ditch, 1.4m wide, 0.2m deep

Context No	Type	Description
1103	Fill	Greyish brown stony silt fill of [1102]
1104	Ditch	Linear Ditch, 1.2m wide, 0.37m deep
1105	Fill	Greyish brown stony silt fill of [1104]
1106	Fill	Reddish brown gravelly silt fill of [1104]
1200	Topsoil	Dark greyish brown sandy silt, 0.3m deep
1201	Subsoil	Greyish brown sandy silt, 0.2m deep
1202	Natural	Bedrock
1300	Topsoil	Dark greyish brown sandy silt, 0.3m deep
1301	Natural	Bedrock
1400	Topsoil	Dark greyish brown sandy silt, 0.3m deep
1401	Natural	Reddish brown sandy clay and gravel
1402	Ditch	Linear Ditch, 1.5m wide, 0.1m deep
1403	Fill	Greyish brown clayey silt fill of [1402]
1500	Topsoil	Greyish brown sandy silt
1501	Natural	Reddish brown sandy loam with gravel patches throughout
1502	Field Boundary	Upstanding linear field boundary, 1.5m wide, 0.6m high
1503	Pit	Sub-rectangular pit, 1.8m x 0.58m x 0.08m
1504	Fill	Yellowish grey silty sand fill of [1503]
1505	Field Boundary	Upstanding linear field boundary, 2.5m wide, 1m high
1506	Field Boundary	Upstanding linear field boundary, 1.5m wide, 0.85m high
1507	Subsoil	Greyish brown sandy silt
1508	Posthole	Posthole with packing stones, 0.5m diameter, 0.38m deep
1509	Fill	Light-mid greyish brown sandy silt, fill of [1508]
1510	Posthole	Posthole with packing stones, 0.58m diameter, 0.33m deep
1511	Fill	Light-mid greyish brown sandy silt, fill of [1510]
1512	Hollow	Shallow sub-oval hollow, 0.85m x 0.8m x 0.08m
1513	Fill	Mid-dark greyish brown sandy silt, fill of [1512]
1514	Pit	Rectangular pit, 1.3m x 0.85m x 0.21m
1515	Fill	Mid-dark greyish brown clayey silt, fill of [1514]
1516	Posthole	Posthole, 0.65m diameter, 0.48m deep
1517	Fill	Greyish brown sandy silt, fill of [1516]
1518	Posthole	Posthole, 0.75m diameter, 0.37m deep
1519	Fill	Dark orangey brown sandy silt, fill of [1518]
1520	Posthole	Posthole, 0.73m diameter, 0.34m deep
1521	Fill	Dark brown clayey silt, fill of [1520]
1522	Posthole	Posthole, 0.68m diameter, 0.48m deep
1523	Fill	Greyish brown sandy silt, fill of [1522]
1524	Ditch	Linear ditch, 0.7m wide, 0.24m deep
1525	Fill	Mid-dark greyish brown clayey silt, fill of [1524]
1526	Hollow	Circular shallow hollow 0.8m x 0.7m x 0.13m
1527	Fill	Mid-dark greyish brown clayey silt, fill of [1527]
1528	Ditch	Linear ditch - Same as [1102]
1529	Fill	Same as (1103), fill of [1528]
1530	Ditch	Linear ditch - Same as [1104]
1531	Fill	Same as (1105), fill of [1530]
1532	Fill	Same as (1106), fill of [1530]
1533	Void	Void
1534	Posthole	Sub oval posthole with packing stones, 0.77m x 0.6m x 0.4m
1535	Void	Void
1536	Void	Void

Context No	Type	Description
1537	Fill	Brownish grey silty loam, fill of [1534]
1538	Fill	Brownish grey silty loam, fill of [1534]
1539	Pit	Oval pit, 0.88 x 0.75m x 0.32m
1540	Fill	Greyish brown sandy silt, fill of [1539]
1541	Void	Void
1542	Void	Void
1543	Ditch	Linear gully, 0.4m wide, 0.1m deep
1544	Fill	Greyish brown sandy silt, fill of [1543]
1545	Pit	Sub circular pit, 1.1m x 0.65m x 0.22m
1546	Fill	Black sandy silt, fill of [1545]
1547	Pit	Sub oval pit, 2.8m x 1.6m x 0.75m
1548	Fill	Greyish brown sandy silt, fill of [1547]
1549	Fill	Black sandy silt, fill of [1547]
1550	Fill	Grey stony silt, fill of [1547]
1551	Fill	Greyish brown stony silt, fill of [1547]
1552	Pit	Sub circular pit, 1.2m x 1m x 0.18m
1553	Fill	Mid-dark greyish brown silty sand, fill of [1552]
1554	Pit	Circular pit? 1m x 0.75m x 0.29m
1555	Fill	Greyish brown sandy silt, fill of [1554]
1556	Ditch	Linear ditch, 0.85m wide, 0.25m deep
1557	Fill	Brownish grey sandy silt, fill of [1556]
1558	Pit	Circular pit, 0.95m diameter, 0.23m deep
1559	Fill	Dark brownish grey sandy silt, fill of [1558]
1560	Pit	Sub oval pit, 2.65m x 1.1m x 0.35m
1561	Ditch	Linear ditch, 0.9m wide, 0.19m deep
1562	Pit	Oval pit, 0.8m x 0.64m x 0.18m
1563	Fill	Dark greyish black burnt sandy silt, fill of [1562]
1564	Fill	Light greyish yellow silty sand, fill of [1562]
1565	Natural	Natural
1566	Pit	Circular pit, 1.2m diameter, 0.25m deep
1567	Fill	Greyish brown sandy silt, fill of [1566]
1568	Ditch	Linear gully, 0.5m wide, 0.1m deep (average)
1569	Fill	Greyish brown sandy silt, fill of [1568]
1570	Ditch	Linear gully, 0.7m wide, 0.18m deep
1571	Fill	Greyish brown gravelly silt, fill of [1570]
1572	Ditch	Linear gully, 0.4m wide, 0.1m deep
1573	Fill	Greyish brown gravelly silt, fill of [1572]
1574	Posthole	Posthole? 0.5m diameter, 0.19m deep
1575	Fill	Dark greyish brown sandy silt, fill of [1574]
1576	Fill	Brownish grey silty loam, fill of [1560]
1577	Fill	Dark greyish red, heated silty clay, fill of [1560]
1578	Fill	Light orangey grey clayey loam, fill of [1560]
1579	Fill	Brownish grey sandy silt, fill of [1561]
1580	Ditch	Linear gully, 0.7m wide, 0.25m deep
1581	Fill	Greyish brown sandy silt, fill of [1580]
1582	Scarp	Semi-circular natural scarp, partially enhanced, 44m diameter, 3.5m width, 0.7m deep (average)
1583	Layer	Fairly square stone pad, 0.48m x 0.42m x 0.28m
1584	Posthole	Posthole with packing stones, 0.46m diameter, 0.44m deep
1585	Fill	Brownish grey silty sand, fill of [1584]

Context No	Type	Description
1586	Pit	Sub rectangular stone-filled pit, 1.1m x 0.6m x 0.4m
1587	Fill	80% stones with dark brown sandy silt matrix, fill of [1586]
1588	Posthole	posthole, 0.65m diameter, 0.16m deep
1589	Fill	Brownish grey sandy silt, fill of [1588]
1590	Posthole	posthole, 0.65m diameter, 0.24m deep
1591	Fill	Dark greyish brown sandy silt, fill of [1590]
1592	Pit/ Posthole	Small circular pit/ posthole, 0.6m x 0.5m x 0.22m
1593	Fill	Dark greyish brown sandy silt, fill of [1592]
1594	Pit/ Posthole	Small circular pit/ posthole, 0.6m x 0.5m x 0.15m
1595	Fill	Brownish grey sandy silt, fill of [1594]
1596	Pit	Sub rectangular pit, 0.7m x 0.4m x 0.39m
1597	Fill	Brownish grey sandy silt, fill of [1596]
1598	Pit	Rectangular pit, 0.9m x 0.47m x 0.26m
1599	Fill	Greyish brown sandy silt, fill of [1598]
1600	Pit	Rectangular pit, 0.7m x 0.35m x 0.22m
1601	Fill	Greyish brown sandy silt, fill of [1600]
1602	Layer	Linear alignment of stones, 3.1m long x 0.62m wide. 0.17m high, in a shallow cut
1603	Layer	Mottled orangey grey and dark grey sandy silt and burnt clay, in-situ burnt layer
1604	Pit	Sub rectangular pit, 0.8m x 0.6m x 0.2m
1605	Fill	Greyish brown sandy silt, fill of [1604]
1606	Posthole	Posthole? 0.4m diameter, 0.3m deep
1607	Fill	Greyish brown sandy silt, fill of [1606]
1608	Pit	Sub rectangular pit, 1.25m x 0.85m x 0.55m
1609	Fill	Dark brownish grey sandy silt, fill of [1608]
1610	Fill	Light brown sandy silt, fill of [1634]
1611	Fill	Dark brownish grey sandy silt, fill of [1608]
1612	Fill	Light brownish grey sandy silt and gravel, fill of [1608]
1613	Void	Void
1614	Pit	Sub circular pit, 1.3m x 1m x 0.18m
1615	Fill	Mottled greyish brown sandy silt, fill of [1614]
1616	Pit	Sub rectangular pit, 3.1m x 1.2m x 0.17m
1617	Fill	Mottled greyish brown sandy silt, fill of [1616]
1618	Pit	Sub oval pit, 2.5m x 2.2m x 0.18m
1619	Fill	Black/ burnt sandy silt and stone, fill of [1639]
1620	Fill	Mottled greyish brown sandy silt, fill of [1618]
1621	Fill	Light brown sandy silt, fill of [1618]
1622	Corn drier	Circular pit, 1.8m x 1.3m x 0.2m
1623	Fill	Dark greyish brown sandy silt and stone, fill of [1622]
1624	Corn drier	Rectangular hollow in base of [1622], 2.2m x 0.7m x 0.2m
1625	Fill	Dark greyish black sandy silt, fill of [1624]
1626	Pit	Oval pit, 2.5m x 2.2m x 0.38m
1627	Fill	Brownish grey sandy silt, fill of [1626]
1628	Posthole	Posthole, 0.22m diameter, 0.24m deep
1629	Fill	Brownish grey sandy silt, fill of [1628]
1630	Pit	Sub circular pit, 3.45m x 2.3m x 0.48m
1631	Fill	Dark brownish grey sandy silt and stone, fill of [1630]
1632	Pit	Sub rectangular pit, 1.2m x 0.7m x 0.12m
1633	Fill	Brownish grey sandy silt, fill of [1632]

Context No	Type	Description
1634	Pit	Sub rectangular re-cut pit? 1.2m x 0.55m x 0.17m
1635	Void	Void
1636	Void	Void
1637	Pit	Sub circular pit, 1.85m x 1.3m x 0.1m
1638	Fill	Brownish grey sandy silt, fill of [1637]
1639	Pit	Sub circular pit, 1.4m x 1.2m x 0.1m
1640	Fill	Brownish grey sandy silt, fill of [1630]
1641	Topsoil	Topsoil
1642	Ring Ditch	Probable Ring Ditch, 12.6m in diameter (Approx.), 0.17m deep
1643	Fill	Brownish grey sandy silt and stone, fill of [1642]
1644	Posthole	Posthole, 0.7m diameter, 0.55m deep
1645	Fill	Brownish grey sandy silt and stone, fill of [1644]
1646	Pit	Circular pit? 0.5m diameter, 0.12m deep
1647	Fill	Black/ burnt sandy silt, fill of [1646]
1648	Pit	Sub circular pit, 0.75m diameter, 0.28m deep
1649	Fill	Black/ burnt sandy silt and burnt bone, fill of [1648]
1650	Fill	Brown sandy silt, fill of [1648]
1651	Fill	Mottled black and brown sandy silt, fill of [1648]
1652	Ring Ditch	Ring Ditch, 8.5m internal 9.5m external diameter, 0.48m deep (max)
1653	Fill	Greyish brown sandy silt and stone, fill of [1652]
1654	Pit	Sub rectangular pit, 1.4m x 1.15m x 0.1m
1655	Fill	Brownish grey sandy silt, fill of [1654]
1656	Ring Ditch	Ring Ditch, 9.5m internal 11.5m external diameter, 0.35m deep (max)
1657	Fill	Light brown sandy silt, fill of [1652]
1658	Fill	Greyish brown sandy silt and stone, fill of [1656]
1659	Fill	Brownish grey and yellow sandy silt and stone, fill of [1656]
1660	Fill	Light brownish grey sandy silt, fill of [1656]
1661	Fill	Brownish grey sandy silt and charcoal, fill of [1656]
1662	Pit	Circular pit/ posthole, 0.4m diameter, 0.2m deep
1663	Fill	Dark greyish brown clayey silt, fill of [1662]
1664	Pit	Circular pit/ posthole, 0.45m diameter, 0.28m deep
1665	Fill	Dark greyish brown clayey silt, fill of [1664]
1666	Pit/posthole	Sub circular pit or posthole, 0.75m x 0.7m x 0.3m
1667	Fill	Dark greyish black clayey silt, charcoal, and burnt bone, fill of [1666]
1668	Pit/posthole	Sub circular pit or posthole, 0.8m x 0.7m x 0.35m
1669	Fill	Dark greyish black clayey silt, charcoal, and burnt bone, fill of [1668]
1670	Void	Void
1671	Void	Void
1672	Pit	Sub circular pit? 0.6m diameter, 0.15m deep
1673	Fill	Dark brownish grey clayey silt, fill of [1672]
1674	Posthole	Sub rectangular posthole, 0.8m x 0.55m x 0.47m
1675	Fill	Greyish black clayey silt and stone, fill of [1674]
1676	Scarp	Natural scarp, possibly partially enhanced, 26m long, 1m wide, 0.25m deep (average)
1677	Linear	Modern linear feature, >4.1m x 1.2m
1678	Probable corn drier flue	Elongated cut with straight sides, ?m x 1m x 0.45m
1679	Fill	Dark grey clayey silt, upper fill of [1678], 0.25m thick
1680	Fill	Black, in-situ burning at base of [1678], 0.15m thick
1681	Open end of corn	Sub-circular pit, 0.8m diameter, 0.3m deep

Context No	Type	Description
	drier	
1682	Fill	Dark greyish black clayey silt, fill of [1681]
1683	Cut	Shallow narrow cut holding stones 1602
66001	Ditch	Linear ditch, 1.78m wide, 0.38m deep
66002	Fill	Reddish brown clayey silt, upper fill of [66001], 0.25m thick
66003	Fill	Light yellowish brown clayey silt, basal fill of [66001], 0.13m thick
66004	Ditch	Linear ditch, 1.1m wide, 0.2m deep
66005	Fill	Greyish brown clayey silt, fill of [66004]

30 APPENDIX XVII: THIMBLE REPORT

A Medieval Sewing-Thimble from Dolbenmaen, Gwynedd

By Jörn Schuster, ARCHAEOLOGICALsmallFINDS

AsF Report: 0009.01, March 2014

Introduction

ARCHÆOLOGICALsmallFINDS (AsF) was commissioned by Gwynedd Archaeological Trust to provide a report for publication of a medieval sewing-thimble found during excavation at Dolbenmaen, Gwynedd (Gwynedd Archaeological Trust Project Number G 2293).

The site comprises three ring ditches as well as several clusters of pits and post-holes, probably mainly of prehistoric (Bronze Age) date. The sewing-thimble ON 5 was recovered from a secondary, perhaps deliberately dumped, charcoal-rich fill (1611) in pit 1608 – a possible cremation related deposit of prehistoric date. Fill 1611 was cut by undated pit 1634, covering almost the entire length and width of the original pit.

Figure 1. Sewing- thimble ON 5. Scale in mm.

No evidence for medieval activity has been recorded on site, but “the geological outcrop and associated earth mound known as Pen Bryn yr Orsedd which is situated directly to the north, and within the same field as the development site, may have served as an assembly mound for the retinue of a peripatetic early medieval court”. The castle earthworks marking the site of the medieval *llys* of Dolbenmaen lies *c.* 830m to the west of the site (D. McNicol, pers. corr. 10.01.2014).

Method

The sewing-thimble was examined visually with the help of a hand lens (x8-magnification), and its dimensions and weight were recorded. It was subsequently compared with other pertinent collections of thimbles.

Discussion

The earliest evidence for the use of sewing-thimbles north of the Alps comes from written sources, indicating their use in the region of the middle Rhine valley during the 12th century (Langedijk and Boon 1999, 17). The earliest archaeological evidence comes from southern France, where bronze thimbles with relatively pointy tops have been recorded from 13th-century contexts at Rougiers and Avignon (ibid.). In Britain, the first use of thimbles can be dated no later than the middle of the 14th century (Holmes 1988 ,1); some of the earliest thimbles – in the form a soldered sheet ring with open top and drilled holes – were found at Billingsgate Lorry Park, London, in a context dated to ceramic phase 9 (*c.*1270–*c.* 1350; Egan 2010, 265), and at the Foundry, York, in a late 13th–early 14th-century layer (Ottaway and Rogers 2002, 2739–40 fig. 1347, 13302).

Since no context date is forthcoming for the Dolbenmaen thimble, its date can only be established by a detailed analysis of marks left by the manufacturing process on the thimble itself.

A good indicator for an early date of the thimble is the fact that it was cast. In Amsterdam, hammered or stamped thimbles start to appear from the second half of the 15th century, about a century later than cast thimbles. By the first half of the 16th century the latter have all but disappeared, and by that time holes also cease to be drilled (Langedijk and Boon 1999, 20). In Britain the picture seems to be slightly different in that stamped domed thimbles have been found in London in contexts dated to ceramic phases 10 and 11 (*c.*1330–*c.* 1380 and *c.*1350–*c.*1400, respectively), while indisputably cast domed thimbles were not recovered from context earlier than ceramic phase 12 (*c.*1400– *c.*1450; Egan 2010 ,266). The above mentioned thimble from York also supports this earlier use of open top thimbles compared to domed examples.

At Nuremberg, casting of thimbles is abandoned around 1530, although this method of manufacture was later reintroduced by Dutch thimble makers in the early 17th century and subsequently introduced to Britain (Holmes 1988, 2); however, these thimbles are easily distinguished from their earlier counterparts by their generally more careful manufacture and finish (ibid, 4 fig. 7b-c).

The tonsure-like patch of thimble ON 5 is equally indicative of an early date. Sewing-thimbles with bare crowns are not found after *c*. 1650 (Holmes 1988, 3).

While it is not uncommon to find cast thimbles with drilled holes featuring one or two lines above the opening (see e.g. Meols: Egan in Griffiths et al. 2007, 179 pl. 34, 2243; London: Egan 2010, 267 fig. 206, 830 and 831), it is very rare to find thimbles with a line separating the tonsure at the crown from the wall. Out of a total of 1140 objects recorded (and photographed) as thimbles of medieval date on the Portable Antiquities Scheme (PAS) database, only two are closely comparable to the Dolbenmaen thimble in sharing this line. One was found on the Isle of Wight (Figure 2; Basford 2010), the other comes from Clothall, Hertfordshire (Figure 3; Watters 2011). Compared to the Dolbenmaen thimble, both these thimbles have their indentations arranged in more carefully aligned vertical rows.

Figure 2. Figure 2. Sewing-thimble from the Isle of Wight. After Basford 2010. ©PAS

Figure 3. Sewing-thimble from Clothall, Hertfordshire. After Watters 2011. ©PAS

It is interesting to note that on the oldest depiction of a thimble, from the Hausbuch der Mendelschen Zwölfbrüderstiftung dated to *c.* 1425 (Amb. 317.2° Folio 5 verso (Mendel I); Treue et al. 1965, 111, Taf. 13; cf. also Egan 2010, 264 fig. 205), the craftsman drilling the holes on both open and domed thimbles appears to have drilled them in no particular pattern. Unevenly scattered holes have been identified as a feature of earlier thimbles, although they are usually applied in regular patterns such as vertical lines or concentric circles, and by the 16th century the patterns commonly take the form of spirals (Holmes 1988, 2).

Conclusion

On the basis of the details of the production process discussed above it can be concluded that the Dolbenmaen thimble was most likely manufactured during the late 14th or early 15th century. Considering the scarcity of thimbles with an additional line between wall and crown, it has however not been possible to link it to a known centre of thimble manufacture like Nuremberg or Amsterdam. It is possible that it may have been made at an unknown location in southern Britain.

The thimble's deposition in the secondary fill of what may be a prehistoric cremation- related deposit is most likely due to a disturbance of that context during or after the late medieval period. Considering its fragmentary condition, it may have been thrown away elsewhere and discarded on site together with other organic settlement waste which might have been used as fertiliser[4].

Catalogue Description

Object Number 5, Context 1611

[4] NB. As pit 1608 proved not to be a cremation there is no difficulty in explaining the presence of the thimble in this feature. (JK)

Sewing-thimble. Incomplete, slightly less than half remaining. Heavy duty, cast, domed thimble with drilled holes (indentations) of varying depths, arranged in irregular vertical lines. Holes do not extend below faint line *c*. 1.9mm above opening, nor above another faint line separating tonsure at the crown (top) from wall. Crown now appears flat (may have been caused by damage). Faint traces of filing visible at middle of wall and near opening. Dark green patina.

Material: Copper alloy (probably brass).

Measurement: H 20mm; Diam (at mouth) 21.4mm; Th of wall 1.04–1.45mm; Weight 4.0g.

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31 APPENDIX XVIII: POTTERY REPORT

Pot Sherd from context 1583, feature 1602/1683 (Small Find 30)

Julie Edwards, West Cheshire and Chester Council

Two joining sherds of pottery were found during excavations at Dolbenmaen, Gwynedd. The sherds were associated with a feature thought possibly to be a corn drier. A burnt layer associated with the feature contained grain and was sampled for radiocarbon dating. The calibrated dates for the two samples are 1284-1430 cal AD and 1408-1478 cal AD.

This report describes the pottery and its fabric and discusses the pieces in relation to the radiocarbon dates.

Description

Two joining sherds (29g) from the body of a closed vessel such as a jar or jug. The exterior and interior surfaces are a purplish brown whilst the core and margins are a brownish red with patches of reduced grey/black along the interior margin. The vessel was partially glazed; the exterior surface has unglazed patches and a glaze that varies from relatively thick, brown and slightly lustrous in places to very thin and purplish brown; a fine glaze partially covers the interior. The interior of the pieces is marked by lines of horizontal ribbing which are indicative of the vessel having been wheel thrown i.e. throwing lines.

The fabric is very hard, dense in appearance with a rough feel and an irregular fracture. Inclusions consist of: fine (up to 0.25mm) and sparse very coarse (1.5mm) ill-sorted creamy white angular rock/vitrified clay fragments; moderate fine (up to 0.25mm) streaks of white clay; moderate well-sorted fine, sub-angular quartz that is clear/colourless and iron stained; moderate medium-fine (up to 0.5mm) rounded red and black iron rich inclusions.

Discussion

The pottery falls into a group of wares known as Midland Purple-type ware. This term is used to describe grey to brownish purple wares, with a hard and often almost vitrified fabric, that were in use in the late medieval to early post-medieval period (roughly 15th to mid-17th centuries). Fabrics such as these can be produced from Coal Measure clays or a mix of clays that include Coal Measure clays. Jars and cisterns are common forms in this ware type. Whilst initially identified in the English Midlands of England evidence from distribution along with variation in fabrics and details of form suggests production is not restricted to the Midlands and took place over a wider area including the north west of England and possibly North Wales (Edwards 2008, 219).

Midland Purple-type wares regularly appear in assemblages excavated in west Cheshire and five fabric groups have been identified in Chester although their place of manufacture is not known (Edwards 2008). The Dolbenmaen sherds are similar to Chester fabrics 779 and 780, which appear as a cistern and jars found in a cess pit associated with pottery of late 15th to mid-16th date at 25 Bridge Street, Chester (Edwards 2008, 194-197 Fig 5.5.1 20-22). However further independently dated assemblages are needed to establish more precisely the date when they came into use. They are commonly found in assemblages with

Cistercian-type ware cups and both wares are representative of the transitional phase between medieval and post-medieval traditions of use and production.

This period does not feature in Campbell's (1993) survey of post-medieval pottery in Wales in respect of North Wales, however since then further excavation has revealed that these types of wares were in use (e.g. Smith 2014, 133) although the assemblages are not securely stratified enough to be able to comment on when they first began to be used.

The radiocarbon dates are therefore significant in confirming a potential 15th century introduction of Midland Purple-type wares into the North Wales region and in respect of this fabric-type in particular providing a date for its appearance in North Wales and Chester. It is unlikely that such wares were in use in the 13th or for much of the 14th centuries as they have not been recorded in published assemblages of that period in North Wales or Chester.

Opportunities to associate medieval and later pottery with absolute dating methods are rare in the North Wales/Chester region, where provisioning of goods in the past was closely linked. This and the paucity of well-stratified independently assemblages has hindered the establishment of chronologies of use and production. If the relationship between the sampled contexts and (1583) is secure then this represents a small step towards refining our knowledge of pottery use in the region particularly for a transitional period where it is difficult to date local/regional wares to within anything less than a 100 or 150 years.

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Sherd SF30 from context **1583**

32 APPENDIX XVIII: SAMPLE ASSESSMENT

Garndolbenmaen Water Treatment Works (G2239): Sample Assessment

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CFA Archaeology Report No: 3252

Introduction

Sixty bulk soil samples were retained for palaeoenvironmental analysis during an archaeological evaluation carried out in 2014 prior to the construction of the Dolbenmaen Water Treatment Works by Gwynedd Archaeological Trust. The majority of the samples were processed by Gwynedd Archaeology Trust through a system of flotation and wet-sieving. The material recovered from these samples and the remaining unprocessed samples were provided to CFA Archaeology Ltd in January 2015 for processing and assessment.

Methodology

The unprocessed soil samples (ranging from 10-20 litres in volume) were processed through a flotation tank. The floating material (flot) was collected in a 250μm sieve and the material remaining in the tank (retent) was sieved through a 1mm mesh; both the flots and retents were then air dried and added to the samples already processed by Gwynedd Archaeological Trust.

All of the flots were scanned using a binocular microscope (x10-x100 magnification) and any carbonised plant remains extracted and preliminarily identified. Where carbonised plant remains (cereal grains, nutshell and weed seeds) were recovered these were extracted and identified. Where flots contained large quantities of charcoal and/or other carbonised plant remain, the flot was sub-sampled using a riffle box, and a proportion of the plant remains sorted and identified. The proportion of flot assessed is noted in appendix XVIII.1. Identifications were made with reference to the modern collection of CFA and standard seed atlases. Plant remains were stored in either plastic finds bags or plastic specimen tubes.

The retents were scanned for any archaeological significant material. The quantity and quality of any artefacts and small finds present in the retents were noted and the remains stored in plastic finds bags.

The quantity of plant remains and small finds (etc) were recorded using a four-point scale (see Table 1). The results are presented in Appendix 1 (Composition of Flots) and appendix XVIII.2 (Composition of Retents).

Table 1. Four point scale

Scale	Abundance	Approx. quantity
+	Rare	1-10 items
++	Occasional	11-50 items
+++	Common	51-100 items
++++	Abundant	101+ items

Results

General Observations

The bulk of the samples contained some carbonised plant remains including wood charcoal, cereal grain and chaff/rachis, hazelnut shell and weed seeds (or wild taxa). The concentration of carbonised plant remains varied considerably across the excavated area. Much of the plant material was in a poor condition and much abraded, suggesting that the material had undergone some movement prior to being buried.

Several high concentrations of cereal grain were noted, particularly from the fills of three pits [**1547**], [**1624**] and [**1678**]. Cereal chaff (culm nodes and rachis fragments) was present, albeit in small amounts, in the fills of four features. High concentrations of weed seeds (wild taxa) were noted in three samples, which also contained large quantities of charred grain. Other potential economic species, including hazelnut shell and fruit pips, were also recovered, although these were never present in large quantities.

A summary of the abundance of the carbonised plant remains recovered from each feature/deposit is provided in Table 2, organised by feature type.

Table 2. Summary Table of Carbonised Plant Remains

Key: + = rare (1-10 items), ++ = occasional (11-50 items), +++ = common (51-100 items) & ++++ = abundant (101+ items)

Feat No.	Flot vol (ml)	Cereal Grain	Rachis Frag.	Culm node	Wil Taxa/ Weed Seeds.	Nutshell	Rhizomes	Peat	Charcoal
BURNT LAYER									
1603	100	+++		+	+++	+++	+	+	++++
POSSIBLE CREMATION									
1608	80	++						++	++
1648	90	+				+			++++
1662	20	+++		+	+	+		++	+++
1664	30	++				+++			++
1666	100	+++			++	++		++	+++
1668	100	+++	+		+	+++		+	++++
POSTHOLE									
1508	10								+
1510	30				+				++++
1516	10	+					+		+
1518	10				+				+
1520	10	++			+				+
1522	10	+							+
1534	10							+	+
1534	10					+		+	+
1539	10	+							++
1560	10	+			++	+			++
1584	20					+		++	++
1588	20					++		+	++
1590	30								++
1606	10	+++							++
1628	10								+
1644	50	+++			+	+			+++
1674	50	+	+		+	+			++++
PIT									
1512	20	+				++		++	+++

Feat No.	Flot vol (ml)	Cereal Grain	Rachis Frag.	Culm node	Wil Taxa/ Weed Seeds.	Nutshell	Rhizomes	Peat	Charcoal
1545	100								++++
1547	1000	++++	++		++++				++++
1562	250								++++

Feat No.	Flot vol (ml)	Cereal Grain	Rachis Frag.	Culm node	Wil Taxa/ Weed Seeds.	Nutshell	Rhizomes	Peat	Charcoal
1596	20							+	++
1598	20	+			+				++
1600	10								+
1604	10					+		+	+
1614	10								+
1616	10					+	+		+
1624	250	++++	+	+	++++	+++			++++
1626	20	+			++	+			++
1630	40	++				++	+	+	+++
1637	20	+				++		+	++
1646	20								++
1654	50					+			+++
1672	50	+				+		+	++++
1681	20	++					+		+
1592	250								++++
1594	10								+
1678	50	++++			+	++		++	++++
RING-DITCH									
103	50								++++
1642	20	+				+	+		+++
1652	10						+		+
1652	10	+				+			+
1656	100	+				+	+		++++

Carbonised Cereal Remains (Grain & Chaff)

A mixture of cereal species were noted within the features, including barley (*Hordeum* sp.), wheat (*Triticum* spp.), oat (*Avena* spp.) and rye (*Secale cereale*). The bulk of the grains were generally poorly preserved, but where well-preserved grain were found these allowed the identification of hulled barley (*Hordeum* var. *vulgare*), emmer/spelt wheat (*Triticum dicoccum*/*spelta*) and bread/club wheat (*Triticum aestivo*/*compactum*). Overall, preliminary assessment suggests that the most abundant cereal grain was barley (*Hordeum* sp.). A small number of oat grain still had palea/lemma (outer hulls) attached, but these were fragmentary and were not sufficiently preserved to allow the distinction between the cultivated or wild species. Of note is the single assemblage of rye (*Secale cereale*) recovered from the fill of a pit [**1624**]; rye was not recovered from any other feature at the site. In this case the rye grains were recovered from a particularly rich-grain assemblage, which also included oat and a small number of bread/club wheat grains.

Occasional fragments of cereal chaff remains were identified along with the grain; the chaff included small culm nodes (straw fragments), internode fragments and occasional glume bases. The quantity of chaff remains was generally small, with only one or two fragments being found within the features. Given the limited quantity of chaff recovered from the samples it would suggest that the bulk of the grain from the site had already been cleaned (having gone through the threshing and winnowing process) prior to being charred.

One feature, the fill of a pit [**1547**] did contain a slightly higher concentration of barley rachis internodes and glume bases in conjunction with several barley grains that were still enclosed in their hulls, potentially indicating that a proportion of the grain recovered from this pit may still have been on the ear when burnt.

Initial assessment of the distribution of the cereal grains, across the excavated area, suggests that there are particular concentrations of grain, for instance:

- Within a cluster of postholes/pits (features [**1662**, **1644**, **1662**, **1664**, **1666** and **1668**]) close to ring ditch [**1642**], these features have been preliminary interpreted as possible cremation burials: however, the large concentration of charred plant remains from these pit fills along with small amounts of bone would be more consistent with domestic debris.
- Within a pit [**1624**] and posthole [**1606**], located close together at the northern edge of the site;
- Within an isolated pit [**1547**] uncovered within the eastern half of the site; and,
- Within a layer (**1603**) and fill of pit [**1678**] both interpreted as having been burnt *in situ*. Interestingly a large quantity of burnt silicate was recovered from both of these and this would be consistent with the interpretation of these deposits as having been burnt *in situ*.

The high concentrations of grain are most likely to have been the result of conflagrations in which stores of grain were burnt or through accidents during the drying of grain. Drying/parching of the grains would have been carried out on a regular basis to aid removal of hulls and to improve milling qualities. Smaller quantities of grain (and other plant remains) observed in pits/postholes surrounding these concentrations may be material reworked and diluted from the larger plant assemblages.

Weed seeds (Wild taxa)

Weed seeds recovered from the site were relatively spare, although two high concentrations of seeds were recovered from the fills of pit [**1547**] and pit [**1624**] together with increased quantities of charred grain.

The bulk of the weed seeds present are typical seeds of disturbed ground/waste places and arable fields, and are typically found on British prehistoric and later archaeological sites along with cereal assemblages. Preliminary identifications of the weed seeds indicate that:

- the most abundant weed species present include: persicaria/pale persicaria (*Polygonum persicaria*/*lapathifolium* L.), hemp-nettle (*Galeopsis* sp.), knotgrass (*Polygonum aviculare* L.), corn marigold (*Chrysanthemum* sp.) and fat hen (*Chenopodium album* L.); both corn marigold and fat hen are common weeds of arable soils.

- additional arable weed seeds and those from more grassy places were also noted including corn cockle (*Agrostemma githago*), hawk's-beard (*Crepis* sp.), heath grass (*Danthonia decumbens* (L.) DC), ribwort (*Plantago lanceolata* L.), corn spurrey (*Spergula arvensis*), wild radish/charlock (*Raphanus rapanistrum*) and vetch/pea (*Vicia*/*Lathyrus* spp.).

- occasional seeds more commonly associated with damp or wet/marshy areas were also noted, such as bugle (*Ajuga reptans*), sedge (*Carex* spp.) and spike-rush/club- rush (*Eleocharis*/*Scripus* spp.).

Many of the wild taxa would have probably been growing on, or near, to the site and their seeds becoming accidentally burnt; others were probably contaminates of the cereal crops and accidentally harvested along with the cereals. The more wet-loving species could have been present in damp areas of the cultivated fields, or equally transported to the site via peaty turfs for fuel or building. Fragments of carbonised peat and charred rhizome fragments (underground stems) were noted in some of the features, albeit in small quantities, and this may suggest that peaty turfs were being collected. Given the large quantity of wood charcoal recovered from the samples it suggests that fire-wood was readily available, therefore it is possible that the turfs were used for other purposes: for instance, Miller (2000) suggests that the presence of rhizomes along with cereal grain indicates the use of turfs to dampen down hearths prior to them being used for corn-drying purposes.

Hazelnut shell

Twenty-five features (burnt layer (1603), possible cremation pits [**1648**, **1662**, **1664**, **1666**, **1668**], six postholes [**1534**, **1560**, **1584**, **1588**, **1644**, **1674**], ten pits [**1512**, **1604**, **1616**, **1624**, **1626**, **1630**, **1637**, **1654**, **1672**, **1678**] and three ring ditch fills [**1642**, **1652**, **1686**] contained fragments of charred hazelnut shell. In most cases the quantity of nutshell recovered was small with only one or two abraded fragments recovered from each deposit. Large quantities of grain were, however, noted in three features: two possible cremations [**1664**, **1668**] and pit [**1624**] along with increased numbers of cereal grains and weed seeds. Hazelnuts have been collected throughout the British Isles from the prehistoric period onwards, and the high concentrations of nutshell recovered from a number of the features suggests that hazelnuts were probably being collected with the nutshell being remnants of discarded food rubbish.

Wood Charcoal

Charcoal was recovered from all of the features, in varying quantities; a mixture of blocky fragments of oak, more indicative of oak timbers and smaller round wood fragments of both oak and non-oak species (for instance, hazel, alder and willow) were found throughout.

Small finds / Other artefacts

The quantity and diversity of other finds recovered from the samples was low:

Pottery: Two small (less than 2cm in dia.) fragments of modern pottery were recovered from the fills of two pits [**1654**] and [**1664**].

Glass: A small (less than 1cm in dia.) fragment of modern glass was recovered from the fill of pit [**1656**].

Iron fragments: Two fragments of what may be iron, potentially the remnants of iron objects, were recovered from the fills of pits [**1596**] and [**1630**].

Metal slag: Low concentrations of metal slag were recovered from eleven samples. In most cases the amount of slag was small with only one or two fragments from each sample; although a large amount of slag was recovered from a burnt layer (**1603**).

Recommendations

Detailed Plant Analysis

Given the recovery of a mixture of cereal grain and other plant remains from across the site, potentially of prehistoric date, it is recommended that further post- excavation analysis be carried out on the plant assemblage. Post-excavation analysis would include: full identification (where possible) and tabulation of the plant remains present in each sample, analysis of any specific spatial distribution (following dating of the site), and discussion of the plant remains in comparison with other excavated sites.

AMS Dating

The majority of the charcoal fragments recovered were very small and would not be suitable for AMS dating: however, fragments of non-oak charcoal were noted in 17 features which may be sufficiently larger enough for dating purposes. The wood species present would need to be identified prior to submission for dating.

<u>Features containing sufficiently large enough charcoal for AMS dating</u>

Ring ditch – 103, 1652, 1656
Pit – 1512, 1547, 1626, 1672
Post hole – 1539, 1584, 1590, 1644
Burnt layer – 1603
Possible cremation – 1648, 1662, 1664, 1666, 1668

Sufficiently well-preserved cereal grains suitable for dating were recovered from 14 samples. Identification of the individual grains would need to be carried out prior to submission for dating.

<u>Features containing cereal grains suitable for dating</u>

Pit – 1547, 1624, 1630, 1672, 1678
Post-hole – 1520, 1606, 1644, 1674
Burnt layer – 1603
Possible cremation – 1608, 1662, 1666, 1668

In addition, 13 features contained sufficiently large enough fragments of hazelnut shell that would also be suitable for dating.

<u>Feature containing hazelnut shell suitable for dating</u>

Pit – 1512, 1624, 1630, 1637, 1678
Post hole – 1588, 1644
Burnt layer – 1603
Possible cremation – 1648, 1664, 1666, 1668

Small finds/Other artefacts

The small finds/artefacts recovered from the samples should be added to any similar hand retrieved material from the site and sent to appropriate specialists for analysis.

References

Miller, JJ, Ramsay, S and Alldritt, D 2000 'Charred and waterlogged plant macrofossils', in Haselgrove, C and McCullagh, R (eds) *An Iron Age Coastal Community in East Lothian: The Excavation of Two Later Prehistoric Enclosure Complexes at Fisher Road, Port Seton:1994–5*, Edinburgh (=STAR Monogr 6).

Appendix XVIII.1: Composition of Flots

Key: PH = posthole, PIT = pit, BL = burnt layer, CRE = possible cremation, RD = ring-ditch
+ = rare (1-10 items), ++ = occasional (11-50 items), +++ = common (51-100 items) & ++++ = abundant (101+ items)
SF = small fragments (below 5mm in dia.), VSF = very small fragments (below 2mm in dia.)
BLOI = Below Level of Identification
* = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
001	107	103	RD	100 %	50													++++	Small non-oak round wood fragments	*			
002	1509	1508	PH	100 %	10													+ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				
003	1511	1510	PH	100 %	30							+	*Galeopsis* sp. *Rumex* sp. Urtica sp.	Abraded				++++	Oak – blocky fragments				
004	1513	1512	PIT	100 %	20	+	*Avena* sp.	Much abraded							++ (SF)	Slightly abraded	*	+++	Small non-oak round wood fragments	*			
005	1517	1516	PH	100 %	10	+	Unidentifiable	Much abraded and fragmentary										+ (VSF)	BLOI		+		
006	1519	1518	PH	100 %	10							+	*Chenopodium* sp. *Galeopsis* sp.	Much abraded				+ (VSF)	BLOI				

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
007	1521	1520	PH	100 %	10	++	*Hordeum* sp. (cf. hulled) *Avena* sp.	Varied preservation	*			+	*Polygonum* sp.	Abraded				+ (VSF)	BLOI				
008	1523	1522	PH	100 %	10	+	cf. *Avena* sp. cf. *Hordeum* sp.	Much abraded and fragmentary										+ (VSF)	BLOI				
009	1537	1534	PH	100 %	10													+ (VSF)	BLOI			+	
010	1538	1534	PH	100 %	10										+ (SF)	Slightly abraded		+ (VSF)	BLOI				
011	1540	1539	PH	100 %	10	+	*Avena* sp.	Much abraded										++	Mixture of small fragments of oak and non-oak round wood fragments	*			
012	1546	1545	PIT	100 %	100													++++	Oak – blocky fragments				
013	1549	1547	PIT	12.5 %	1000	++ ++	*Hordeum* var. *vulgare* (hulled) *Avena* sp. cf.	Varied preservation – generally well-preserved	*	++		++		Slightly abraded				++++	Mixture of small fragments of oak and non-oak round wood fragments	*			

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
							Triticum (bread/club wheat) Hundreds of grains																
014	1563	1562	PIT	25%	250													++++	Oak – blocky fragments				
016	1585	1584	PH	100 %	20													++	Mixture of small fragments of oak and non-oak round wood fragments	*			
017	1603	-	BL	100 %	100	+++	*Avena* sp.	Varied preservation – generally abraded	*		+	+++	*Carex* spp. *Chenopodium* spp. *Chrysanthemum* sp. *Eleocharis/Scirpus* sp. (crushed to check if charred) Gramineae indet. *Lapsana* sp. *Polygonum persicaria/lapathifolium* L. *Raphanus raphanistrum* L. *Spergula arvensis* L. Unidentified thorns x 2	Slightly abraded	++	Varied preservation, generally abraded	*	++++	Mixture of small fragments of oak and non-oak round wood fragments	*	+	+	+++

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
018	1591	1590	PH	100 %	30													++	Mixture of small fragments of oak and non-oak round wood fragments	*			
019	1593	1592	PIT/ PH	25%	250													++++	Oak charcoal – blocky fragments				
020	1597	1596	PIT	100 %	20													++ (VSF)	BLOI				
021	1599	1598	PIT	100 %	20	+	cf. *Avena* sp.	Much abraded and fragmentary				+	*Ajuga reptans* L.	Slightly abraded				++ (VSF)	BLOI				
022	1589	1588	PH	100 %	20										+	Slightly abraded	*	++ (VSF)	BLOI				
023	1595	1594	PIT/ PH	100 %	10													+ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				
024	1601	1600	PIT	100 %	10													+ (VSF)	BLOI				
025	1605	1604	PIT	100 %	10													+ (VSF)	BLOI				

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	**Preliminary Id.**	**Pres.**	**AMS**	**Rachis**	**Culm node**	**Qty**	**Preliminary Id.**	**Pres.**	**Qty**	**Pres.**	**AMS**	**Qty**	**Preliminary Id.**	**AMS**			
026	1607	1606	PH	100 %	10	+++	*Avena* sp. *Hordeum* sp.	Varied preservation – generally abraded and fragmentary	*									++ (VSF)	BLOI				
027	1609	1608	PIT	100 %	30	++	*Avena* sp. cf. *Hordeum* sp.	Much abraded	*									+ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				
028	1611	1608	PIT	100 %	20	+	*Avena* sp.	Much abraded	*														
029	1612	1608	PIT	100 %	10													+ (VSF)	BLOI			+	
030	1625	1624	PIT	12.5 %	250	++++	*Avena* sp. *Secale cereale* *Triticum* sp. (cf. bread/club wheat) Hundreds of grains	Varied preservation	*	+	+	++++	*Chrysanthemum* sp. *Lapsana* sp. *Plantago* sp. *Polgonum persicaria*/*lapathiofolium* L.	Varied preservation	+++	Slightly abraded	*	++++ (VSF)	BLOI				

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
031	1629	1628	PH	100 %	10													+ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				
032	1611	1608	CRE	100 %	10	+	*Avena* sp.	Much abraded and fragmentary										+ (VSF)	BLOI				
033	1612	1608	CRE	100 %	10	+	*Avena* sp.	Much abraded and fragmentary										+ (VSF)	BLOI				
034	1647	1646	PIT	100 %	20													++ (VSF)	BLOI				
035	1649	1648	CRE	100 %	50	+	cf. *Triticum* sp.	Much abraded							+	Slightly abraded	*	++++	Mixture of small fragments of oak and non-oak round wood fragments	*			
036	1651	1648	CRE	100 %	20													+++	Oak charcoal				
037	1650	1648	CRE	100 %	20										+	Slightly abraded	*	+++ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
038	1655	1654	PIT	100 %	50													+++ (SF)	Mostly small fragments of oak charcoal				
039	1645	1644	PH	100 %	50	+++	*Avena* sp. *Triticum* sp. (cf. bread/club wheat) cf. *Hordeum* sp.	Varied preservation – generally abraded	*			+	*Chrysanthemum* sp. *Galeopsis* sp. *Plantago* sp. *Polygonum* sp. *Spergula arvensis* L. cf. *Danthonia* sp.	Abraded	+	Abraded	*	+++	Mixture of small fragments of oak and non-oak round wood fragments	*			
040	1643	1642	RD	100 %	20	+	*Avena* sp. *Hordeum* sp.	Much abraded and fragmentary							+ (SF)	Much abraded		+++ (VSF)	BLOI		+		
041	1653	1652	RD	100 %	10													+	Mixture of small fragments of oak and non-oak round wood fragments	*	+		
042	1657	1652	RD	100 %	10	+	Unidentifiable	Much abraded							+ (SF)	Much abraded		+ (VSF)	BLOI				
043	1658	1656	RD	100 %	20													++	Non-oak round wood fragments	*	+		
044	1659	1656	RD	100 %	20	+	cf. *Hordeum* sp.	Abraded										++ (VSF)	BLOI		+		

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
045	1615	1614	PIT	100 %	10													+ (VSF)	BLOI				
046	1617	1616	PIT	100 %	10													+ (SF)	Mixture of small fragments of oak and non-oak round wood fragments		+		
047	1620	1618	PIT	100 %	10	+	*Avena* sp.	Varied preservation – generally much abraded and fragmentary				++	*Danthonia decumbens* (L.) DC *Galeopsis* sp. *Plantago lanceolata* L. *Ranunculus* sp. cf. *Chrysanthemum* ap. cf. *Crepis* sp.	Slightly abraded	+ (SF)	Much abraded		++ (VSF)	BLOI				
048	1660	1656	RD	100 %	10	+	Unidentifiable	Much abraded and fragmentary							+ (SF)	Much abraded		++	Mixture of small fragments of oak and non-oak round wood fragments	*			
049	1661	1656	RD	100 %	50													++++	Small non-oak round wood fragments	*			

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
050	1627	1626	PIT	100%	20	+	*Triticum* sp. *Avena* sp.	Much abraded and fragmentary				++	*Chenopodium album* L. *Rubus* spp. *Rumex* sp. cf. *Danthonia* sp.	Slightly abraded				++	Mixture of small fragments of oak and non-oak round wood fragments	*			
051	1631	1630	PIT	100%	20	+	*Avena* sp.	Varied preservation – generally much abraded and fragmentary	*						+	Slightly abraded	*	+++ (SF)	Mixture of small fragments of oak and non-oak round wood fragments		+	+	
052	1638	1637	PIT	100%	20	+	*Avena* sp.	Much abraded and fragmentary							++	Slightly abraded	*	++ (VSF)	BLOI			+	
053	1663	1662	PIT/PH	100%	20	+++	*Avena* sp. *Triticum* sp. (cf. spelt/emmer)	Varied preservation – generally slightly abraded	*		+	+	Chenopodiaceae indet.	Abraded				+++	Mixture of small fragments of oak and non-oak round wood fragments	*		++	
054	1665	1664	PIT/PH	100%	30	++	*Avena* sp. cf. *Hordeum* sp.	Much abraded							++	Abraded	*	++	Mixture of small fragments of oak and non-oak round wood fragments	*			

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
055	1667	1666	PIT/PH	50%	100	+++	*Avena* sp. *Triticum* sp. (bread/club wheat) *Hordeum* sp.	Abraded	*			++	*Agrostemma githago* L. *Polygonum persicaria/lapathifolium* L. *Vicia/Fabis* spp.	Abraded and fragmentary	++	Abraded	*	+++	Mixture of small fragments of oak and non-oak round wood fragments	*		+	
056	1669	1668	PIT/PH	50%	100	+++	*Avena* sp.	Abraded	*	+		+	*Polygonum persicaria/lapathifolium* L.	Abraded	++	Abraded	*	++++	Mixture of small fragments of oak and non-oak round wood fragments	*			
058	1673	1672	PIT	100%	50	+	*Triticum/Hordeum* sp.	Much abraded	*									++++	Mixture of small fragments of oak and non-oak round wood fragments	*			
059	1675	1674	PH	100%	50	+	*Triticum* sp. (cf. bread/club wheat)	Varied preservation – generally much abraded and fragmentary	*	+		+	*Atriplex/Chenopodium* spp.	Much abraded	+ (VSF)	Much abraded		++++ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				

Sample No.	Context No.	Feat. No.	Feat. type	% of sample sorted	Approx flot vol. (ml)	Cereal Grain				Chaff		Wild Taxa/Weed Seeds			Hazelnut shell			Charcoal			Rhizomes	Peat	Silicate
						Qty	Preliminary Id.	Pres.	AMS	Rachis	Culm node	Qty	Preliminary Id.	Pres.	Qty	Pres.	AMS	Qty	Preliminary Id.	AMS			
060	1640	1630	PIT	100 %	20	++	*Hordeum* sp. *Avena* sp.	Much abraded and fragmentary							+	Much abraded	*	++ (SF)	Mixture of small fragments of oak and non-oak round wood fragments				
061	1682	1681	PIT	100 %	20	++	*Avena* sp. cf. *Hordeum* sp.	Much abraded and fragmentary										+ (VSF)	Occasional blocky oak fragments – mostly BLOI		+		
062	1680	1678	PIT/ BL	100 %	50	++ ++	*Avena* sp. *Triticum* sp.	Abraded and fragmentary	*			+	*Galium aparine* L.	Abraded	++	Abraded	*	++++ (VSF)	BLOI			++	+++

Appendix XVIII.2: Composition of plant remains

Key: PH = posthole, PIT = pit, BL = burnt layer, CRE = possible cremation, RD = ring-ditch
+ = rare (1-10 items), ++ = occasional (11-50 items), +++ = common (51-100 items) & ++++ = abundant (101+ items)
SF = small fragments (below 5mm in dia.), VSF = very small fragments (below 2mm in dia.)
BLOI = Below Level of Identification
* = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No.	Context No.	Feature No.	Feature type	Sample vol (litres)	Pot	Glass	Iron frags	Slag	Nutshell		Charcoal		Peat	Silicate	Other notes
									Qty	AMS	Qty	AMS			
1	107	103	RD	10							+ (VSF)				Charcoal fragment not kept
2	1509	1508	PH	10							+ (VSF)				
3	1511	1510	PH	10				+			+ (VSF)				
4	1513	1512	PIT	10				+	++				++		
5	1517	1516	PH	20				+			+				
6	1519	1518	PH	20							+ (VSF)				
7	1521	1520	PH	20							+				
8	1523	1522	PH	20							+				
9	1537	1534	PH	10							+		+		
10	1538	1534	PH	20							+		+		
11	1540	1539	PH	20							+				Stone conglomerates
12	1546	1545	PIT	10							+				
13	1549	1547	PIT	20							++				
14	1563	1562	PIT	10							+ (VSF)				
16	1585	1584	PH	20					+				++		
17	1603	-	BL	20				+++	++						
18	1591	1590	PH	20							+ (VSF)				
19	1593	1592	PIT/PH	20							+ (VSF)				
20	1597	1596	PIT	20			+						+		
21	1599	1598	PIT	20							+ (VSF)				
22	1589	1588	PH	10									+ (cf.)		

Sample No.	Context No.	Feature No.	Feature type	Sample vol (litres)	Pot	Glass	Iron frags	Slag	Nutshell		Charcoal		Peat	Silicate	Other notes
									Qty	AMS	Qty	AMS			
23	1595	1594	PIT/PH	10							+ (VSF)				
24	1601	1600	PIT	10				+			+ (SF)				
25	1605	1604	PIT	10					+		+		+		
26	1607	1606	PH	10							+ (VSF)				
27	1609	1608	CRE	20				+			+ (VSF)		+		
28	1611	1608	CRE	10				+			+ (VSF)		+		
29	1612	1608	CRE	10							+ (VSF)				
30	1625	1624	PIT	20					++	*	+ (VSF)				
31	1629	1628	PH	10							+ (VSF)				
32	1611	1608	CRE	10							+ (VSF)				
33	1612	1608	CRE	20							+ (VSF)				
34	1647	1646	PIT	10							+ (VSF)				
35	1649	1648	CRE	10					+	+	+ (VSF)				
36	1651	1648	CRE	20							+ (VSF)				
37	1650	1648	CRE	10							+ (VSF)				
38	1655	1654	PIT	20	+ (VSF)					+	++ (VSF)				
39	1645	1644	PH	30						+	++ (VSF)				
40	1643	1642	RD	30						+	+ (VSF)				
41	1653	1652	RD	30							+ (VSF)				
42	1657	1652	RD	30							+ (VSF)				
43	1658	1656	RD	30							++ (VSF)				
44	1659	1656	RD	30							+ (VSF)				Stone conglomerates
45	1615	1614	PIT	10							++ (VSF)				
46	1617	1616	PIT	10						+	+ (VSF)				
47	1560	-	PIT	10							+ (VSF)				
48	1660	1656	RD	30		+ (VSF)				+	+ (VSF)				

Sample No.	Context No.	Feature No.	Feature type	Sample vol (litres)	Pot	Glass	Iron frags	Slag	Nutshell		Charcoal		Peat	Silicate	Other notes
									Qty	AMS	Qty	AMS			
49	1661	1656	RD	10						+	++ (VSF)				
50	1627	1626	PIT	20						+	++ (VSF)				
51	1631	1630	PIT	20				+		+	+ (VSF)				
52	1638	1637	PIT	20							+ (VSF)				
53	1663	1662	CRE	10					+	+	++ (VSF)				
54	1665	1664	CRE	10	+ (VSF)					++	+ (VSF)				
55	1667	1666	CRE	20				++	++	*	++ (VSF)		++		
56	1669	1668	CRE	20					++	*	++ (VSF)		+		Peat fragment not kept
58	1673	1672	PIT	10					+		++ (VSF)		+		
59	1675	1674	PH	20					+		++ (VSF)				
60	1640	1630	PIT	10							+ (VSF)				
61	1682	1630	PIT	10							+ (VSF)			++	
62	1680	1678	PIT/BL	10					+	*	+ (VSF)			++++	

33 APPENDIX XIX: CHARCOAL INDENTIFICATION

Garndolbenmaen Water Treatment Works (G2293): Charcoal Identifications

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CFA Archaeology Report No: 3439

Introduction

Sixty-two individual charcoal samples were processed for charcoal identification from bulk soil samples retrieved during an archaeological evaluation carried out in 2014 prior to the construction of the Dolbenmaen Water Treatment Works by Gwynedd Archaeological Trust. This report outlines the results of charcoal identifications carried out as a pre-requisite for AMS radiocarbon dating selection and to assess the types of wood selected for domestic and funerary use.

Methodology

The soil samples, which ranged from 10-30 litres in volume, were processed through a flotation tank. The floating material (flot) was collected in a 250μm sieve then, once dried, scanned using a binocular microscope (x10-x100 magnifications) and any carbonised plant remains extracted and preliminary identified. Where flots contained large quantities of charcoal and/or other carbonised plant remains, the flot was sub-sampled using a riffle box, and a proportion of the plant remains sorted and identified.

Charcoal >2mm in transverse section were considered suitable for identification. Samples falling below 2mm were considered to be below the limit of identification and are labelled as BLOI in the identification list (appendix XIX.1).

Identifications were carried using bi-focal reflective microscopy at magnifications ranging between x50 and x400. Anatomical keys listed in Schweingruber (1992) and in-house reference charcoal was used to aid identifications. Asymmetry and morphological characteristics were recorded using standard in-house methodology.

Results

Four wood species were identified within the assemblage and in order of abundance oak was the most abundant (51%) followed by hazel (39%). Birch attained a frequency of 8.6% with willow producing only trace amounts of charcoal (0.5%).

Species	No of Ids	Total wt (g)	% frequency
Birch (Betula sp.)	51	93	8.6
Hazel (*Corylus avellana*)	233	40	39.2
Oak *(Quercus)*	306	69	51.6
Willow (Salix sp.)	3	0.5	0.5

Table 1 Taxonomic composition based on number of identifiable fragments >2mm

Burnt Layer

Context [1603] contained hazel (3.7g), birch (1.7g) and oak (1.9g) charcoal respectively.

Possible Cremations

Birch, hazel and oak charcoal are well represented within the eleven possible cremation features but the numbers of identifiable fragments was low in frequency and were mainly amorphous. Contexts [1667] and [1669] contained birch and hazel roundwood. Vitrified charcoal normally associated with cremation-type contexts was absent. Roundwood charcoal was present in contexts [1669, 1667] the rest of the samples were amorphous with trace amounts of blocky-shaped charcoal identifiable as oak.

Pit Features

Twenty-one contexts from features classified as pits produced an abundance of oak (42g) and hazel (16g). Birch was low in frequency and weight (n=6/ 1.6g). The bulk of the charcoal was amorphous and probably represents domestic fire residues. Pit [1673] produced two fragments of hazel nutshell.

Postholes

Sixteen contexts associated with posthole features produced oak, birch and two fragments of willow charcoal. Context [1511] produced well over 25 individual oak fragments (11g) and the blocky nature of the charcoal suggests not surprisingly that it was from mature wood, probably representing a post.

Ring Ditches

The ring-ditch features were dominated by mainly oak and hazel charcoal, contexts [107 and 1643] producing over 25 individual fragments (1.3g and 4g). These values are very low and the charcoal was abraded and amorphous, which strongly suggests that the charcoal was probably residual.

Discussion

Charcoal condition

Although a rough indication of woodland composition can be postulated from deposits of fuel debris surviving from burnt spreads, pits, hearths and funerary pyres, the interpretation of such material must take into account the biases inherent in the sub-sampling process and differential survival as a result of pyrolisis in the first instance (Asouti, *et al* 2005, Braadbart *et al* 2008) and the differential survival of taxa as a result of taphonomic processes (Thery-Parisot *et al* 2010).

The amorphous sub-rounding effect on the charcoal is a result of the abrasive nature of the local soils which are derived from mudstone and siltstones of the Dol-Cyn-Afon Formation (British Geological Survey on-line geology viewer). The free draining nature of these types of soils can result in saturation of the charcoal which leads to increased fragmentation. The type of wood being burnt and its position in the fire will also have a direct bearing on how the fragments have been derived, and in the case of cremation deposits how the pyre deposits have been handled as part of the ritual.

Species composition as an index to the local woodland

For the purposes of this report, the overall dominance of species is based on the frequency of charcoal fragments per species in each sample and the overall abundance of species in the total number of samples examined. Although only four species are represented, all four species would have been common within the locality of the site during the Later Prehistoric Period. Oak is at the apex of woodland development and would have been well represented on the soils within the locality. Birch is hardy and most versatile and will grow in everything from wet to relatively dry conditions. It is a small tree (15m), light demanding pioneer and short lived, only living for 50-80 years. Hazel is often described in palynological literature as a shrub but in the absence of animal grazing it will go on to develop low statured trees. Willow is a wetland species and would have been exploited from watercourses. None of the species identified are more resilient to abrasion than the other. Roundwood attributed to twig and branches is low in frequency. Some of the 'blocky' charcoal probably represents mature timber possibly associated with structural elements.

The charcoal identified from the cremation contexts probably represents pyre or starter fuels. Paradoxically, no large diameter roundwood fragments were observed nor were any of the fragments vitrified which are commonly associated with cremations[5]. The samples from the cremation features represent only a fraction of the wood that would be needed in the cremation ritual. Experimental research on pyre structures has demonstrated that approximately one tonne of wood is required to consume an adult human body (McKinley 1994). Traditional methods of pyre construction employ the use of substantial billets/poles of wood to form a rectangular platform.

Given the amorphous nature of the charcoal assemblage and the possibility of re-working very little of the charcoal would be suitable for radiocarbon dating unless it is clear that the charcoal is from primary undisturbed basal fills. Contexts containing roundwood charcoal marked (*) in appendix XIX.1 are considered to be the best candidates for AMS radiocarbon dating.

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[5] As these features were proved not to be cremation burials as initially thought the comments on cremation pyres are not relevant and it is unsurprising that the charcoal was no different from normal fuel wood. (JK)

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Appendix XIX.1. Charcoal Identifications

Key: PH = posthole, PIT = pit, BL = burnt layer, CRE = possible cremation, RD = ring-ditch
BLOI = Below Level of Identification
***** = sufficiently large enough fragments/well-preserved material suitable for AMS dating

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
1	107	RD	Corylus	25	Some roundwood present	4	Mainly amorphous frags
2	1509	PH	N/a	N/a	BLOI	N/a	N/a
3	1511	PH	Quercus	25	Blocky frags present	11	Mainly amorphous frags
4	1513	PIT	Corylus	10		0.6	Amorphous frags
5	1517	PH	N/a	N/a	BLOI	N/a	N/a
6	1519	PH	N/a	N/a	BLOI	N/a	N/a
7	1521	PH	N/a	N/a	BLOI	N/a	N/a
8	1523	PH	N/a	N/a	BLOI	N/a	N/a
9	1537	PH	N/a	N/a	BLOI	N/a	N/a
10	1538	PIT	N/a	N/a	BLOI	N/a	N/a
11	1540	PH	Betula	3		0.2	Amorphous frags
12	1546	PIT	Quercus	25		6.6	Amorphous frags
13	1549	PIT	Corylus	10		0.8	Amorphous frags
13	1549	PIT	Quercus	16	Roundwood	8.3	Some amorphous frags
13	1549	PIT	Corylus	25	Roundwood	3.8	Some amorphous frags
13	1549	PIT	Betula	2		0.4	Amorphous frags
14	1563	PIT	Quercus	25	Blocky frags present	5.1	Amorphous frags
14	1563	PIT	Corylus	19	Some roundwood present	4.9	Amorphous frags

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
14	1563	PIT	Betula	2		0.4	Amorphous frags
16	1584	PH	Quercus	1		0.2	Amorphous frags
17	1603	Corn drier	Corylus	10		3.7	Amorphous frags
17	1603	Corn drier	Betula	8		1.7	Amorphous frags
17	1603	Corn drier	Quercus	5		1.9	Amorphous frags
18	1591	PH	Quercus	4		1.1	Amorphous frags
19	1593	Pit/PH	Quercus	30	Mainly blocky frags	6.8	Some amorphous frags
20	1597	PIT	Quercus	9		12.6	Amorphous frags
20	1597	PIT	Corylus	5		0.4	Amorphous frags
21	1599	PIT	Corylus	4		0.2	Amorphous frags
21	1599	PIT	Quercus	12		0.5	Amorphous frags
22	1589	PH	N/a	N/a	BLOI	N/a	N/a
23	1595	PIT/PH	N/a	N/a	BLOI	N/a	N/a
24	1601	PIT	N/a	N/a	BLOI	N/a	N/a
25	1605	PIT	N/a	N/a	BLOI	N/a	N/a
26	1607	PH	N/a	N/a	BLOI	N/a	N/a
27	1609	PIT	Quercus	2		0.7	Amorphous frags
27	1609	PIT	Betula	2		0.4	Amorphous frags
27	1609	PIT	Corylus	4		1.2	Amorphous frags
28	1611	PIT	N/a	N/a	BLOI	N/a	N/a
29	1612	PIT	Quercus	3	Mainly blocky frags	0.4	Some amorphous frags
30	1625	Corn drier	Betula	1		0.6	Amorphous frags
30	1625	Corn drier	Corylus	14		2.5	Amorphous frags
30	1625	Corn drier	Corylus	4	Nut Shell	0.3	
31	1629	PH	N/a	N/a	BLOI	N/a	N/a
32	1611	PIT	N/a	N/a	BLOI	N/a	N/a

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
33	1612	PIT	N/a	N/a	BLOI	N/a	N/a
34	1647	PIT	N/a	N/a	BLOI	N/a	N/a
35	1615	PIT	Corylus	4		0.7	Amorphous frags
35	1651	PIT	Quercus	4		0.4	Amorphous frags
36	1649	PIT	Quercus*	7		0.9	Amorphous frags
36	1649	PIT	Corylus*	2		0.4	Amorphous frags
37	1650	PIT	N/a	N/a	BLOI	N/a	N/a
38	1655	PIT	N/a	N/a	BLOI	N/a	N/a
39	1645	PH	Quercus*	9		2.1	Amorphous frags
39	1645	PH	Betula*	1		0.1	Amorphous frags
39	1645	PH	Salix*	2		0.4	Amorphous frags
40	1643	RD	Quercus	25		1.3	Amorphous frags
41	1653	RD	N/a	N/a	BLOI	N/a	N/a
42	1657	RD	Quercus	15		0.8	Amorphous frags
43	1658	RD	Corylus	5		0.4	Amorphous frags
43	1658	RD	Salix	1		0.1	Amorphous frags
43	1658	RD	Quercus	5		0.4	Amorphous frags
44	1659	RD	Quercus	9		0.9	Amorphous frags
45	1615	PIT	BLOI	N/a		N/a	N/a
46	1617	PIT	BLOI	N/a		N/a	N/a
47	1620	PIT	BLOI	N/a		N/a	N/a
48	1660	RD	Corylus	10		0.6	Amorphous frags
49	1661	RD	Corylus*	25	Roundwood	3.4	
50	1627	PIT	Quercus	5		0.8	Amorphous frags
50	1627	PIT	Corylus	3		0.7	Amorphous frags
51	1631	PIT	N/a	N/a	BLOI	N/a	N/a

Sample No	Context No.	Feature Type	Species	No of Ids	Comment	Wt (g)	Cond
52	1638	PIT	Vitrified	N/a		N/a	N/a
52	1638	PIT	Corylus	3		0.4	Amorphous frags
52	1638	PIT	Betula	1		0.2	Amorphous frags
53	1663	PIT	Betula	2		0.6	Amorphous frags
53	1663	PIT	Corylus	5		0.3	Amorphous frags
54	1665	PIT	Corylus	6		0.5	Amorphous frags
54	1665	PIT	Quercus	3		0.3	Amorphous frags
54	1665	PIT	Betula	1		0.1	Amorphous frags
55	1667	PIT	Corylus*	13	Roundwood	5.6	Some amorphous frags
55	1667	PIT	Betula*	13	Roundwood	2.5	Some amorphous frags
56	1669	PIT	Corylus	13	Roundwood	2.9	Some amorphous frags
56	1669	PIT	Betula*	15	Roundwood	2.1	Some amorphous frags
56	1669	PIT	Quercus*	7		0.9	Amorphous frags
58	1673	PIT	Quercus	25		1.2	Amorphous frags
58	1673	PIT	Corylus	8		0.7	Amorphous frags
58	1673	PIT	Corylus*	1	Nut Shell	0.1	2 small frags
59	1675	PH	Quercus	27		2.6	Amorphous frags
59	1675	PH	Corylus	5		0.4	Amorphous frags
59	1659	PH	Vitrified	N/a		N/a	N/a
60	1640	PIT	Quercus	8		0.7	Amorphous frags
60	1640	PIT	Corylus	3		0.7	Amorphous frags
61	1682	Corn drier	N/a	N/a		N/a	N/a
62	1680	Corn drier	N/a	N/a		N/a	N/a

34 APPENDIX XX: CHARRED PLANT REMAINS

Dolbenmaen Water Treatment Works (G2293): Carbonised Plant Remains

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CFA Archaeology Report No: 3500

Introduction

This report presents the detailed analysis of the carbonised plant remains recovered during archaeological excavations undertaken by Gwynedd Archaeological Trust at Dolbenmaen Water Treatment Works (G2293), Dolbenmaen, Wales.

The report concentrates on the cereal remains (cereal grain and chaff) and other plant remains (weed seeds, nutshell, fruit remains etc) that were recovered from the samples retained during the excavation; focusing principally on the large assemblages of carbonised plant remains recovered from two potentially 12th-13th century medieval corn-drying kilns.

Analysis of the wood charcoal assemblages is discussed in a separate report by Dr Mike Cressey.

Methodology

Sample assessment

Sixty bulk soil samples were retained during the excavation for the analysis of palaeoenvironmental remains. All of the samples were processed through a system of flotation, the floating debris (flot) was collected in a 250μm sieve and material remaining in the tank (retent) was washed through a 1mm mesh.

In order to gain a quick characterisation of the samples, all of the flots were scanned using a low-powered binocular microscope to assess the quantity and quality of the plant remains present in each. A database was compiled recording the quantity and diversity of the plant remains present (Hastie 2015, Appendices 1 and 2), with the aim to characterise the deposits, highlighting any samples that were distinctive and any trends in the data.

An assessment of the plant remains was provided in Hastie (2015) which recorded that 28 samples contained carbonised cereal grains. Several high concentrations of grain were noted along with assemblages of charred weed seeds, other potentially economic species (such as nutshell, fruit pips), and cereal chaff. Further post-excavation analysis of the samples, containing carbonised cereal grains and other plant remains (44 samples in total), was recommended.

Detailed analysis

Forty-four samples found to contain carbonised plant remains were fully sorted, and the remains identified and counted. All identifications were made with reference to the modern collection of CFA Archaeology Ltd, and standard seed atlases. Results are summarized in Appendices App XX.1-5.

App XX.1: Composition of Plant Remains from Possible Prehistoric/Early Features

App XX.2: Composition of Plant Remains from Early Medieval Features

App XX.3: Composition of Wild Taxa from Medieval Features

App XX.4: Composition of Cereal Remains from Medieval Features

App XX.5: Composition of Plant Remains from Post-medieval and Undated Features

Where very large quantities of carbonised plant remains were present, the sample was sub-divided using a riffle box, and a proportion of the plant remains sorted and identified. The portion of sample assessed is noted in Appendices 3 and 4 (% of sample sorted). The quality of grain and other plant remains in these samples were then multiplied to give an estimate of the total in the full sample; estimates are identified by a number followed by '(e)'.

Spatial Distribution of Carbonised Plant Remains on Site

Out of 60 samples analysed (Hastie 2015), 44 contained carbonised plant remains. The concentration of plant remains varied considerably across the excavated areas. Much of the plant material was in a poor condition and abraded. This suggests that the plant debris had undergone some movement prior to being buried and in most cases is unlikely to relate to the primary function, or use, of the features from which they were recovered.

Several high concentrations of plant remains (most notably cereal grain assemblages) were recorded, particularly from the fills of two corn-drying kilns [1547] and [1624], AMS dates from cereal grains recovered from kiln [1547] indicated that it was of early medieval date (4^{th}-5^{th} century), and potentially associated with the remains of an early medieval four-post structure. While the archaeological record suggests that the second kiln [1624] was later, and of probable 12^{th}-13^{th} century date. Other grain concentrations were noted in deposits and features dating to the medieval period (12-13^{th} century), including postholes [1606], [1662], [1644], [1666], [1668] and a spread of dumped material (1603). Postholes [1662], [1644], [1666] and [1668] are all clustered together at the southern end of what may be the truncated remains of a building.

Occasional grains have been dated by AMS to the prehistoric period (Bronze Age/Iron Age) suggesting that some earlier activity, including small-scale crop/food processing, had been taking place at the site. .

Composition of Carbonised Plant Remains

Cereal remains

Overall, oat (*Avena* sp.) and barley (*Hordeum* var *vulgare*) were most often recorded within the excavated features. Oat first became widely cultivated as a staple crop during the medieval period in north-west Wales and its predominance, along with hulled barley, at Dolbenmaen Water Treatment Works would fit well with the overall medieval (12-13th century) date indicated by AMS dating for the bulk of material from the site. Both oat and hulled barley have been recovered from other medieval sites in Wales, for instance at South Hook (Herbranston) (Carruthers forthcoming, as cited by Edwards *et al* 2010), Cefn Graeanog (Gwynedd), Collrfyn, Llansantffraid (Powys), Cefn Du (Anglesey) (all cited by Challinor et al 2008) and Llandygai (Challinor *et al* 2013), and Thomas (1968), in his review of 13th century farm economies in North Wales, records that it was the most widely grown field crop in this period.

A small number of oat grain from the medieval features were found to still have their palea/lemma (outer hulls) attached, but these were fragmentary, and the bulk of the oat could not be identified to species level. Only one oat grain, from posthole [1606], was sufficiently well-preserved to be identified as the wild species, *Avena fatua*. The presence of wild oat does demonstrate that even though oat was a cultivated crop during the medieval period, some of the oat remains may represent the wild variety, which was likely growing as a weed in the arable fields.

Many of the barley grains were still enclosed in their hulls, indicating that the bulk is likely to be the hulled variety (*Hordeum* var *vulgare*). Only one grain of naked barley (*Hordum* var *nudum*) was recovered from the fill of a possible ring-ditch [1656]. Naked barley was a principal cultivar during the early prehistoric period until the Iron Age when it tended to be replaced by the hulled variety and it could be possible that this single naked barley grain is a remnant of earlier food debris. Nevertheless, naked grains do occur in a population of hulled barley if the lemma and palea fail for some reason to enclose the grain tightly (Moffet 1987), therefore this single naked barley grain cannot be considered to specifically indicate the cultivation of the naked variety. Several straight (symmetrical) grains of hulled barley were recorded from the cereal assemblage recovered from the fill of corn-drying kiln [1547] and this could indicate that the two-row variety of barley was being cultivated. Barley rachis internodes of both cf. two-row and cf. six-row were noted, suggesting the presence of both varieties.

Of note, is the recovery of an assemblage of oat grain from a corn-drying kiln [1547] dated to the early medieval period (4-5th century). The plant assemblage from this structure was dominated by barley grains suggesting that this was the principal crop being cultivated at the time; nevertheless, a significant proportion of oats were also recovered. None of the oat grains were found with their outer hulls attached and the presence of the wild or cultivated species could not be confirmed. Yet, the proportion of oat grain present in the drying kiln (15% of cereal grains present) would suggest that these are likely from a cultivated crop, rather than the remnants of wild species growing as weed seeds in the fields.

Several hundred grains of rye (*Secale cereale*) were found, together with oat and hulled barley, in the fill of kiln [1624]. Interestingly, this is the only context from which rye was definitively identified; although two poorly preserved grains, tentatively identified as rye (cf), were noted in postholes [1666] and part of kiln [1678 (1681)]. Rye has been noted at other medieval sites throughout the British Isles and the evidence indicates that it was cultivated in small amounts during this period. Rye is tolerant of drought, temperature extremes and poor light soils and it is often grown on sandy soils where other crops would be less successful (Moffet 1987).

A poorly preserved grain of hulled (glume) wheat (emmer/spelt) was identified in each of the fills of postholes [1648] and [1662], while a possible fragment of emmer wheat glume base and an emmer/spelt spikelet fork were found in the fill of pit [1674]. Emmer was the main wheat crop cultivated in the earlier prehistoric period in Britain but appears to have been largely replaced by spelt by the Iron Age; yet Challinor *et al* (2008, 46), suggest that this may have not been entirely the case in Wales, where recent evidence (cited in Challinor *et al* 2008) suggesting that emmer cultivation continued on into the Iron Age and Romano-British periods. Jones & Milles (1984) have also recorded the presence of emmer/spelt grains within the fill of a 15th century corn-drying kiln at Collfryn, Powys, although it is unclear whether they believe the grains are remnant weed seeds or specifically cultivated during this period. It is possible that emmer continued to be cultivated in small amounts for specific purposes throughout the medieval period, perhaps as a prized food or, as suggested by Holden *et al* (2008) in relation to a small amount of emmer wheat recovered from an Early Historic oven at Kintore (Aberdeenshire), the crop may have had a particular value, such as its cultivation on marginal land as security against famine.

At Dolbenmaen Water Treatment Works, only one or two emmer/spelt grains were recorded from a possible Iron Age/early medieval posthole [1648] and two probable medieval postholes [1662 and 1674]. AMS dates (cereal grain) from the site have indicated that there has been some low level activity during the prehistoric period (Bronze Age, Iron Age) at the site, and given this it may be possible that, in this instance, the hulled wheat grains may be earlier debris that has become disturbed and re-deposited into later features.

More rounded grains suggesting the presence of free-threshing bread/club wheat (*Triticum aestivum*/*compactum*) were identified from the fill of kiln [1624], forming part of a particularly rich cereal assemblage that included wheat, oat and hulled barley. Small numbers of probable bread/club wheat grains were also noted in the fills of postholes [1644], [1666], [1674]; pit [1681] and kiln [1678]; all dating to the medieval period.

Occasional fragments of cereal chaff remains were identified along with the grain; the chaff included small culm nodes (straw fragments), internode fragments and occasional glume bases. The bulk of the chaff was recovered from the fills of two corn-drying kilns [1547] and [1624]. Kiln [1547] contained a slightly higher concentration of barley rachis, in conjunction with several barley grains that were still enclosed in their hulls and this could potentially indicate that a portion of the grain in this feature may still have been on the ear when burnt.

Other plant remains

Fragments of hazelnut shell (*Corylus avellana*) were noted in the fills of many different features across the site. The quantity of nutshell varied from feature to feature, with many only containing one or two abraded fragments, although several larger concentrations of nutshell were noted in a number of medieval deposits, including postholes [1664], [1666] and [1668], dumped material (1603) and corn-drying kiln [1624]. Hazelnut shell is most often associated with prehistoric sites in Britain, but their recovery from medieval sites does demonstrate that the nuts continued to be collected as a nutritious food source throughout this period.

Fruits would have also provided a useful resource and fruit stones of bramble (*Rubus fruiticuous*) were noted in the fill of pit [1626], thought to be potentially of post-medieval date. The seeds suggest the presence of scrubland in the vicinity of the site during this period.

A small number of vetch seeds (*Vicia*/*Lathyrus* sp.) were recovered from the fill of a posthole [1666]. As the seeds of leguminous crops decay rapidly they are seldom preserved on archaeological sites unless they are accidentally charred. The seeds were cultivated for animal fodder from early medieval times (Challinor *et al* 2013); the plant is a common weed of arable fields and in this instance the small amount of seeds along with some charred cereal grains suggests that they could have arrived with the cereals.

Wild taxa/weed seeds

Seeds from wild taxa were recovered from many samples across the site; in most cases only low numbers of seeds were noted in the majority of the samples, although large concentrations of weed seeds were found in the fills of two corn-drying kilns [1547] and [1624] together with large amounts of cereal grain.

Throughout, the bulk of the weed seeds present were from species commonly associated with arable land or grassy places, including *Polygonum persicaria*/*lapathifolium* (persicaria/pale persicaria), *Polygonum aviculare* (knotgrass), *Galeops* sp. (hemp-nettle), *Chenopodium album* (fat hen) and *Chrysanthemum segetum* (corn marigold), which were likely growing in the fields along with the cereal crops and brought to the site with the harvested grain. Similar trends are noted on other prehistoric and medieval sites throughout the British Isles. A number of the seeds were from species that were once prevalent weeds of cornfields, such as corn marigold which was formerly one of the worst weeds of cornfields on sands and lighter loams (www.gardenorganic.com).

Occasional seeds from more damp-loving species, for instance *Ajuga reptans* (bugle), *Carex* spp. (sedge) and *Eleocharis*/*Scripus* spp (spike-rush/club-rush), which are associated with damp or wet/marshy areas, were also noted. These were likely brought to the site along with peaty turfs, evidenced by the recovery of small amounts of peat and charred rhizome (underground stems) fragments in a number of features from the site, or, may have been growing in damp patches in the cornfields, for example a large number of bugle seeds, which prefer heavy wet soils and today are usually found at woodland edges or in damp grassland areas, were present in the fill of corn-drying kiln [1624] along with a rich corn assemblage.

Corn-Drying Kilns

Excavations at Dolbenmaen Water Treatment Works identified three possible earth-cut corn-drying kilns on the site: [1547], [1624] and [1678]. The fills from two of these, [1547] and [1624], were found to contain large amounts of carbonised cereal grains along with a range of weed seeds and occasional cereal chaff fragments. The quantity of grain and other plant remains recovered from both of these features indicate that the cereals were likely burnt accidentally during the drying process.

Damp grain can easily spoil and cannot be milled without problems therefore in temperate climates it is necessary to dry the grain before storage and grinding. Fenton (1978) notes that there are three main reasons for grain-drying: as part of the malting process; the seed for the next year's harvest must be dried for storage; and, most importantly, as a prelude to grinding. This is borne out in experiments by Monk (1981) which shows that the drying of the grain speeds up the process of grinding even when using a hand quern.

Evidence from across Britain indicates that corn-drying kilns became common features during the medieval period, and Monk (1981) suggests that the use of the kiln is probably a reflection of the intensification of cereal growing. The presence of three kilns at Dolbenmaen Water Treatment Works would suggest that bulk crop processing (harvesting, threshing, etc) was being carried out at the site.

Kilns constituted a potential fire hazard and as such were located away from dwelling houses; this is reflected in the distribution of the corn-drying kilns at Dolbenmaen Water Treatment Works, which have been placed away from the main focus of activity on the site; corn-drying kiln [1547] being positioned around 100m to the south-east in the corner of a field, while the other kilns were clustered together at the northern edge of the excavated area.

AMS dates from cereal grains recovered from kiln [1547] indicated that it was of early medieval date (4th-5th century), and potentially associated with the remains of an early medieval four-post structure ([1516], [1518], [1520] and [1522]) identified on site. The four-post structure could be interpreted as the footings of a corn store; however, Clark and Long (2009) interprets a potentially similar four post structure at Sallymount, Co. Limerick, as being the possible footings for a corn rick. The archaeological record suggests that the other kilns, [1624] and [1678], were probably 12th-13th century and contemporary with the remains of a potential long building uncovered on site.

Early Medieval Corn-Drying Kiln (4-5th Century)

Corn-drying kiln [1547]

The base of this feature was heat-reddened in places and its fill (1549) contained over 3,000 carbonised cereal grains (89% of the quantified remains) along with a rich assemblage of weed seeds (9%). A large amount of grain were poorly preserved and could not be identified to species; however, where preservation allowed oat, hulled barley and wheat (probably bread/club wheat) were recorded; the bulk of the grain being hulled barley with lesser amounts of oat and only occasional grains of wheat. Preservation of symmetrical grains, along with possible two-row internodes suggests that at least some of the barley within the kiln was of the two-row variety. The two-row variety is more suited to the production of malt (Carruthers 1991), although there is no indication that the barley from the kiln had germinated.

Given the proportion of barley it suggests that this was the main crop being dried in the corn-drying kiln at the time of the conflagration. As noted above (Section 4: Cereal Remains) several barley grains were found still enclosed in their hulls and these along with the presence of some barley chaff (rachis internodes) could potentially suggest that a small portion of the grain were being dried whilst still on the ear. Cultivation of the hulled variety can be advantageous, particularly during storage, as the hulls can provide a useful barrier against water and insect damage; however, the hulls are more difficult to remove and the drying process would not only aid grinding of the grain, but would have helped make the hulls more brittle to aid in their removal.

Gilligan (*unpublished*) notes that barley, which can be grown on a range of soils, could have been used to make coarse bread or malt, however, there is no indication that the barley from the kiln at Dolbenmaen Water Treatment Works had germinated, a process which is necessary to produce malt for alcohol production.

The small number of wheat grain (and wheat chaff) recovered from the kiln may have been left over from previous uses of the kiln. This could be equally true of the oat grains, although with over 400 grains recovered (15% of cereal grains present), the proportion of grain suggests that it was being grown as a crop, potentially together with the barley. Koch (2006) suggests that barley and oat, which would have been cultivated as spring cereals, may have been grown together in order to provide a failsafe crop; the two cereals being processed and ground together to make porridge, bread, biscuits and cakes (Stone 2009).

The presence of wheat, albeit in small amounts within the kiln, does suggest that bread/club wheat was also being cultivated. Bread wheat which is more sensitive to bad weather and poor soils, would have required deep or clay loams for cultivation and an increased input of labour, compared to other cereals (McCormick *et al* 2011). With its high gluten content bread wheat would have made a well-risen loaf and because of this and its more intensive cultivation it appears to have had a higher status than barley or oat during the medieval period.

The weed assemblage consists predominantly of arable field species, including persicaria/pale persicaria, knotgrass, hemp nettle, fat hen and grass seeds. Some of the weed species are similar in size to grain, for instance the medium-grained grass seeds and hemp-nettle seeds, and these are likely to have only been separated from the crop by hand-sorting. Other smaller seeds, such as knotgrass and fat hen are present in quite large numbers within the kiln fill. Both are commonly found associated with charred cereal assemblages from the medieval period and fat hen is particularly associated with cultivated land. The smaller seeds could have been removed during the winnowing/sieving processes and their presence in the kiln fill may represent the use of crop processing by-products for fuel (Hillman, 1984 & Moffett, 1987).

There is little evidence from the weed seed assemblage present in this kiln for the mode of harvesting. Some of the weed species present can be low growing (such as persiacria/pale persicaria and knotgrass) but they can also grow relatively high and their presence would not be a specific indicator that the crop was being cut low on the straw.

Medieval Corn-Drying Kilns (12-13th Century)

Corn-drying kiln [1624]

This roughly key-hole shaped feature contained a grain-rich assemblage which appears to have been burnt *in situ*, suggesting that this was the remains of a corn-drying kiln where the drying grain had at least once caught fire. Deposit 1625 from the base of the kiln was found to contain over 11,000 grains. Many of these (just over 40% of the grain) were abraded and could not be identified to species, but where preservation was sufficient the majority of the grain (46% of the quantified remains) were identified as oat and it is probably safe to consider that the bulk of unidentifiable grain were also oat grains. In addition, a small number of hulled barley (4% of the qualified remains), wheat (1%) and rye (5%) were also recorded.

Given the proportion of oat to other cereal species within the kiln, it would suggest that this was the main crop being dried at the time of the conflagration. Oat is well suited to a humid, wet climate and will tolerate poorer soils, and would be suitable to grow on the free-draining acid loamy soils in the area surrounding the site. The evidence from several other Welsh sites (see Section 4: Cereal Remains) suggests that oats were the principal cultivar during the medieval period. Steane (2016) draws attention to the fact that oats would have been useful for two purposes: they produce a reasonable quantity of grain despite poor acidic soils, damp weather and low summer temperatures, and they also supply a source of straw which is more palatable and nutritious than that from other cereals and could be used in place of hay for winter fodder.

The small amounts of other cereal types found with the oat could either be grains accidentally charred during earlier uses of the kiln, or have been weeds of the oat crop from past use of the same fields.

Of note is the presence of rye within the assemblage; rye can tolerate acidity and low soil fertility and may have been cultivated on the coastal sandy soils of the region. Rye is suitable for growing over winter and evidence from a 12th century Irish text (*Aislinge Meic Con Glinne*) (cited by Kelly 1997) suggests that rye may have indeed been autumn sown during this period. If this were also the case in Wales, then this would have helped spread the agricultural work cycle over a longer period in the year and reduced the risk of crop failure (McCormick *et al* 2011).

Given that only a small proportion of chaff to quantity of grain was recovered from this kiln, it would potentially suggest that the harvested oats, drying in the kiln, had already been cleaned prior to being charred. Relatively large-sized weed seeds such as nipplewort and some of the grass seeds, present with the grain, would have been similar in size to the oats and only removable through hand-sorting. As with kiln [1547], other generally small-sized weed seeds, such as pale persicaria/persicaria, fat hen, ribwort plantain and corn marigold, may represent by-products of the processed crop that have been separated through winnowing and/or fine sieving, and then used as fuel. Occasional fragments of straw (culm nodes) were identified in the fill of the kiln and this may represent remnants of possible kindling, to start the kiln fire, or from a bed of straw on which the grains were being dried (Gibson 1989). Fragments of hazelnut shell were also recorded from the fill of this kiln. While it is possible that the nuts could have been dried within the kiln before storage, in this case it is more likely that the charred nutshell recovered was food waste being used as fuel.

The underrepresentation of cereal chaff in these assemblages (and that of kiln [1547] above) cannot, however, be overlooked, Moffet (1987) argues that chaff remains are lighter than the grains and would tend to stay in the upper, more aerobic, part of the fire where they would be consumed. It is therefore possible that the assemblages found in ovens/kilns may bear little relation to the composition of the original assemblage.

Interestingly, the bulk of the charred corn marigold (*Chrystanthemum segetum*) and nipplewort (*Lapsana communis*) seeds recovered were found in the fill of this corn-drying kiln. Both species are frequently associated with lighter loams and corn marigold is usually associated with spring grown crops. It is therefore possible that these are associated with the oats, which are less frost hardy than other species and are best suited to spring sowing on lighter soils (Challinor *et al* 2013).

As with the weed seed assemblage from kiln [1547] many of the weed species present from the kiln fill can be low growing, but equally can grow relatively high, for example bugle (*Ajuga reptans*) which grows in a dense mat but in the spring sends up tall flower stalks, or fat hen (*Chenopodium album*) which can grow to heights of 1.5m but typically becomes recumbent after flowering. Therefore it is difficult to make any assumptions regarding crop harvesting techniques. One species present in large amounts within the kiln – nipplewort (*Lapsana communis*) – does, however, typically grow to 1-1.2m high, therefore its presence may tentatively suggest that the harvested crop was being cut high up the straw.

Corn-drying kiln [1678]

There was surprisingly few plant remains recovered from the fill of this kiln. Given the relative lack of plant remains it seems likely that the kiln had been cleaned out and its contents (fuel ash, burnt grain etc) deposited elsewhere. Occasional cereal grains were noted and these possibly represent grains that have trickled down into the kiln bowl becoming charred during the drying process. The majority of the grains were oat with one or two grains of bread/club wheat and rye, and other much abraded grains that could only be identified as barley/wheat. Occasional fragments of nutshell, possibly remnants of debris used to fuel the kiln, were also present. Overall, the composition of the cereal assemblage is similar to that recovered from kiln [1624] which was located just south of this kiln and may suggest that these two kilns were contemporary.

Other Concentrations of Plant Remains

Relatively high concentrations of carbonised cereal grains were recovered from the fills of several postholes: [1606], [1662], [1664], [1644], [1666] and [1668], and a dumped layer of material [1603]. The postholes all form part of what may be a long building, with postholes [1662-1668] concentrated at the south-eastern end of the structure.

AMS dating of cereal grains from postholes [1644], [1666] and [166] suggest a 12-13th century date for this structure, also suggesting that it is contemporary with the corn-drying kilns [1624] and [1678] present to the north.

All of the postholes contained quite high concentrations of cereal grain, principally oat, and some charred nutshell. The general lack of other plant elements, such as cereal chaff and weed seeds, indicates that relatively clean grain has accumulated in the postholes as the posts decay. There are two potential sources for this grain: 1) remnants of a corn store destroyed by fire; and 2) reworked and diluted remains of food debris produced during daily activities within the building. There is no evidence from the archaeological record to suggest that the building was destroyed by fire, therefore, it would seem likely in this instance that the plant material trapped in the postholes is directly associated with occupation activities, particularly food preparation, carried out inside the building. Similar distributions of plant and other domestic remains, concentrated in internal pits and postholes which lie either against the wall of the structure, or form part of the house wall, have been noted by Rotschild (1991) and Joyce & Johanessen (1993) (both cited by Pope 2003). These ethno-historical parallels record that domestic rubbish tended to accumulate around the edges of house structures, as central preparation areas were swept clean and it is possible that the distribution of plant remains seen within this structure may have resulted from similar processes.

One other relatively high concentration of cereal grain was noted from a deposit (1603) interpreted in the field as a possible dumped deposit. This deposit was associated with a linear alignment of stones [1602] and a stone pad [1583], the function of which is unknown. The deposit contained a mixture of cereal grains, nutshell, occasional wild taxa seeds, large amounts of charcoal, fuel ash slag and low amounts of carbonised peat. The composition of plant remains from [1603], which contained both cereal grains and a small assemblage of weed seeds, is similar in composition to those recovered from corn-drying kilns [1624] and [1678]. This mixture of carbonised plant remains is primarily lacking from other features on the site, apart from within the corn-drying kilns. Given this it is possible that deposit [1603] may be the dumped remains of burnt material from a corn-drying kiln. The quantity of grain per litre of soil recovered from deposit [1603] is, however, much lower than that present in any of the other corn-drying kilns uncovered on site. Yet, the low number of grain and other plant remains from deposit [1603] could just be a reflection that the material is the remnants of fuel ash and other burnt debris that has become charred during the use of a kiln (similar to that of kiln [1678]).

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Appendix XX.1: Composition of Plant Remains from Possible Prehistoric/Early Features

		Period	Bronze Age?			Iron Age?	Pre-Medieval?		Iron-Age/Early-Medieval		Iron Age/Medieval				Upper deposits medieval, pit earlier		
		Sample no	003	010	016	040	025	033	035	037	042	044	048	049	027	028	032
		Context no	1511	1538	1585	1643	1605	1612	1649	1650	1657	1659	1660	1661	1609	1611	1611
		Feat no.	1510	1534	1584	1642	1604	1608	1648		1652	1656				1608	
		Feature type	PH			RD	PIT		PH		RD	RD				PIT	
		% of sample sorted	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Latin name	**Plant part**	**Common name**															
WILD TAXA																	
Corylus avellana L.	nutshell	hazel		1	1	3	1		7	1	1		2	1			
Polygonum persicaria / *lapathifolium* L.	nutlet	persicaria / pale persicaria	1														
Polygonum cf. *aviculare*	nutlet	knotgrass	1														
Rumex sp.	nutlet	dock	1														
Galeopsis spp.	nutlet	hemp nettle	3														
CEREAL REMAINS																	
Triticum cf. *dicoccum/spelta*	caryopsis	emmer/spelt wheat							1								
Avena sp.	caryopsis	oat				1		8							8	4	2
cf. *Avena* sp.	caryopsis	oat						1			1				8		1
Hordeum cf. var *nudum*	caryopsis	naked barley										1					
Hordeum sp.	caryopsis	barley				3											
Indeterminate	caryopsis	cereal grains				2											
Indeterminate	rachis internode	chaff											1		2		1
Monocotyledon	rhizome	underground stem/root				1						1					

Appendix XX.2: Composition of Plant Remains from Early Medieval Features

		Period	Early Medieval				
		Sample no	005	006	007	008	013
		Context no	1517	1519	1521	1523	1549
		Feat no.	1516	1518	1520	1522	1547
		Feature type	PH				Corn-kiln
		% of sample sorted	100	100	100	100	12.5
Latin name	**Plant part**	**Common name**					
WILD TAXA							
Corylus avellana L.	nutshell	hazel			1	1	
Polygonum persicaria / lapathifolium L.	nutlet	persicaria / pale persicaria			1		240(e)
Polgonum aviculare L.	Nutlet	knotgrass					24(e)
Polygonum sp.	Nutlet	Knotgrass					16(e)
Galeopsis sp.	nutlet	hemp nettle		1			24(e)
Chenopodium album L.	seed	fat hen		1			16(e)
Eleocharis/Scripus spp.	Nutlet	Sedge / club-rush					8(e)
Indeterminate	Seed	Indeterminate					16(e)
CEREAL REMAINS							
cf. *Triticum* sp.	rachis internode	wheat					16(e)
cf. *Triticum* sp.	caryopsis	wheat					8(e)
Avena sp.	caryopsis	oat			2	1	496(e)
cf. *Avena* sp.	c~~C~~aryopsis	oat					8(e)
Avena sp.	floret base	oat					8(e)
Hordeum var *vulgare*	caryopsis	hulled barley			3		576(e)
Hordeum var *vulgare* (straight grain)	caryopsis	hulled barley					128(e)
Hordeum sp.	caryopsis	barley			5	1	856(e)
cf. *Hordeum* sp.	caryopsis	barley			1		408(e)
Hordeum var *vulgare*	rachis internode	hulled barley					56(e)
Indeterminate	caryopsis	cereal grains	1		3		1000(e)
Indeterminate	rachis internode	chaff					8(e)
Monocotyledon	rhizome	underground stem / root	2				

Appendix XX.3. Composition of Wild Taxa from Medieval Features

			Medieval?					Medieval							
		Sample no	026	053	054	058	059	017	022	030	039	055	056	061	062
		Context no	1607	1663	1665	1673	1675	1603	1589	1625	1645	1667	1669	1682	1680
		Feat no.	1606	1662	1664	1672	1674	-	1588	1624	1644	1666	1668	1681	1678
		Feature type	PH			PIT	PH	DM	PH	Corn-kiln	PH			Corn-kiln	
		% of sample sorted	100	100	100	100	100	100	100	12.5	100	50	50	100	100
Latin name	**Plant part**	**Common name**													
Corylus avellana L.	nutshell	hazel	1	1	65	1	4	67	11	64(e)	6	34	51		24
Polygonum persicaria / *lapathifolium* L.	nutlet	persicaria / pale persicaria						12		928(e)			1		
Polygonum aviculare L.	nutlet	knotgrass								2					
Polygonum cf. *aviculare*	nutlet	knotgrass									1				
Polygonum sp.	nutlet	knotgrass													
cf. *Polygonum* sp.	nutlet	knotgrass					1								
Rumex spp.	nutlet	dock						2							
Galeopsis spp.	nutlet	hemp nettle									3				
Ajuga reptans L.	nutlet	bulge								56(e)					
Chenopodium album L.	seed	fat hen								56(e)					
Chenopodiace indet.	seed	fat hen													
Spergula arvensis L.	seed	corn spurrey									1				
cf. *Rancunclus* sp.	achene	buttercup									1				
Raphanus raphanistrum L.	siliqua	wild charlock						5							
Plantago lanceolata L.	seed	ribwort plantain								56(e)					
Galium cf. *aparine*	seed	goosegrass / cleavers													3
Bromus / *Lolium* type	caryopsis	brome grass / rye grass						1							1
Gramineae (small-grained)	caryopsis	small-grained grass						1		56(e)					
Gramineae (medium-grained)	caryopsis	medium-grained grass										11			
Danthiona decumbens (L.) DC.	caryopsis	heath grass									1				
Carex spp.	nutlet	sedge						2							
Eleocharis/*Scirpus* spp.	nutlet	sedge / club-rush						1							
cf. *Trifolium* sp.	seed	clover					1								
Vicia / *Lathyrus* spp.	seed	vetch / pea										17			
Lapsana communis L.	achene	nipplewort						2		160(e)					
Chrysanthemum segetum L.	achene	corn marigold						4		24(e)	4				
Indeterminate	seed	indeterminate									1				1

Appendix XX.4. Composition of Cereal Remains from Medieval Features

			Medieval?						Medieval							
		Sample no	013	026	053	054	058	059	017	022	030	039	055	056	061	062
		Context no	1549	1607	1663	1665	1673	1675	1603	1589	1625	1645	1667	1669	1682	1680
		Feat no.	1547	1606	1662	1664	1672	1674	-	1588	1624	1644	1666	1668	1681	1678
		Feature type	Corn-kiln	PH			PIT	PH	DM	PH	Corn-kiln	PH			Corn-kiln	
		% of sample sorted	12.5	100	100	100	100	100	100	100	12.5	100	50	50	100	100
Latin name	**Plant part**	**Common name**														
Secale cereale	caryopsis	rye									312(e)					
cf. *Secale cereale*	caryopsis	rye									208(e)		1		1	
Triticum aestivo / *compactum*	caryopsis	bread / club wheat						2			96(e)	1	4			1
Trictium cf. *aestivo* / *compactum*	caryopsis	bread / club wheat										1	1			3
cf. *Triticum* sp.	rachis internode	wheat	16(e)													
Triticum dicoccum / *spelta*	caryopsis	emmer / spelt wheat												1		
Triticum cf. *dicoccum* / *spelta*	caryopsis	emmer / spelt wheat			1											
Triticum dicoccum	glume base	emmer wheat						1								
Triticum dicoccum / *spelta*	spikelet fork	emmer / spelt wheat						1								
Triticum sp.	caryopsis	wheat		1				1								
cf. *Triticum* sp.	caryopsis	wheat	8(e)	1							168(e)					2
Avena cf. *fatua*	caryopsis	wild oat		1												
Avena sp.	caryopsis	oat	496(e)	43	70	10		1	58		4600(e)	58	59	74	4	62
cf. *Avena* sp.	caryopsis	oat	8(e)	17	22	7			20		744(e)	5	8	7	6	12
Avena sp.	palea/lemma	oat									48(e)					
Avena sp.	floret base	oat	8(e)													
Hordeum var *vulgare*	caryopsis	hulled barley	576(e)													
Hordeum var *vulgare* (straight grain)	caryopsis	hulled barley	128(e)													
Hordeum cf. var *vulgare*	caryopsis	hulled barley									48(e)					
Hordeum sp.	caryopsis	barley	856(e)				2				240(e)	4				
cf. *Hordeum* sp.	caryopsis	barley	408(e)			1					128(e)			1		
Hordeum / *Triticum* sp.	caryopsis	barley / wheat			1											5
Hordeum var *vulgare*	rachis internode	hulled barley	56(e)								16(e)					
Indeterminate	caryopsis	cereal grains	1000(e)	15		1		2	6		5000(e)	12		6	13	21
Indeterminate	rachis internode	chaff	8(e)								8(e)					
Indeterminate	culm node	straw			2						16(e)					
Monocotyledon	rhizome	underground stem / root						1	2			1			1	
Indeterminate	thorns	indeterminate							2							
Indeterminate	leaflets	indeterminate							2							

Appendix XX.5. Composition of Plant Remains from Post-medieval and Undated Features

		Period		Post-medieval				Unknown Date			
		Sample no	021	050	051	060	052	011	038	046	047
		Context no	1599	1627	1631	1640	1638	1540	1655	1617	1620
		Feat no.	1598	1626	1630		1637	1539	1654	1616	1618
		Feature type		PIT				PIT/PH	PIT		
		% of sample sorted	100	100	100	100	100	100	100	100	100
Latin name	**Plant part**	**Common name**									
WILD TAXA											
Corylus avellana L.	nutshell	hazel		1		7	5		1	1	1
Polygonum persicaria / *lapathifolium* L.	nutlet	persicaria / pale persicaria		1							
Rumex sp.	nutlet	dock		1							
Galeopsis spp.	nutlet	hemp nettle									10
Ajuga reptans L.	nutlet	bulge	1								
Chenopodium album L.	seed	fat hen		1							
Agrostemma cf. *githago*	seed	corn cockle		1							
cf. *Rancunclus* sp.	achene	buttercup									1
Plantago lanceolata L.	seed	ribwort plantain									2
Danthiona decumbens (L.) DC.	caryopsis	heath grass									1
cf. *Danthonia* sp.	caryopsis	heath grass		1							
Lapsana communis L.	achene	nipplewort									1
Chrysanthemum segetum L.	achene	corn marigold									1
Rubus fruiticous agg.	seed	bramble		16							
Indeterminate	seed	indeterminate		1							13
CEREAL REMAINS											
Triticum sp.	caryopsis	wheat		1							
Avena sp.	caryopsis	oat	1			2	2	1			5
cf. *Avena* sp.	caryopsis	oat	1	3		2					3
Hordeum sp.	caryopsis	barley				5					
cf. *Hordeum* sp.	caryopsis	barley									1
Hordeum / *Triticum* sp.	caryopsis	barley / wheat									1
Indeterminate	caryopsis	cereal grains		2		5	5				2
Indeterminate	rachis internode	chaff					3				

35 APPENDIX XXI: BONE ASSESSMENT

Garndolbenmaen Water Treatment Works (G2239) Bone Assessment

By Jennifer Thoms, CFA Archaeology Ltd, The Old Engine House Eskmills Business Park Musselburgh, East Lothian, EH21 7PQ

Report No: 3262

Introduction

Nineteen small bags of burnt bone were submitted for analysis. The material came from the sample processing carried out in the laboratory by CFA Archaeology Ltd.

The contexts were secure and there was no indication that any of the sampled contexts had suffered either contamination or residuality from nearby contexts. The samples from cremation pits had been excavated by hand and 100% sampled. The contexts containing the burnt bone consisted of five types: nine were from features recognised in the field as being “cremation pits”; six were from pits; one was from a smaller feature identified as “pit/posthole”; two from post-holes (1590 and 1644) and one from a burnt clay layer (1603). The samples analysed were from cremation pits 1608, 1646, 1648, 1664, 1666 and 1668. Two of these pits, 1646 and 1648, were located centrally within Ring Ditch 1652. The pit 1608 had also produced a small copper object, possibly part of a thimble, and a polished stone tool. The sampled post-holes 1590 and 1644 were among the 40 pits and postholes of varying depths and sizes described as being located on the eastern half of the site and likely to be associated with the nearby ring ditches and burial practices. The other pits within that collection on the eastern half of the site, which produced burnt bone were 1584, 1600, 1604, 1618, 1630 and 1637. Another sample was from the fil (1549) of pit 1547, also located in the eastern part of the site.

The bone fragments were all very fragmented and contained no articulating surfaces or other identifiable features that might have identified them as being human, or identified them to a particular animal species. All the fragments were burnt, most were oxidised (white or pale grey in colour) indicating they had burnt at high temperatures in a high oxygen environment. The fact that no unburnt fragments were retrieved indicates that the soil conditions were unsuited for the preservation of bone, therefore the assemblage has been affected by preservation bias in that only burnt bone survived.

The material is all in a stable condition, being both clean and dry, and could be stored indefinitely without any further attention, should this be necessary.

Methodology

The fragments of burnt bone had been picked out of flots and residues produced during sample processing and bagged according to fragment size. The material was then examined under a low power microscope by the osteological specialist. The results are presented in Table 1 bellow.

Occasional fragments could be identified as having derived from long bones, and were of a size that indicated they could have been from human bones, so the possibility that the samples came from cremation pits cannot be ruled out from the osteological evidence. However, the small amount of bone retrieved, despite 100% sampling having been undertaken, suggests that either the pits contained only parts of human cremations, or that they were not cremation pits, but instead contained other burnt material, such as ash from domestic fires, which may contain burnt animal bones. A cremation pit would be expected to yield around two kilos of burnt fragmented bones.

Statement of Potential

The results of this osteological analysis does not raise any new research questions, and is of no value to further local, regional and national research priorities. It is not recommended that any further analysis be carried out on this material.

Table 1: Results of bone analysis

Context	Sample	Weight (g)	bone present	Type of context
1549	13	2	Indeterminate small fragments	Fill of pit 1547,
1584	16	1	indeterminate small fragments	Pit /posthole
1591	18	1	indeterminate small fragments	Fill of 1590 posthole
1601	24	1	indeterminate small fragments	Fill of 1600, rectangular pit
1603	17	1	indeterminate small fragments	Burnt clay layer
1605	25	1	indeterminate small fragments	Fill of 1604, sub-rectangular pit
1609	27	1	indeterminate small fragments	Fill of 1608, sub-rectangular cremation pit
1612	29	4	indeterminate small fragments	Fill of 1608, sub-rectangular cremation pit
1620	47	1	indeterminate small fragments	Fill of 1618, sub-oval pit
1631	51	1	indeterminate small fragments	Fill of 1630, sub-circular pit
1638	52	1	indeterminate small fragments	Fill of 1637, sub-circular pit
1645	39	1	indeterminate small fragments	Fill of 1644, post-hole
1647	34	1	indeterminate small fragments	Fill of 1646, circular cremation pit
1649	36	15	indeterminate small fragments	Fill of 1648, sub-circular cremation pit
1650	37	1	indeterminate small fragments	Fill of 1648, sub-circular cremation pit
1651	35	1	indeterminate small	Fill of 1648, sub-circular

Context	Sample	Weight (g)	bone present	Type of context
			fragments	cremation pit
1665	54	1	indeterminate small fragments	Fill of 1664, circular cremation pit
1667	55	11	indeterminate small fragments	Fill of 1666, sub-circular cremation pit
1669	56	4	indeterminate small fragments	Fill of 1668 sub-circular cremation pit

36 APPENDIX XXII: BURNT BONE ASSESSMENT

Note on burnt bone.

By Jacqueline I. McKinley, April 2015

Small quantities (maximum 8g, majority <1g) of well calcined bone from 19 contexts was subject to a rapid scan. The material derived from pits and post-holes all >0.10m depth, most being in excess of 0.25m. The bone is very worn and chalky in appearance, indicative of erosion/degradation in the acidic sandy silt soils prevalent across the site, with a consequent loss of surface morphology. All appears to comprise compact bone.

In many cases the surviving bone was of such a small size (<50mm) and poor condition no statement on its possible original can be given. Broadly identifiable bone fragments were observed in six contexts. Fragments of sheep bone were identified in contexts 1609, 1649 and 1667 (radius and metapodia-sized bone), cattle-sized metapodia in context 1612, and medium-sized mammal bone in contexts 1603 and 1669 (species identifications by Lorrain Higbee). The rest of the bone from these contexts is of a size commensurate with these identifications, and no human bone could be identified within the overall assemblage.

37 Appendix XXIII: Stone Assessment Report

G2293 Dolbenmaen, Gwynedd: Stone Objects

By George Smith

SF 1 (1511) Sub-angular broken boulder fragment of hard igneous rock, possibly diorite, with accidental natural concave facet. Such semi-conchoidal facets occur naturally as a result of ice action, but could also result from plough damage. DISCARD

SF 2 () Natural, sub-rounded cobble. DISCARD

SF3 (1538) Natural sub-rounded cobble. DISCARD

SF 4 (1585) Fire-shattered burnt cobble fragment, probably dolerite. Appears unnaturally flat-sided for a glacial cobble and has possible peck-marks. Rock not suitable for a quern but possibly a fragment of a shaped working slab. Undateable.

SF 6 (1611) Utilised pebble polishing tool. A small, flat oval natural pebble of a hard, very fine-grained stone, possibly chert. Smoothed from use on both flattish faces and worn to a facet on one narrow edge. There is a chip from one end possibly from use as a light hammer and the resulting broken edge has some fine cut 'nicks', so the tool was probably still used after the chip was removed. The opposite end also has a few some fine peck marks from light hammering. There is a concave facet in one face that has sharp edges so was probably created accidentally by burning after the tool ceased being used. Similarly polished stones have come from two places in Anglesey and those have been compared to similar stones interpreted as metal burnishers found in Early Bronze Age metalworkers graves in the Netherlands (Lynch 1991, 365). However, the edge faceting suggests a different use, possibly for leather burnishing.

Reference

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38 APPENDIX XXIV: SLAG ASSESSMENT REPORT

Assessment of possible archaeometallurgical residues from Dolbenmaen, G2293

By T. P. Young, GeoArch, 9th April 2015, Report 2015/10

Abstract

The assemblage includes a very small proportion of fragments of indeterminate iron slag.

The more significant material is a fuel ash slag, very similar to slags from cereal kilns, as well as to poorly-known slags from other long- burning hearths. Detailed analysis of the fuel ash slags is not recommended at present, but may be informative if the likely originating feature (cereal kiln or other hearth) is identified.

The submitted material also included particles of indeterminate burnt organic matter, as well as a variety of natural geological materials.

Methods

All materials were examined visually with a low- powered binocular microscope where required. As an evaluation, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

The examined materials are listed in Table 1.

This project was commissioned by Dave McNicol of the Gwynedd Archaeological Trust.

Results

Iron slag

Small fragments of dense grey slag were recovered from (1599) and (1609). Even the larger piece (from (1609)) weighed just 6g, so they were not identifiable in detail, although the textures would certainly be compatible with identification as smithing slags. Such materials might be from Iron Age to modern in date.

Fuel ash slag

Three contexts, (1603), (1667) and (1680) yielded assemblages of fuel ash slags. These materials comprised residues in the form of blebs and sheet fragments of up to 15mm thickness, formed of highly altered lithic clasts and grains in a dominantly glassy matrix. These slags are the result of partial melting of a substrate under the influence of alkali- and alkali earth- rich fuel ash.

The assemblage from (1667) weighed just 5g (18pieces), with larger collections from (1680) and (1603). That from (1680) comprised mainly rather spiky fragments and hollow blebs, showing inclusions of variously foliated and bloated grains, along with the dominant sand clasts. The collection from (1603) typically had a more glass-rich composition (indicating a higher degree of melting) and had more evidence for fluid flow. This collection also included fragments with an adhering red sandy ceramic, possibly from a hearth wall or floor.

Burnt organic matter

Fragments of burnt and/or coked organic matter occurred in contexts (1513), (1599), (1609), and (1669), as well as a minor component of the fuel ash slag-bearing assemblages ((1603), (1667) and (1680)).

The original nature of the organic material was not determinable.

Natural materials

Fragments of a natural conglomerate, formed of small quartzose pebbles and granules, were abundant, occurring in contexts (1540), (1609), (1651), (1659), (1663) and (1667). Other fragments of rock occurred in (1511), (1517) and (1601), together with a piece of ferruginous crust in (1667) and an iron mottle in (1599).

Interpretation

The fragments of iron slag were not diagnostic of either process or age – except that they must be Iron Age or younger.

The fuel ash slags resemble those described from cereal kilns (Young 2005, 2010a, 2010b, 2015) in possessing a fine-grained or thin-sheet morphology and in the variety of detailed textures.

Examples associated with cereal kilns are mostly ex situ, in small fragments closely resembling the present material. A recent early medieval example from Llandeilo (Young 2015) was, however, in situ, and was a friable sheet, approximately 300mm by 400mm and up to 25mm thick, with a total original weight of 1755g. Chemical evidence was employed to suggest that the burning of grain contributed much to the formation of this slag mass. Emptying of the firebox of kiln by raking might typically dislodge any slag formed and fragment the slag into the small pieces more usually observed.

Somewhat similar fuel ash slags are common in Iron Age contexts, apparently generated in long-lived domestic hearths (Young 2011, 2012), with similar material having previously been labelled ‘Iron Age grey slag’ (Cowgill 2000, 2008; Cowgill et al. 2001; Swiss & McDonnell 2001). These materials usually differ from the present material in being fragments from much thicker (20-80mm thick) sheets.

In theory, at least, such fuel ash slags might be generated in a wide variety of mainly non-metallurgical contexts, but the firing of cereal kilns with straw and the accidental consumption of cereal grains, appears to produce a chemical environment that particularly favours the development of fuel ash slags.

Conclusion

The materials are not particularly diagnostic of processes or dates. The fuel ash slags are strongly suggestive of the nearby presence of cereal kilns, although other interpretations are possible.

No further analytical investigations are recommended for the present material at present, which should, however, be retained with the site archive. Should the field archaeology reveal the likely source of these residues, then their characterisation might have further value.

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Appendix XXIII.1: catalogue

FAS = fuel ash slag, BOM = burnt organic matter.

Context	Sample	No.	Item wt.	Notes
1511	3	1	<1	probable weathered rock
1513	4		7	2 tiny fragments of BOM, 1 large piece of probable natural concretion
1517	5	2	<1	probable weathered sulphide clast in conglomerate and small fragment of possible BOM
1540	11		8	fragments of natural conglomerate
1599	21	4	4	3g iron slag bleb, 1g iron mottle, 1 tiny iron slag bleb, 1 piece of coked BOM
1601	24	3	1	1 fragment of weathered stone, piece possible slag, 1 iron mottle
1603	17		26	coarser, darker fragments of more fluid FAS than that from 1680. Many rock inclusions, including slightly bloated red shale. Some pieces show well- formed grey glass. Fragments of sheet up to 15mm. Some pieces show red sandy adhering ceramic - very like furnace lining surface, but may be just hearth base.
1609	27		8	6g iron slag bleb, 6 small BOM pieces, 1 piece conglomerate and 1 pebble
1611	28	1	<1	conglomerate - but has smooth fissured texture so just possibly burnt
1651	35	2	<1	conglomerate
1659	44	2	4	two pieces of cemented gravel, probably naturally cemented material
1663	53	1	1	natural conglomerate
1667	55		7	5g (18 pieces) of conglomerate, 18 pieces of FAS, 2 pieces BOM, 1 piece ferruginous crust
1669	56	6	<1	BOM
1680	62		25	Assemblage of small fragments of FAS. Slag varies from thin spikey sheets to hollow blebs, white to dark grey and rarely maroon, Some larger fragments show inclusions of foliated and bloated grains, also sand and coarser grains. Sparse fragments of granular organic matter.

39 APPENDIX XXIV: RADIOCARBON DATING REPORT

Dolbenmaen Water Treatment Works (G2293: Radiocarbon dating and Bayesian modelling

Derek Hamilton (SUERC)

Twenty-three samples of charcoal and charred plant remains were submitted to the Scottish Universities Environmental Research Centre (SUERC) for radiocarbon dating by accelerator mass spectrometry (AMS). The samples were single-entities (Ashmore 1999) and were pretreated following the methods described in Dunbar et al. (2016) and dated by AMS following Naysmith et al. (2010). The radiocarbon results are given in Table 1. These are conventional radiocarbon ages (Stuiver and Polach 1977), quoted according to the international standard set at the Trondheim Convention (Stuiver and Kra 1986). The dates are calibrated following the maximum intercept method (Stuiver and Reimer 1986) with the internationally agreed curve of Reimer et al. (2013) using OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009), and rounded outward to 10 years. The probability distributions seen in Figures 1 and 2 were obtained by the probability method (Stuiver and Reimer 1993).

One sample was failed during pretreatment, leaving 22 results for statistical consideration. Of these, 20 results are paired samples from ten contexts. The pairing of samples for dating, or duplication, is one way to assess the security of contexts. If the context formed rapidly and did not suffer much in the way of post-depositional disturbance, then the expectation is that the two samples will have statistically consistent radiocarbon measurements. Table 2 shows the T-values for the paired samples, following the test of Ward and Wilson (1978), and five of the duplicates are not statistically consistent. Four of the pairs, contexts 1649, 1645, 1661, and 1679, are considerably different, and almost certainly represent residual material being incorporated into the dated deposit. The pair from context 1603 does pass the test at 3σ (T_{crit}=8.81), and is discussed in further detail below.

The samples

Ten of the twelve dated features at Dolbenmaen Water Treatment Works, had paired samples measured (Fig. 1). The measurements from five of the ten pairs are not statistically consistent (Table 2).

One of the postholes [1520] in a four-post feature has two radiocarbon dates (SUERC-68324 and -68325) from single cereal grains in (1521). The two measurements are statistically consistent and suggest the oat and barley samples could be the same actual age. The later of the two dates (SUERC-69324) provides the best estimate for the date of this feature (cal AD 380–540; 95% confidence).

There is a single date (SUERC-68326) on a hazelnut shell from a fill (1585) in posthole [1584]. This suggests the posthole is Bronze Age, though the presence of residual material in other features does bring this into question, especially as hazelnut shells are especially robust.

Two oats were dated from a burnt spread (1603) at the east of the site, which also contained slag. While the two results (SUERC-68327 and -68328) are not statistically consistent at 95%, they are consistent at 3σ. Given the nature of the deposit, this might suggest the layer developed over a period of time and was not the result of a single short-lived event. The later date (SUERC-68328) provides the best single date estimate for the activity (cal AD 1410–1470; 95% confidence). However, SUERC-68327 dates from the end of the 13th century cal AD through to the beginning of the 15th century cal AD, and so the activity could have some longevity stretching across this entire period.

There is a result on a single hazelnut shell (SUERC-68332) from a fill (1589) in pit [1588] that dates to medieval period (cal AD 1270–1390; 95% confidence).

A charred wheat grain and hazelnut shell were dated (SUERC-68333 and -68334, respectively) from the basal fill (1649) of pit [1648]. The two results are not statistically consistent, with the wheat dating from the Early Iron Age and the hazelnut shell dating from the early medieval period. The pit lies within the area defined by a circular ditch, which was provisionally interpreted as a round barrow.

From posthole [1666] there are two results (SUERC-68342 and -68343) on single grains of wheat and oat, respectively, in the burnt fill (1667). The measurements are statistically consistent and the later date (SUERC-68343) provides the best estimate for the formation of this deposit (cal AD 1260–1390; 95% confidence). Single grains of barley and oat were dated (SUERC-68344 and -689345) from the burnt fill (1669) in nearby posthole [1668], and these measurements are also statistically consistent. The later date (SUERC-68345) provides the best estimate for the date of this feature (cal AD 1270–1390; 95% confidence).

Two samples of wheat and oat were dated (SUERC-68335 and -68336) from the fill (1645) of posthole [1644] that cuts into curvilinear ditch [1642]. The two measurements are not statistically consistent and date from the Middle Iron Age and medieval periods. The close proximity of this pit to [1667] and [1669], which both have statistically consistent measurements on paired samples, and the fact that there is a stronger chance, barring specific archaeological evidence for disturbance, a sample is residual than intrusive, would suggest posthole [1644] dates to the medieval period. The Middle Iron Age date might be related to the date of the activity associated with the ditch [1642], however, this remains speculative without having directly dated deposits securely associated with the ditch.

The basal fill (1661) of ring ditch [1656] had two samples, hazelnut shell and hazel charcoal, dated (SUERC-68337 and -68338). The hazelnut shell is Mesolithic, while the hazel charcoal is Early Iron Age. The nutshell is likely to be residual, leaving the charcoal date (SUERC-68338) to provide the best estimate for the date of the ring ditch (540–390 cal BC; 95% confidence).

There are two results (SUERC-68346 and -68347) on single-entity samples of wheat and oat, respectively, recovered from the fill (1679) of pit [1678], near the north end of the site. The two results are not statistically consistent, but both are medieval in date. This suggests either the deposit is not from a short-lived event, or that the earlier date is residual/reworked in this context. The later date (SUERC-68346) provides the best single date estimate for this feature (cal AD 1210–1290; 95% confidence).

There are two results (SUERC-70635 and -70636) from single fragments of hazel charcoal recovered from the fill (1563) of pit [1562], which is possibly an earth oven. The two results are statistically consistent, and the more recent date (SUERC-70636) provides the best estimate for the date of the feature (3960–3710 cal BC; 95% confidence).

Two charred grains (oat and hulled barley) were dated (SUERC-70637 and -70638) were dated from the fill (1549) of a corn drier [1547]. The two results are statistically consistent, and the more recent of the two (SUERC-70637) provides the best estimate for the date of this feature (cal AD 420–600; 95% confidence).

Bayesian chronological modelling

A Bayesian approach has been adopted for the interpretation of the chronology for some of the activity dated at Dolbenmaen, Wales (Buck et al. 1996). The methodology allows the combination of different types of information (e.g. radiocarbon dates, phasing, and stratigraphy) explicitly, to produce realistic estimates of the dates of archaeological interest. It should be emphasised that the *posterior density estimates* produced by this modelling are not absolute. They are interpretative *estimates*, which can and will change as further data become available and as other researchers choose to model the existing data from different perspectives. The technique used is a form of Markov Chain Monte Carlo sampling, and has been applied using the program OxCal v4.2. Details of the algorithms employed by this program are available from the on-line manual or in Bronk Ramsey (1995; 1998; 2001; 2009). The algorithm used in the model described below can be derived directly from the model structure shown in Figure 2.

Medieval activity at Dolbenmaen WTW

The archaeology and dating from the Dolbenmaen WTW site suggests there was perhaps a small medieval settlement, represented by only a few remaining postholes, a few pits, corn driers to the north of the house, and possibly two rickyards to the west. The chronological model for the medieval activity includes the radiocarbon results from pits [1588], [1666], [1668], and [1678], along with posthole [1645] and burnt spread (1603) that are medieval in date. There is no stratigraphy between the dated features, and so they are modelled as a single phase of continuous activity with the assumption that the material was deposited at a relatively uniform rate across the phase. As feature 1602/1683 is isolated from the other medieval activity the date on context (1603) from this feature has been excluded from the model, see figure 2.

The model has good agreement between the dates and the model assumption (Amodel=80). The medieval activity began in *cal AD 1095–1265* (*95% probability*; Fig. 2; *start: G2293 medieval*), and probably in *cal AD 1170–1260* (*68% probability*). That activity ended in *cal AD 1280–1415* (*95% probability*; Fig. 2; *end: G2293 medieval*), and probably in *cal AD 1285–1330* (*68% probability*). The overall span of medieval activity was *20–290 years* (*95% probability*; Fig. 3; *span: G2293 medieval*), and probably *35–155 years* (*68% probability*).

Finally, the five results (SUERC-68324, -68325, -68334, -70637, and -70638), from three features, dating to the mid-1st millennium cal AD were particularly interesting, as there are so few early medieval settlements known in Wales. While the spatial distance between the results makes it difficult to justify the assumptions of a Bayesian model, the results were investigated using classical statistical methods. While all five measurements are not statistically consistent (T'=31.9; v=4; T'(5%)=9.5), the four from posthole 1520 and corn drier 1547 are consistent (T'=4.3; v=3; T'(5%)=6.0), suggesting the samples from these two features could be the same actual age.

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Figures

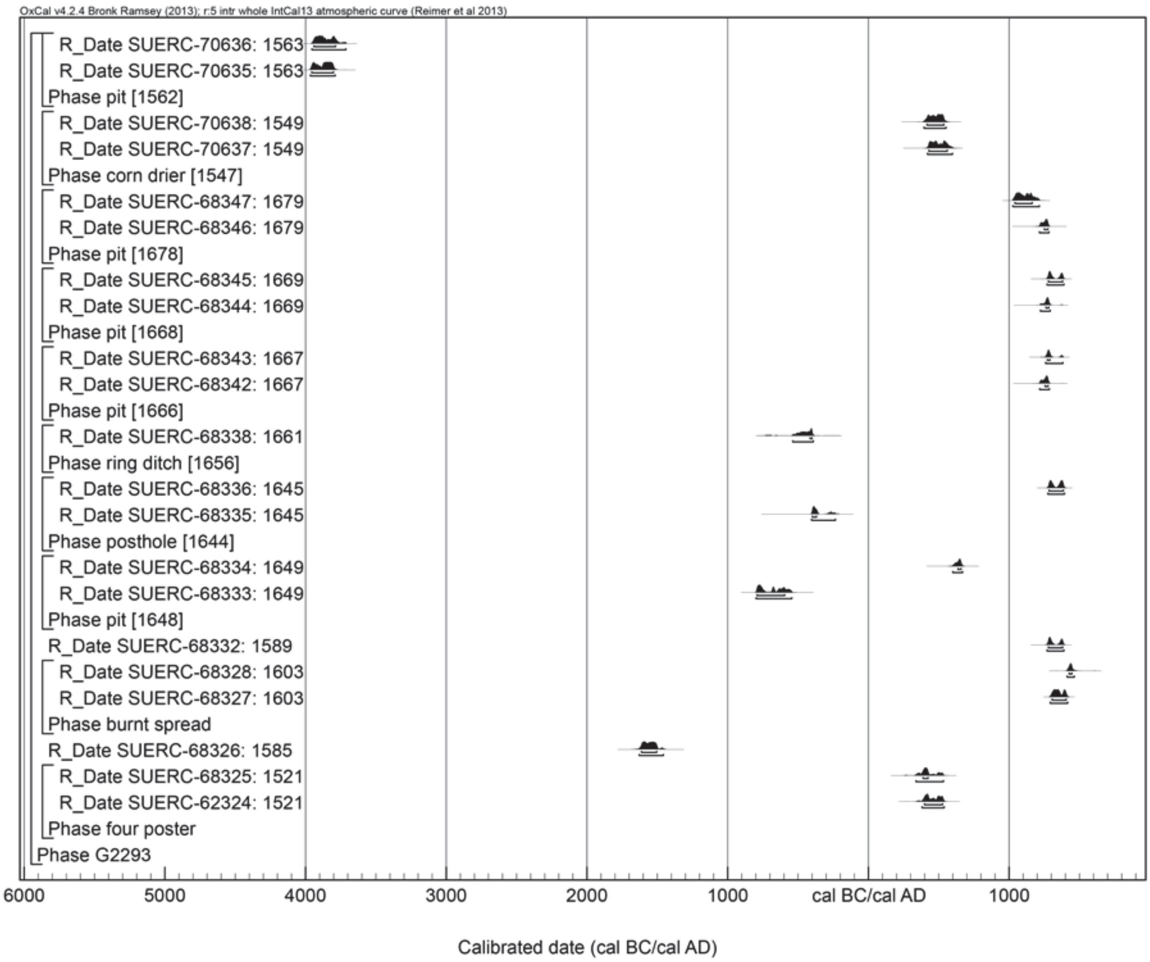

Figure 1: Calibrated radiocarbon dates from Dolbenmaen WTW. The Mesolithic date, SUERC-68337, is not shown.

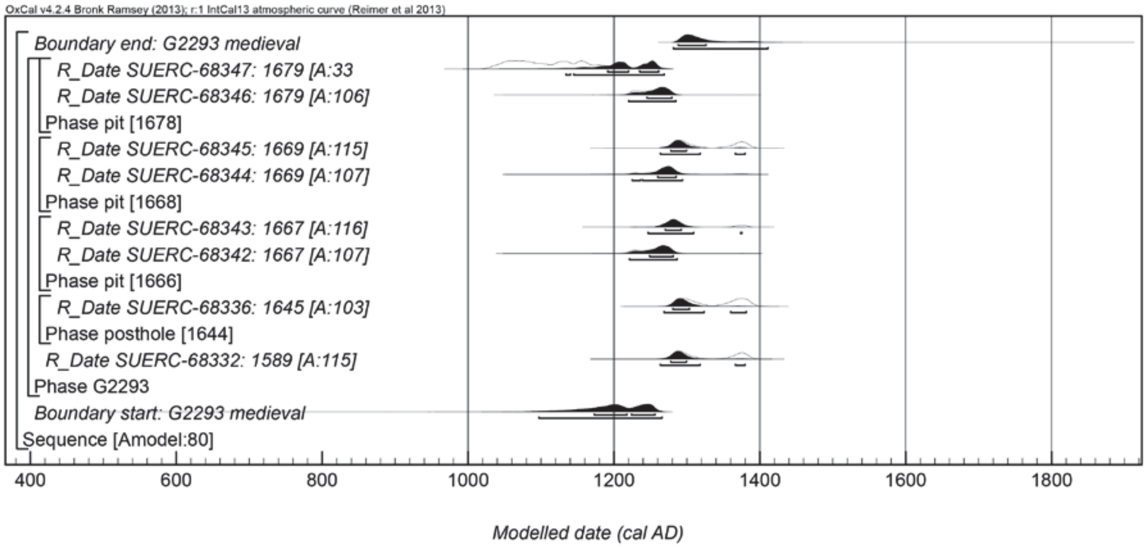

Figure 2: Chronological model for the medieval activity from site G2293 at Dolbenmaen, Wales. Each distribution represents the relative probability of an archaeological event. The distributions in outline show the calibration of each result by the probability method (Stuiver and Reimer 1993). The solid distributions are *posterior density estimates* derived from the chronological model. This model is exactly defined by the square brackets and OxCal keywords at the left of the diagram.

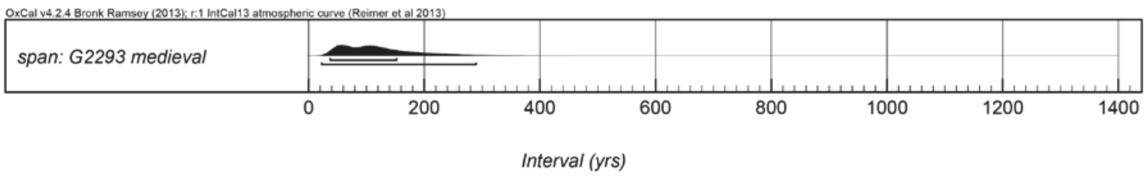

Figure 3: Span for the modelled medieval activity at Dolbenmaen WTW. The span is based on the model shown in Figure 2.

Tables

Table 1: Radiocarbon results from the Dolbenmaen Water Treatment Works (G2293)

Lab No	Sample ID	Context No	Context Description	Material/species	Radiocarbon Age (BP)	$\delta^{13}C$ (‰)	Calibrated date (95% confidence)
SUERC-68324	7A	1521	Fill of posthole [1520]	charred grain: *Avena* sp. (oat)	1616 ± 34	−26.2	cal AD 380–540
SUERC-68325	7B	1521	Fill of posthole [1520]	charred grain: *Hordeum var vulgare* (hulled barley)	1637 ± 34	−25.0*	cal AD 330–540
SUERC-68326	16	1585	Fill of posthole [1584]	charred hazelnut shell	3276 ± 34	−25.0*	1630–1450 cal BC
SUERC-68327	17A	1603	Burnt spread associated with possible corn drier 1602/1683	charred grain: *Avena* sp. (oat)	592 ± 64	−25.0*	cal AD 1290–1420
SUERC-68328	17B	1603	Burnt spread associated with possible corn drier 1602/1683	charred grain: *Avena* sp. (oat)	461 ± 34	−22.9	cal AD 1410–1470
SUERC-68332	22A	1589	Fill of pit [1588]	charred hazelnut shell	677 ± 34	−26.0	cal AD 1270–1390
SUERC-68333	35A	1649	Basal fill of pit [1648]	charred grain: *Triticum dicoccum/spelta* (emmer/spelt wheat)	2537 ± 34	−23.6	800–540 cal BC
SUERC-68334	35B	1649	Basal fill of pit [1648]	charred hazelnut shell	1395 ± 34	−24.8	cal AD 600–670
SUERC-68335	39A	1645	Fill of posthole [1644]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	2296 ± 34	−22.0	410–230 cal BC
SUERC-68336	39B	1645	Fill of posthole [1644]	charred grain: *Avena* sp. (oat)	658 ± 34	−25.0*	cal AD 1270–1400
SUERC-68337	49A	1661	Basal fill of ring ditch [1656]	charred hazelnut shell	8971 ± 34	−27.2	8280–7990 cal BC

Lab No	Sample ID	Context No	Context Description	Material/species	Radiocarbon Age (BP)	$\delta^{13}C$ (‰)	Calibrated date (95% confidence)
SUERC-68338	49B	1661	Basal fill of ring ditch [1656]	charcoal: *Corylus* sp.	2374 ± 34	−25.8	540–390 cal BC
SUERC-68342	55A	1667	Burnt fill of pit [1666]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	758 ± 34	−24.2	cal AD 1210–1280
SUERC-68343	55B	1667	Burnt fill of pit [1666]	charred grain: *Avena* sp. (oat)	708 ± 34	−26.2	cal AD 1260–1390
SUERC-68344	56A	1669	Burnt fill of pit [1668]	charred grain: *Hordeum var vulgare* (hulled barley)	737 ± 34	−25.8	cal AD 1220–1300
SUERC-68345	56B	1669	Burnt fill of pit [1668]	charred grain: *Avena* sp. (oat)	677 ± 34	−25.6	cal AD 1270–1390
SUERC-68346	62A	1679	Fill of pit [1678]	charred grain: *Triticum aestivo/compactum* (bread/club wheat)	764 ± 34	−22.1	cal AD 1210–1290
SUERC-68347	62B	1679	Fill of pit [1678]	charred grain: *Avena* sp. (oat)	909 ± 34	−25.0*	cal AD 1020–1220
SUERC-70635	14A	1563	Fill of pit/earth oven [1562]	charcoal: *Corylus avellana*	5083 ±33	−27.3	3970–3790 cal BC
SUERC-70636	14B	1563	Fill of pit/earth oven [1562]	charcoal: *Corylus avellana*	5042 ±33	−28.2	3960–3710 cal BC
SUERC-70637	13A	1549	Fill of corn drier [1547]	charred grain: *Avena* sp. (oat)	1544 ±33	−23.9	cal AD 420–600
SUERC-70638	13B	1549	Fill of corn drier [1547]	charred grain: *Hordeum var vulgare* (hulled barley)	1588 ±33	−24.6	cal AD 390–560

*Assumed value

Table 2: Chi-square test results (Ward and Wilson 1978) for paired measurements from dated contexts at the Dolbenmaen Water Treatment Works (G2293), Wales. The T_{crit} (5%) value for all pairs (df=1) is 3.8

Context	**Chi-square result**	**Pass/Fail**
1521	**T'=0.2**	**Pass**
1549	**T'=0.9**	**Pass**
1563	**T'=0.8**	**Pass**
1603	**T'=7.4**	**Fail**
1649	**T'=559.4**	**Fail**
1645	**T'=1140.7**	**Fail**
1661	**T'=14683.3**	**Fail**
1667	**T'=1.1**	**Pass**
1669	**T'=1.6**	**Pass**
1679	**T'=9.1**	**Fail**

40 APPENDIX XXV: RADIOCARBON DATING CERTIFICATES

Scottish Universities Environmental Research Centre

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RADIOCARBON DATING CERTIFICATE
29 July 2016

Laboratory Code	SUERC-68324 (GU41284)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1521
Sample Reference	7A
Material	Cereal grain : Avena sp.
$\delta^{13}C$ relative to VPDB	-26.2 ‰
Radiocarbon Age BP	1616 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

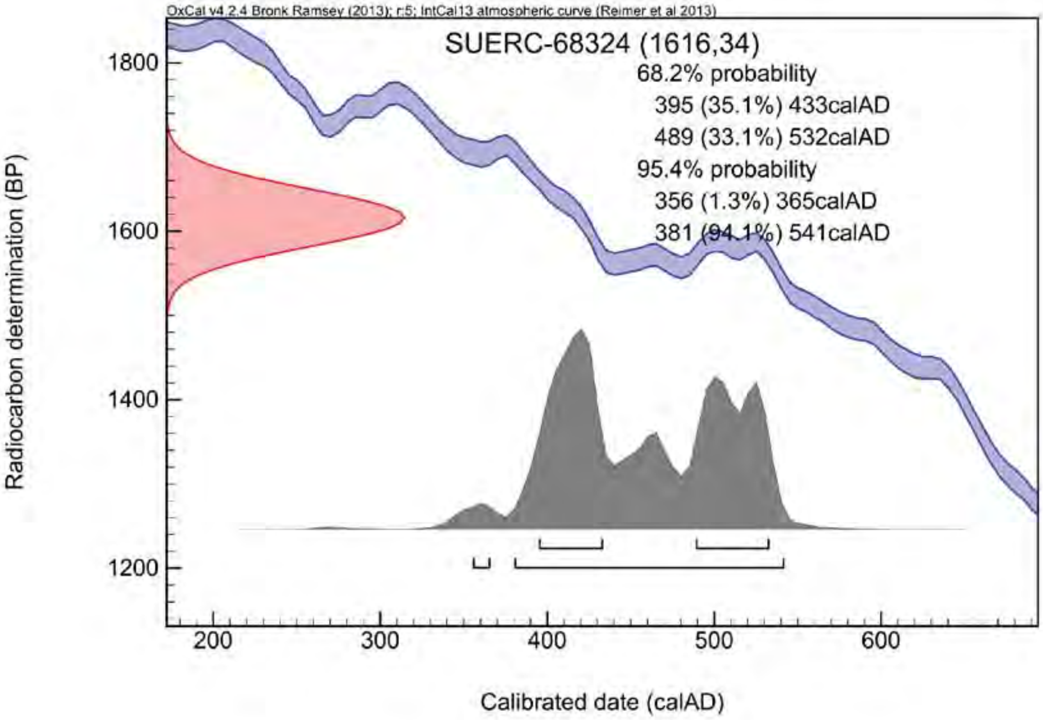
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B. Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68325 (GU41285)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1521
Sample Reference	7B
Material	Cereal grain : Hordeum var vulgare
$\delta\,^{13}$C relative to VPDB	-25.0 ‰ assumed
Radiocarbon Age BP	1637 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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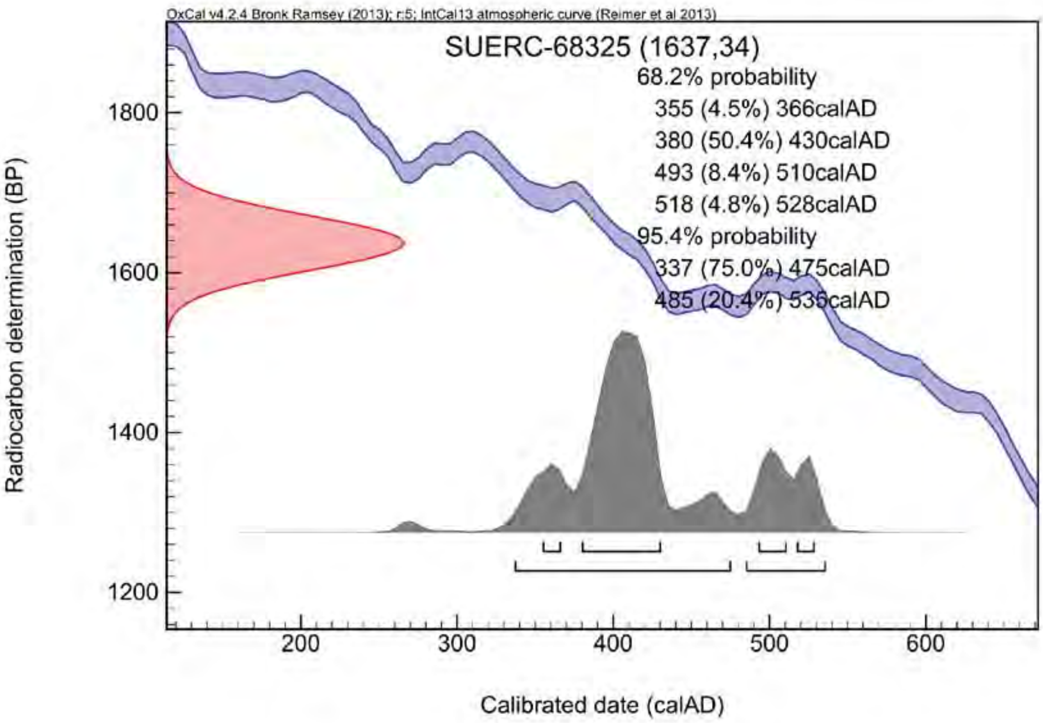
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- [signature] Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68326 (GU41286)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1585
Sample Reference	16
Material	Nutshell : Hazelnut
$\delta^{13}C$ relative to VPDB	-25.0 ‰ assumed
Radiocarbon Age BP	3276 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

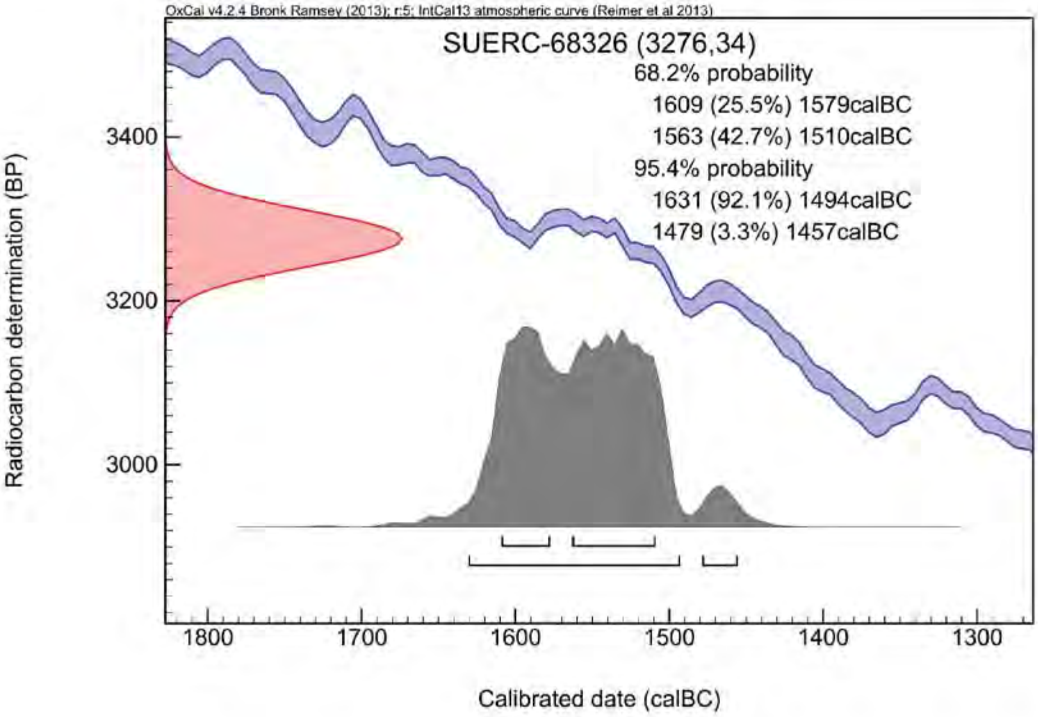
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

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Laboratory Code	SUERC-68327 (GU41287)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1603
Sample Reference	17A
Material	Cereal grain : Avena sp.
$\delta^{13}C$ relative to VPDB	-25.0 ‰ assumed
Radiocarbon Age BP	592 ± 64

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

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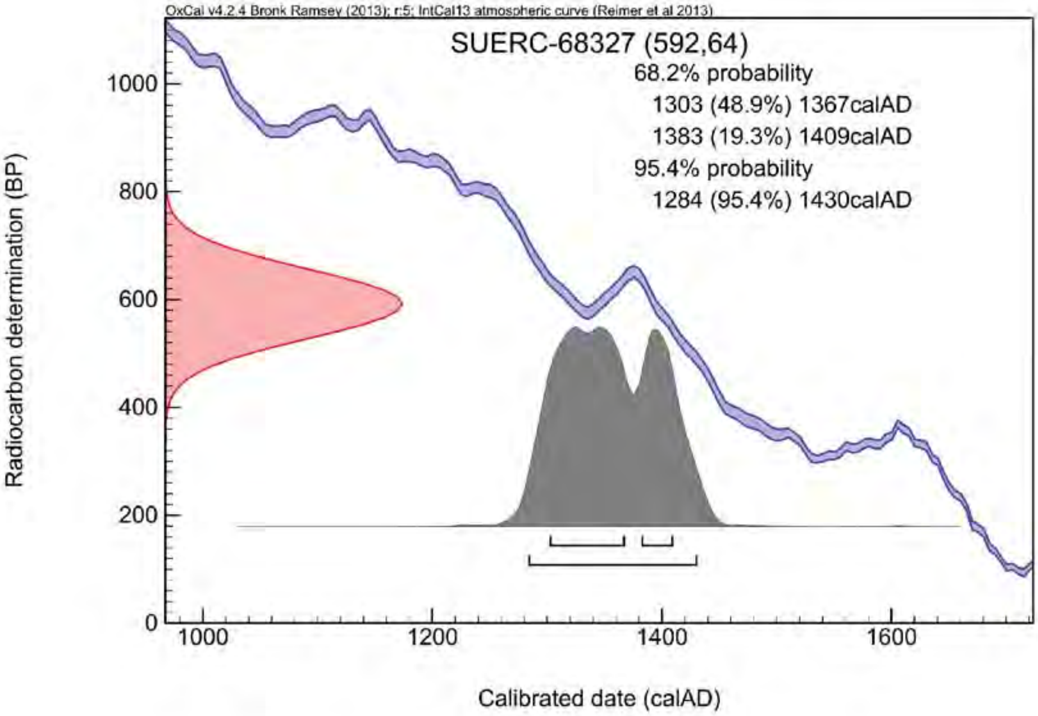
Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68328 (GU41288)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1603
Sample Reference	17B
Material	Cereal grain : Avena sp.
$\delta^{13}C$ relative to VPDB	-22.9 ‰
Radiocarbon Age BP	461 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

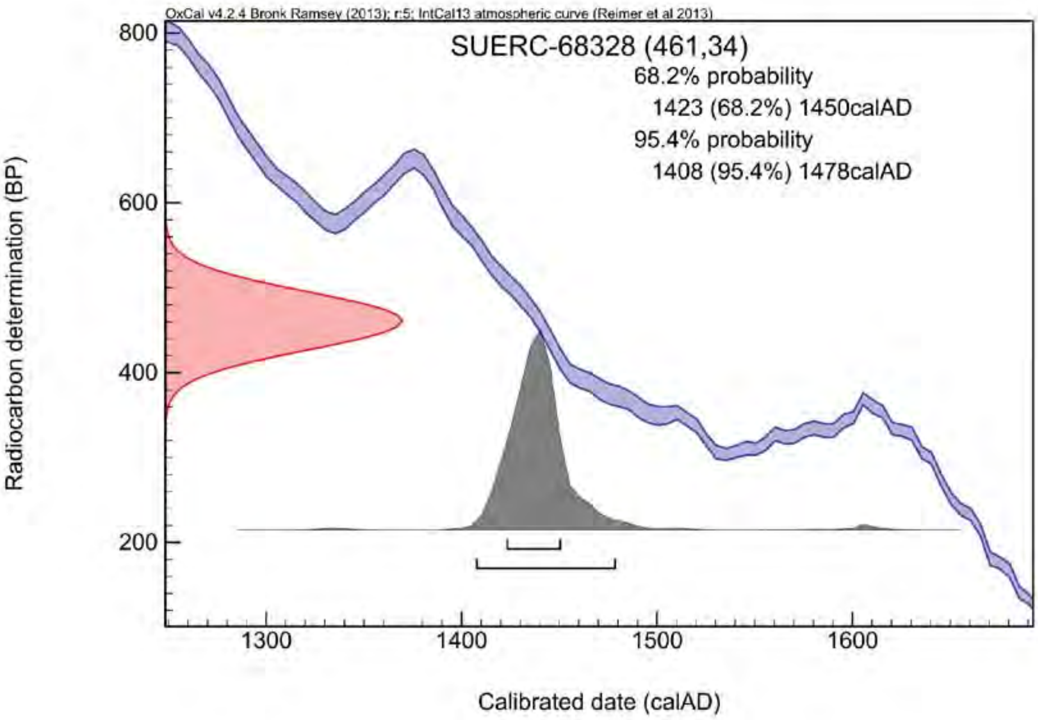
Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after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

Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- [signature] Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68332 (GU41289)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1589
Sample Reference	22A
Material	Nutshell : Hazelnut
$\delta^{13}C$ relative to VPDB	-26.0 ‰
Radiocarbon Age BP	677 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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 Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

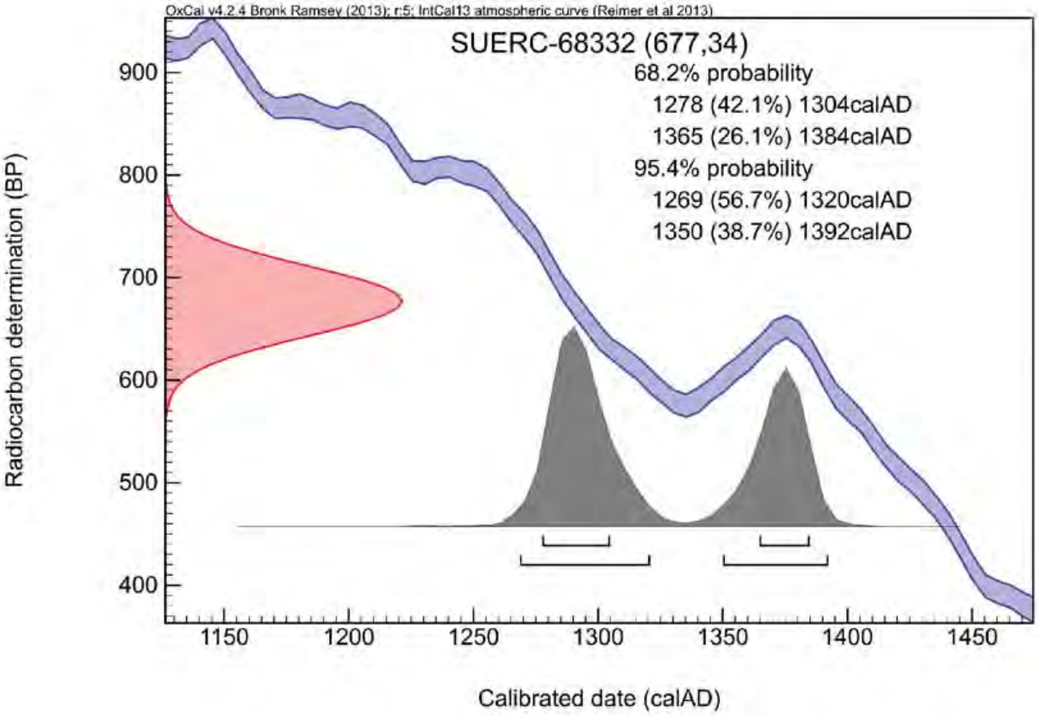
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- [signature] Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	GU41290
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1589
Sample Reference	22B
Material	Nutshell : Hazelnut
Result	Failed: insufficient carbon.

N.B. Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email Gordon.Cook@glasgow.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :- B Tagney

Date :- 29/07/2016

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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68333 (GU41291)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1649
Sample Reference	35A
Material	Cereal grain : Triticum dicoccum/spelta
δ^{13}C relative to VPDB	-23.6 ‰
Radiocarbon Age BP	2537 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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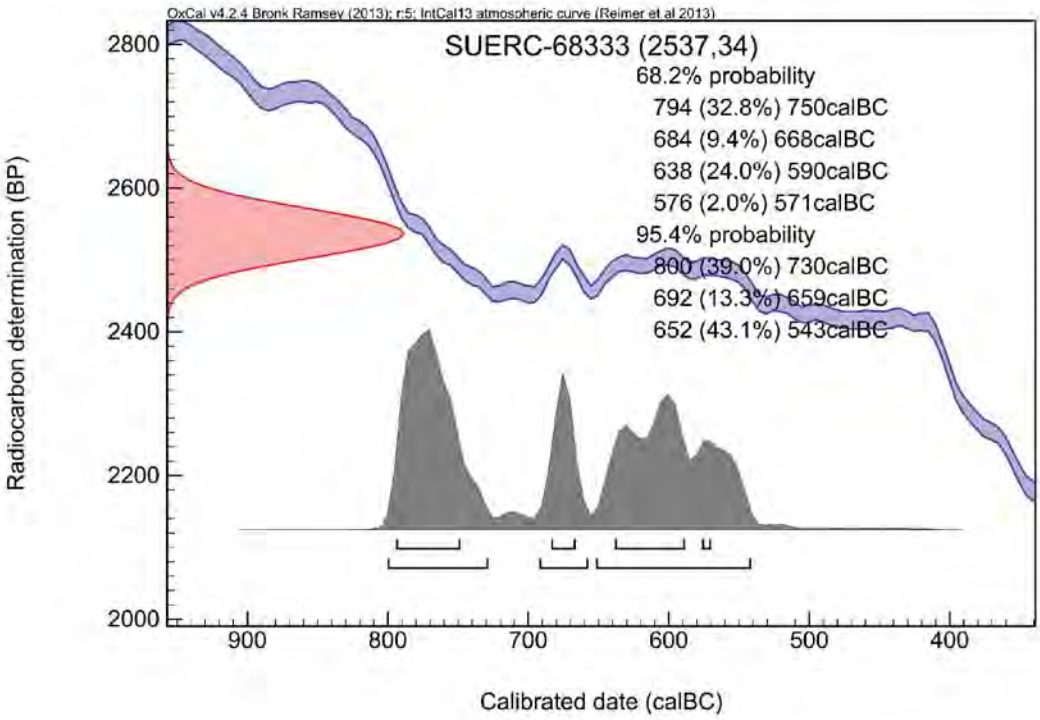
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68334 (GU41292)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1649
Sample Reference	35B
Material	Nutshell : Hazelnut
δ ^{13}C relative to VPDB	-24.8 ‰
Radiocarbon Age BP	1395 ± 34

N.B. 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.

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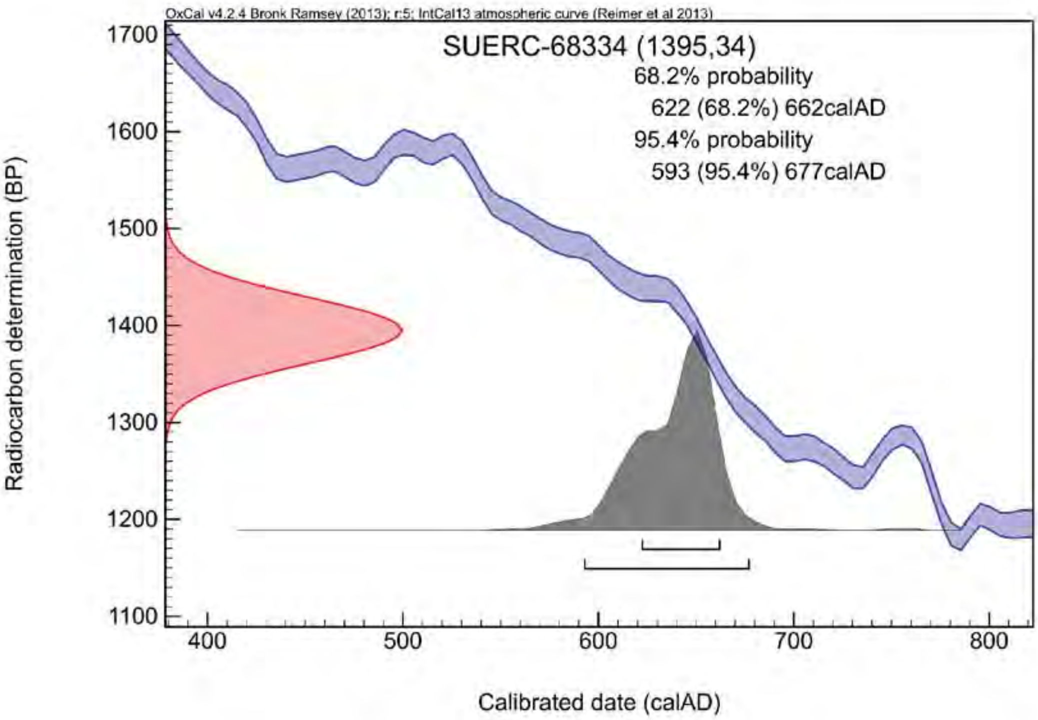
Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code SUERC-68335 (GU41293)

Submitter John Roberts
Gwynedd Archaeological Trust
Craig Beuno
Garth Road
Bangor
Gwynedd, LL57 2RT

Site Reference G2293
Context Reference 1645
Sample Reference 39A

Material Cereal grain : Triticum aestivo/compactum

$\delta^{13}C$ relative to VPDB -22.0 ‰

Radiocarbon Age BP 2296 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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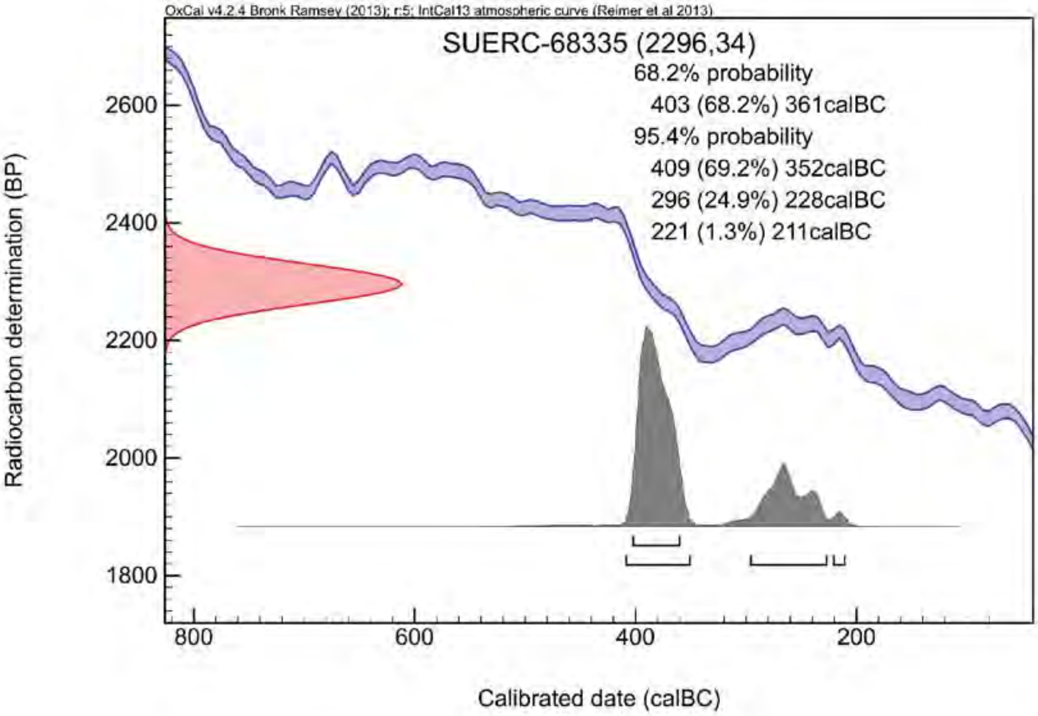
Checked and signed off by :- B Tagney Date :- 29/07/2016

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68336 (GU41294)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1645
Sample Reference	39B
Material	Cereal grain : Avena sp.
δ ^{13}C relative to VPDB	-25.0 ‰ assumed
Radiocarbon Age BP	658 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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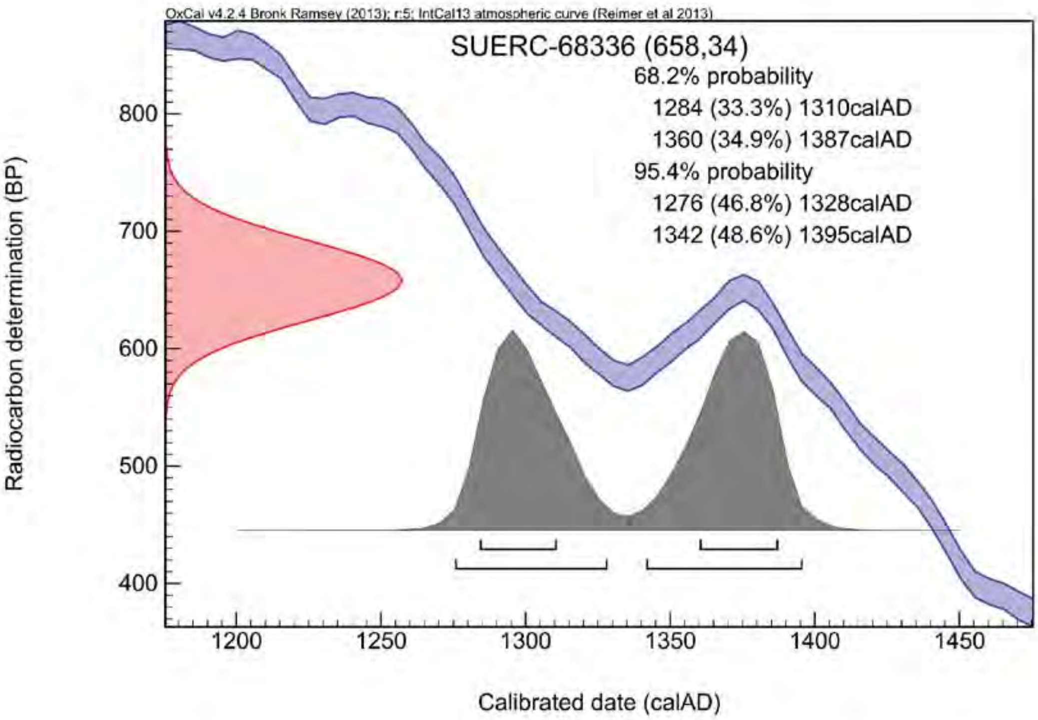
Conventional age and calibration age ranges calculated by :- P. Nayonto Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68337 (GU41295)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1661
Sample Reference	49A
Material	Nutshell : Hazelnut
$\delta\,^{13}C$ relative to VPDB	-27.2 ‰
Radiocarbon Age BP	8971 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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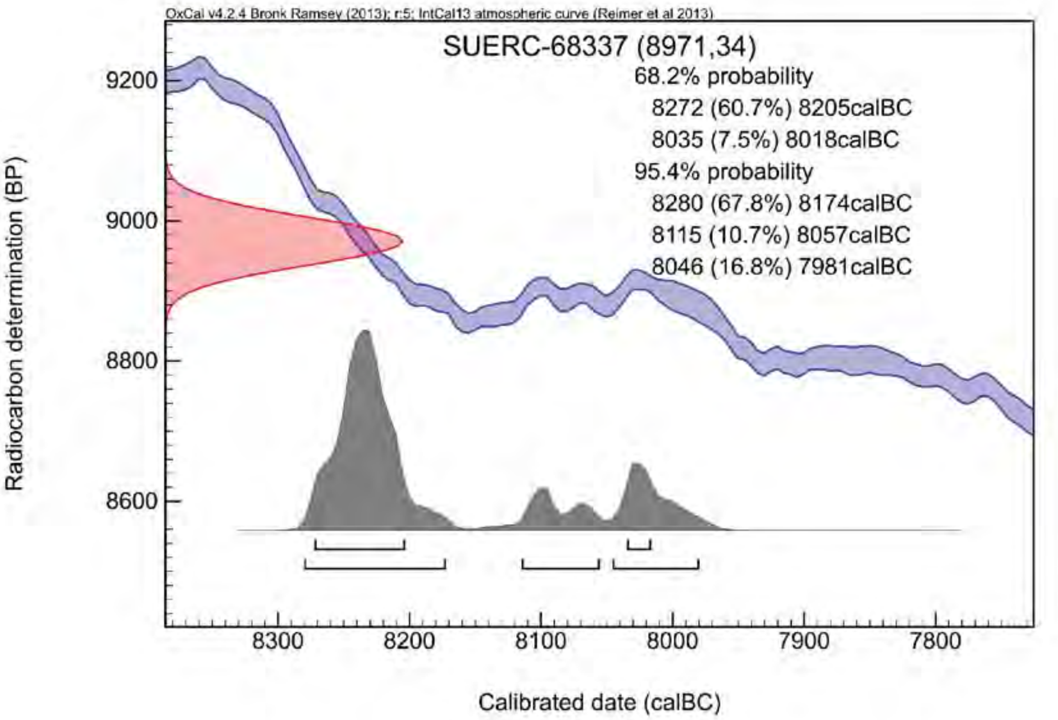
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- [signature] Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68338 (GU41296)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1661
Sample Reference	49B
Material	Charcoal : Corylus sp.
$\delta^{13}C$ relative to VPDB	-25.8 ‰
Radiocarbon Age BP	2374 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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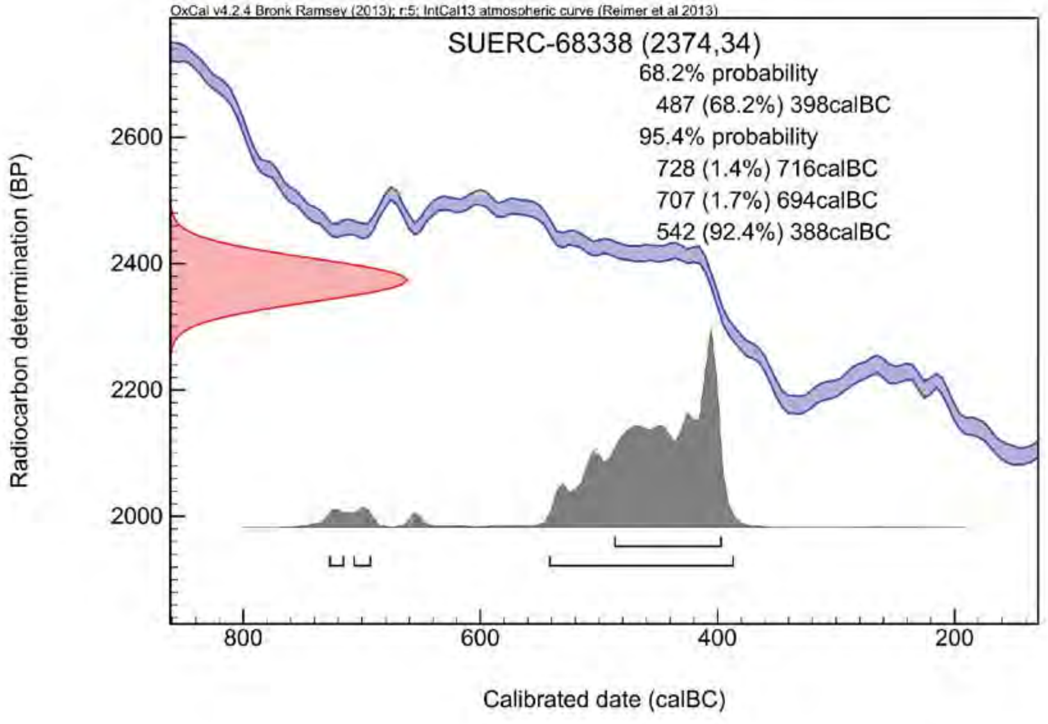
Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68342 (GU41297)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1667
Sample Reference	55A
Material	Cereal grain : Triticum aestivo/compactum
$\delta^{13}C$ relative to VPDB	-24.2 ‰
Radiocarbon Age BP	758 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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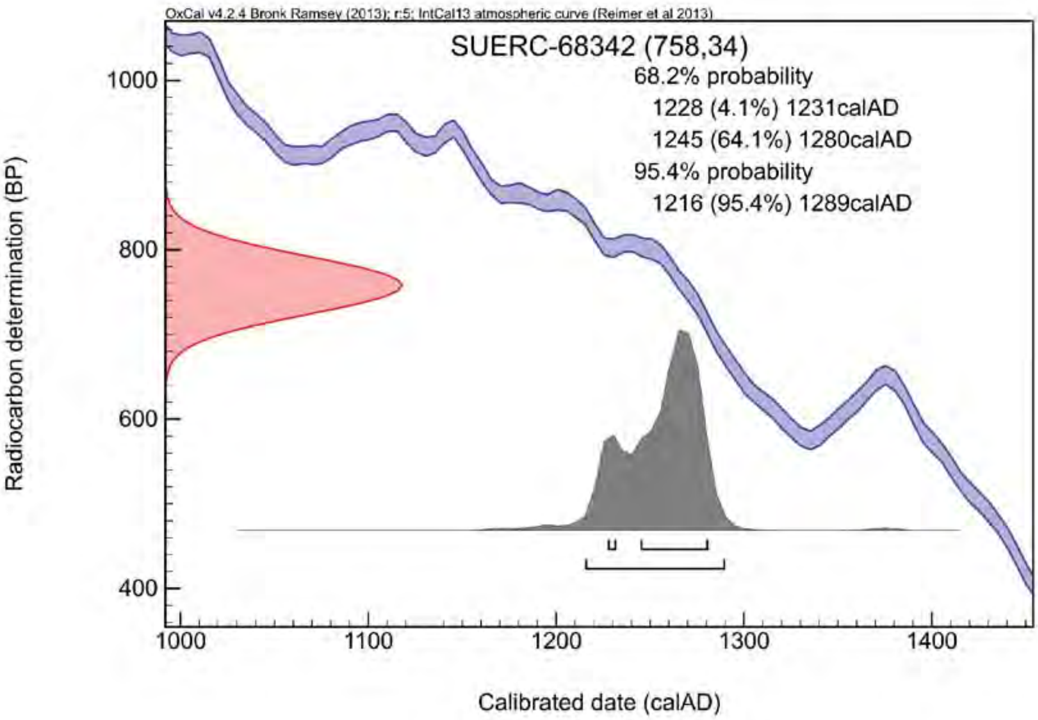
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68343 (GU41298)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1667
Sample Reference	55B
Material	Cereal grain : Avena sp.
$\delta^{13}C$ relative to VPDB	-26.2 ‰
Radiocarbon Age BP	708 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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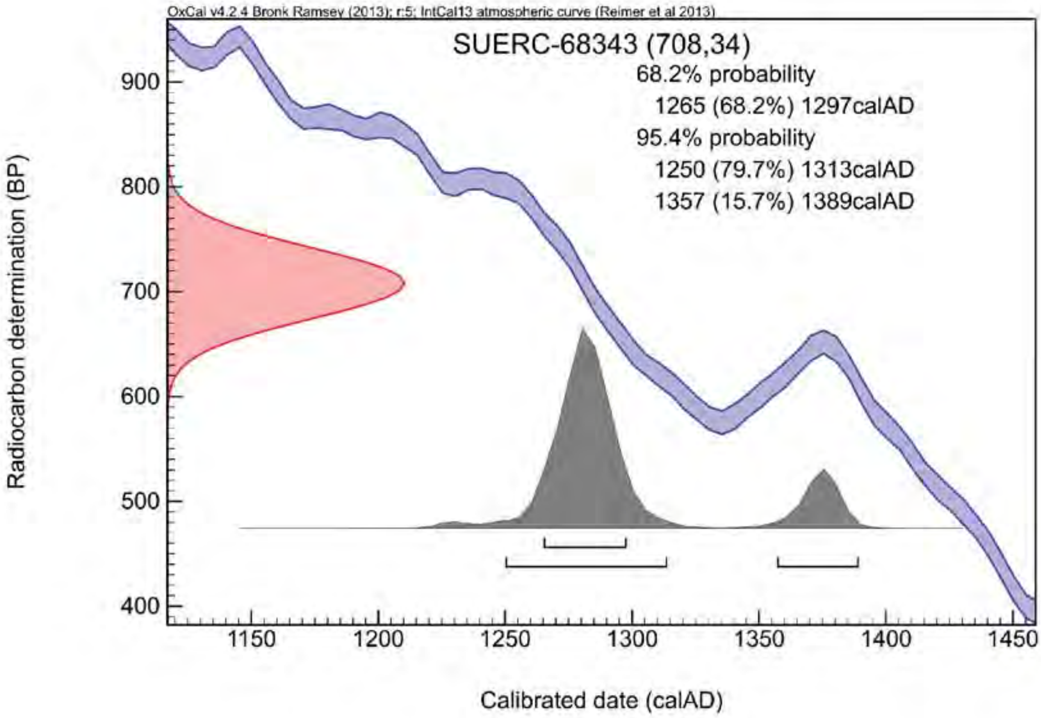
Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68344 (GU41299)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1669
Sample Reference	56A
Material	Cereal grain : Hordeum var vulgare
$\delta^{13}C$ relative to VPDB	-25.8 ‰
Radiocarbon Age BP	737 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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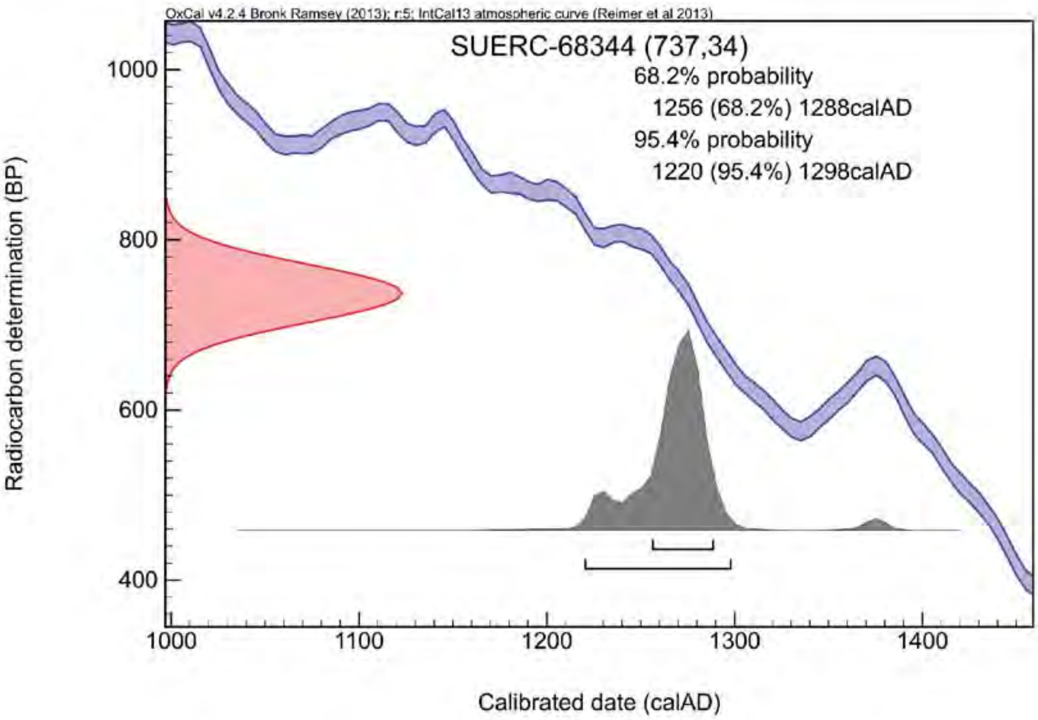
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

The University of Edinburgh

Calibration Plot



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Director: Professor R M Ellam Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68345 (GU41300)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1669
Sample Reference	56B
Material	Cereal grain : Avena sp.
δ^{13}C relative to VPDB	-25.6 ‰
Radiocarbon Age BP	677 ± 34

N.B. 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.

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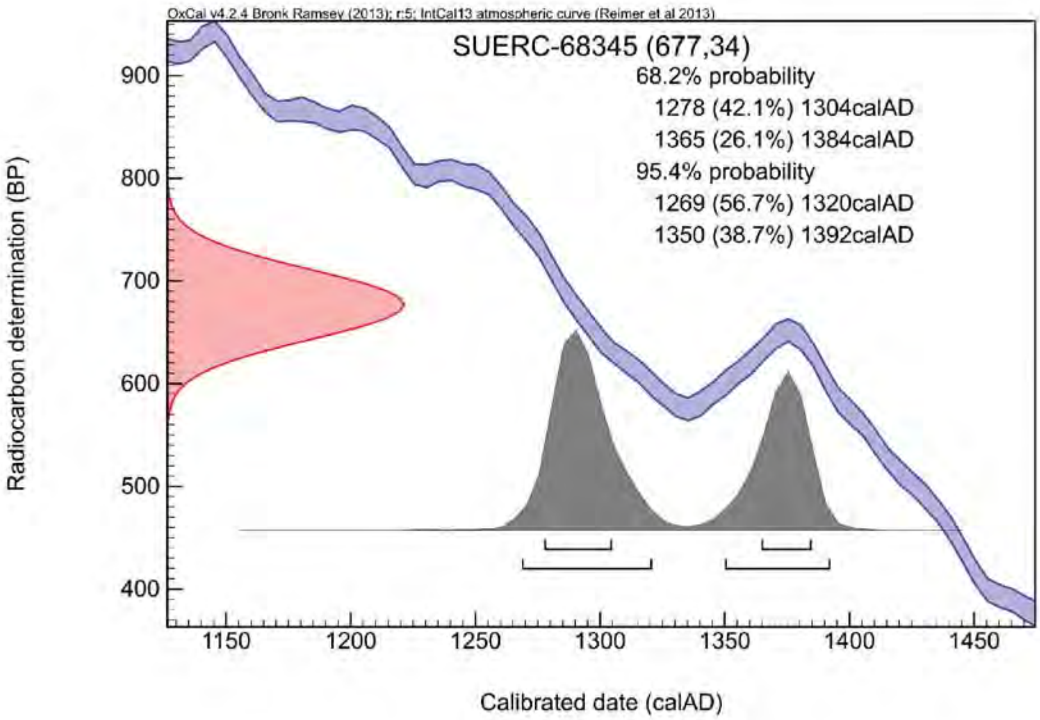
Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



Scottish Universities Environmental Research Centre

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Director: Professor R M Ellam Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code SUERC-68346 (GU41301)

Submitter John Roberts
Gwynedd Archaeological Trust
Craig Beuno
Garth Road
Bangor
Gwynedd, LL57 2RT

Site Reference G2293
Context Reference 1679
Sample Reference 62A

Material Cereal grain : Triticum aestivo/compactum

δ ^{13}C relative to VPDB -22.1 ‰

Radiocarbon Age BP 764 ± 34

N.B. 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.

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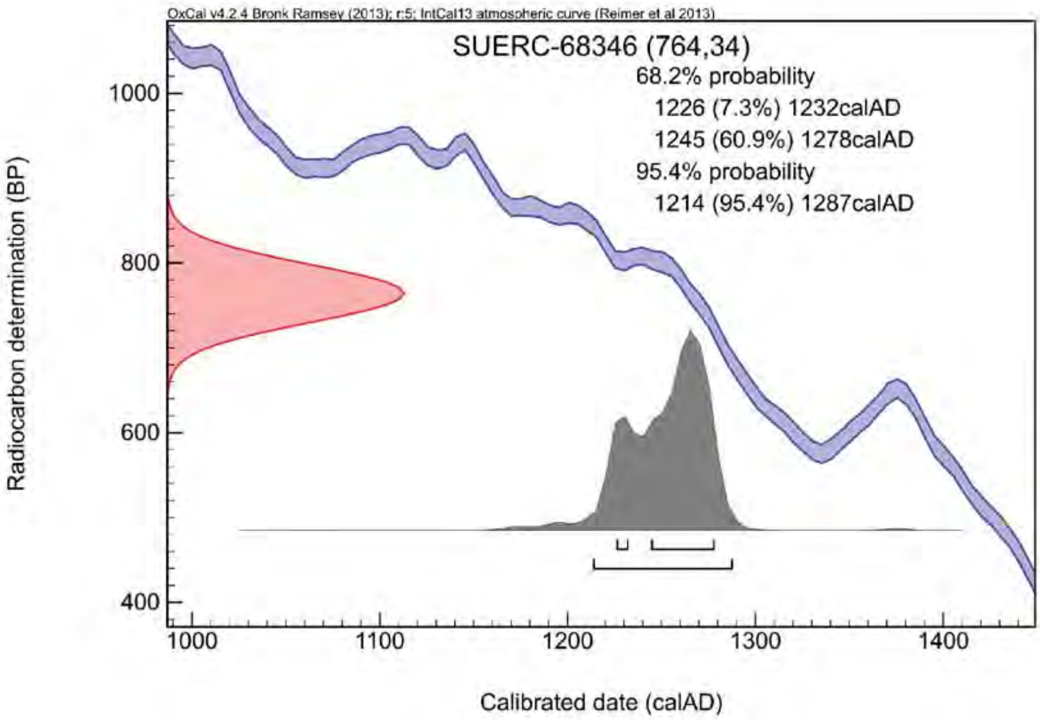
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- B Tagney Date :- 29/07/2016

University of Glasgow

Calibration Plot



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Rankine Avenue, Scottish Enterprise Technology Park, East Kilbride, Glasgow G75 0QF, Scotland, UK
Director: Professor R M Ellam Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

29 July 2016

Laboratory Code	SUERC-68347 (GU41302)
Submitter	John Roberts Gwynedd Archaeological Trust Craig Beuno Garth Road Bangor Gwynedd, LL57 2RT
Site Reference	G2293
Context Reference	1679
Sample Reference	62B
Material	Cereal grain : Avena sp.
$\delta^{13}C$ relative to VPDB	-25.0 ‰ assumed
Radiocarbon Age BP	909 ± 34

N.B. 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.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

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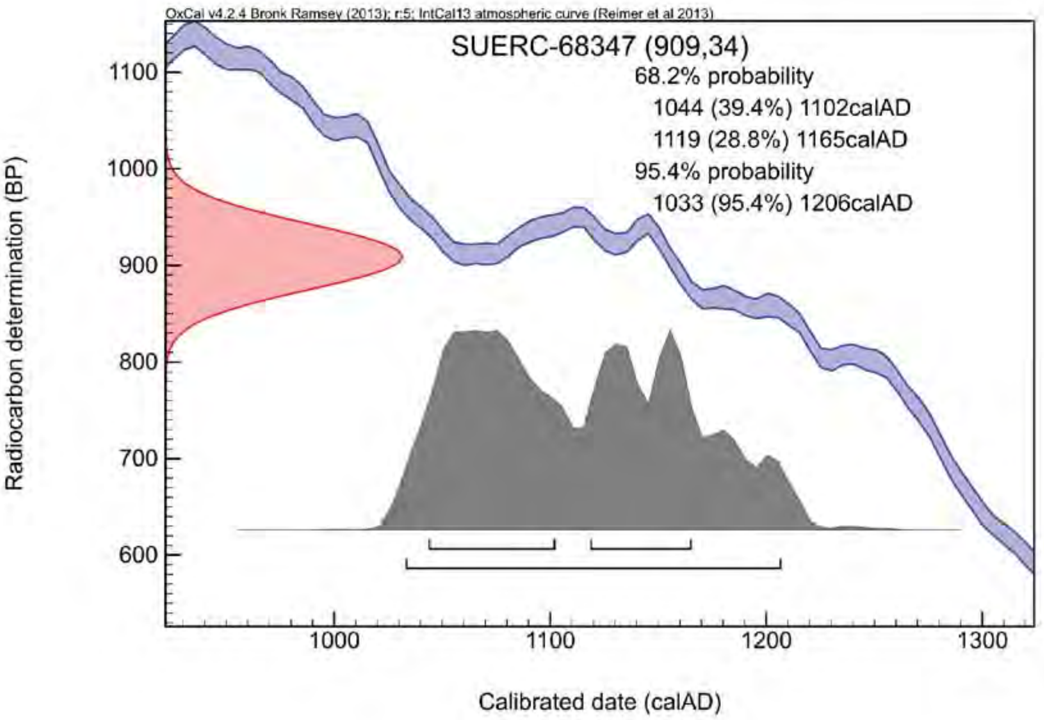
Conventional age and calibration age ranges calculated by :- P. Naysmith Date :- 29/07/2016

Checked and signed off by :- [signature] Date :- 29/07/2016

University of Glasgow

Calibration Plot



41 FIGURES AND PLATES

FIGURES

PLATES

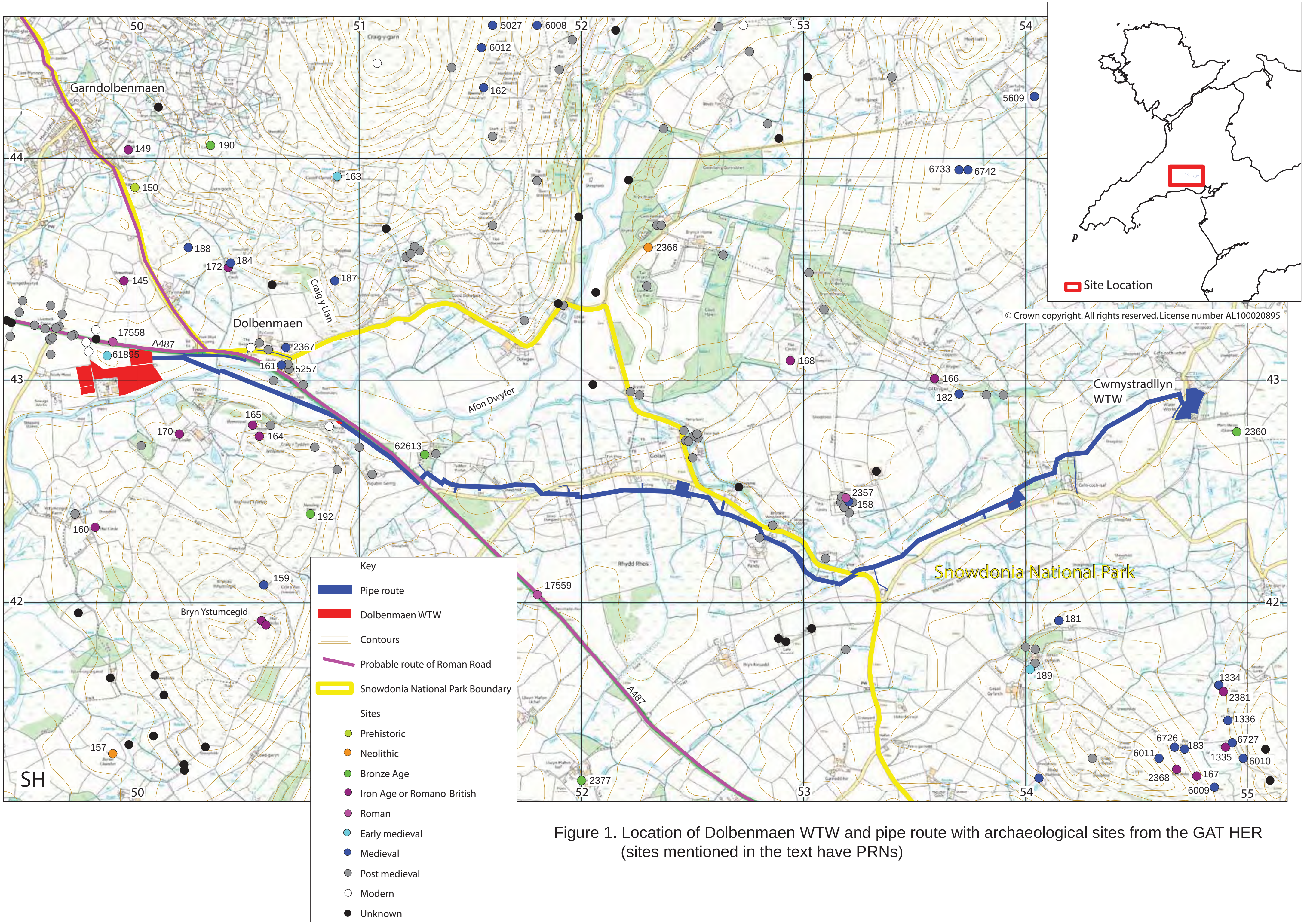


Figure 1. Location of Dolbenmaen WTW and pipe route with archaeological sites from the GAT HER (sites mentioned in the text have PRNs)

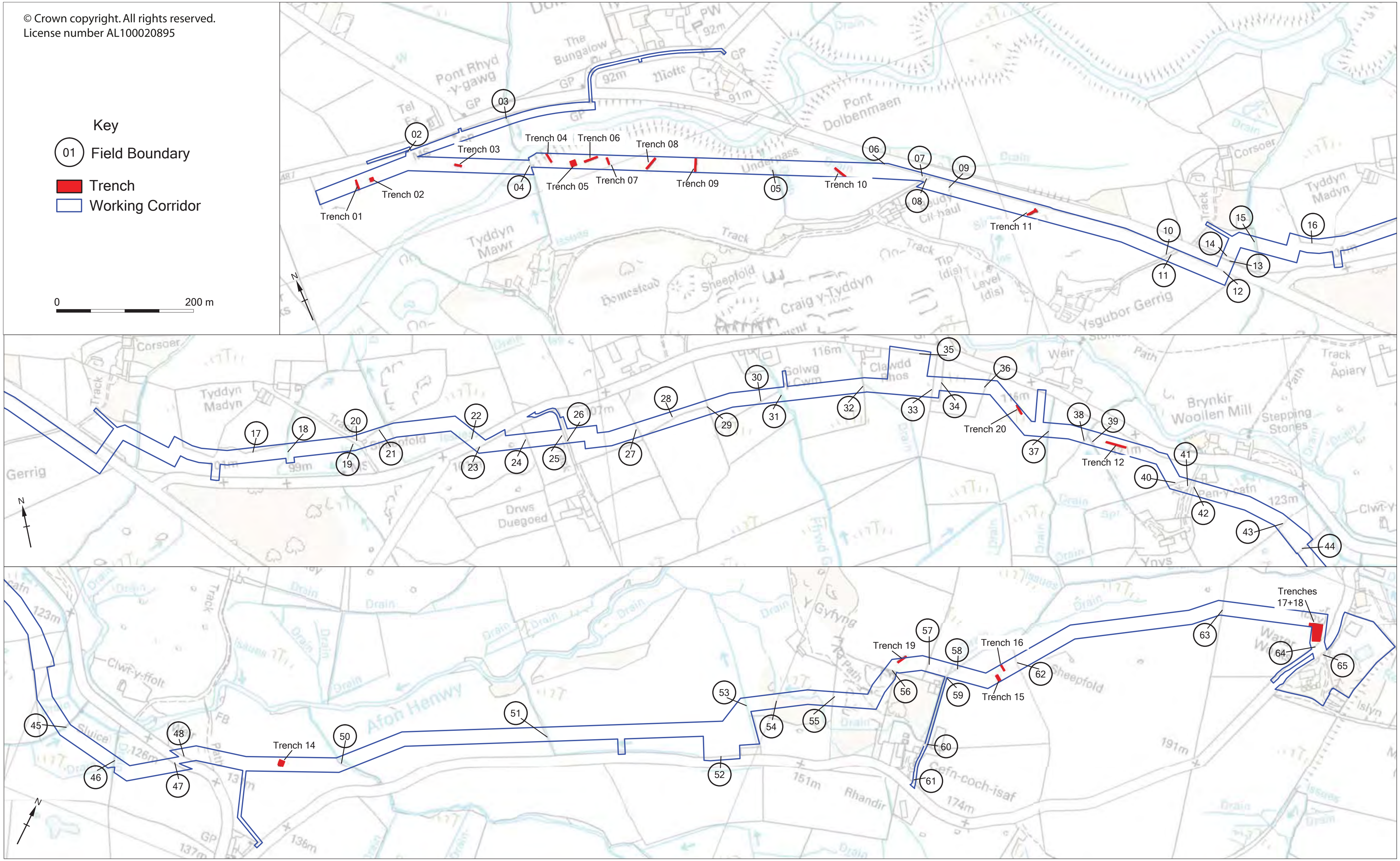


Figure 2. Location of evaluation trenches and recorded field boundaries

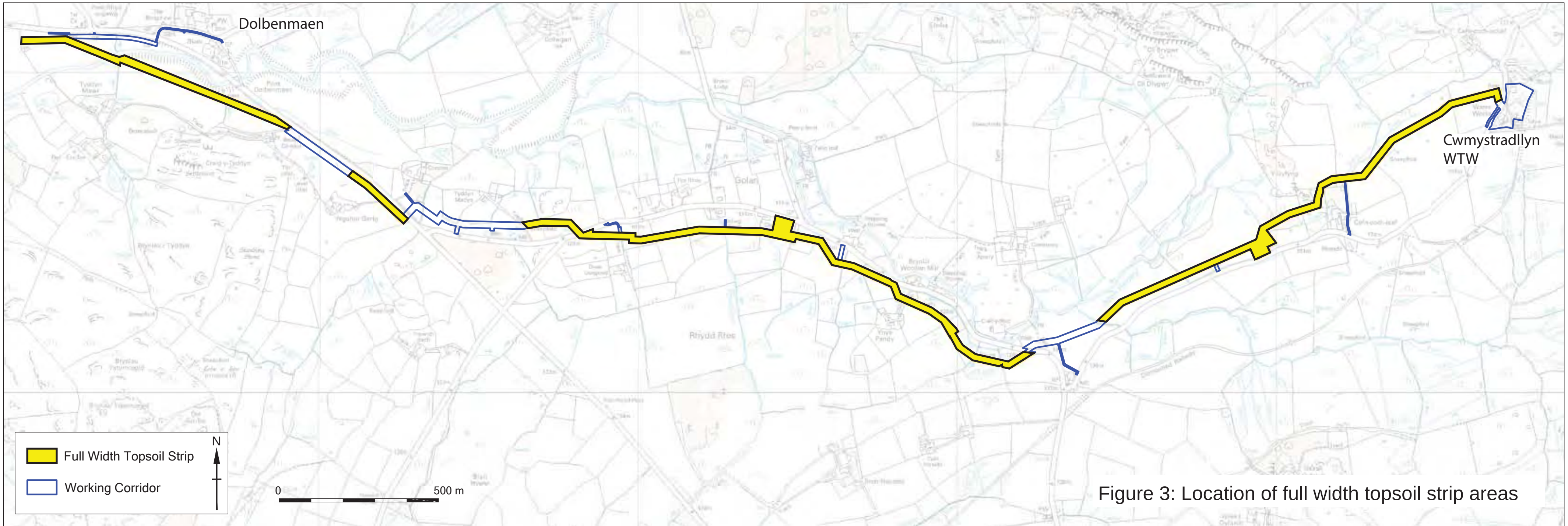


Figure 3: Location of full width topsoil strip areas

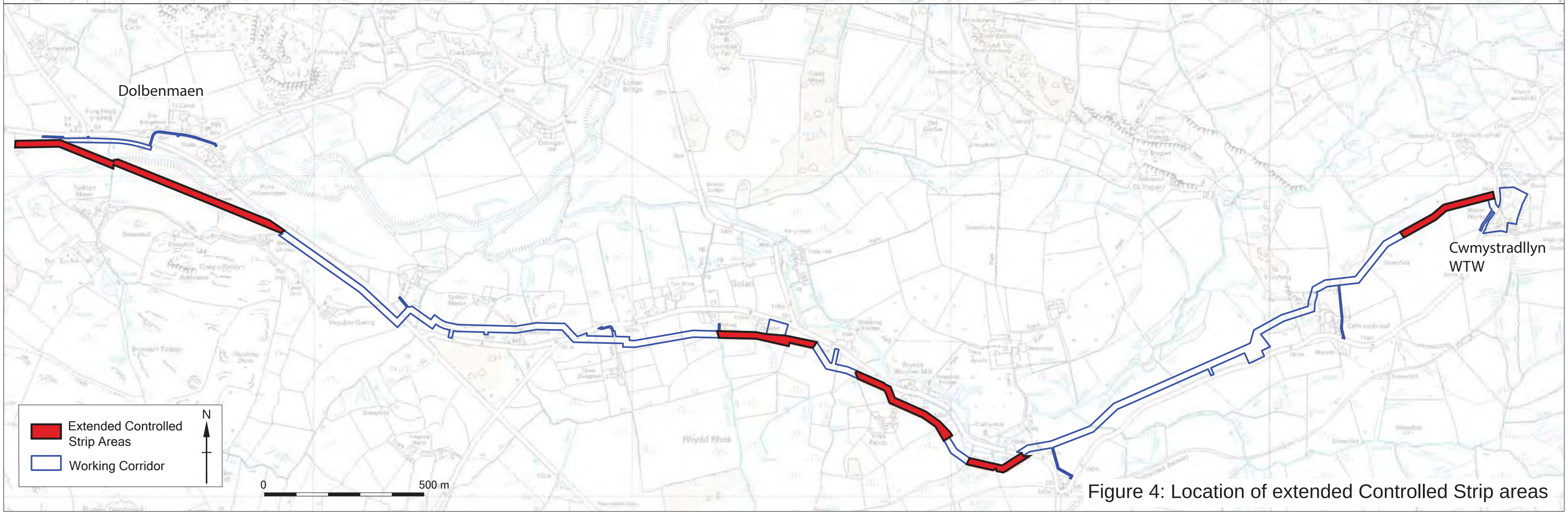


Figure 4: Location of extended Controlled Strip areas

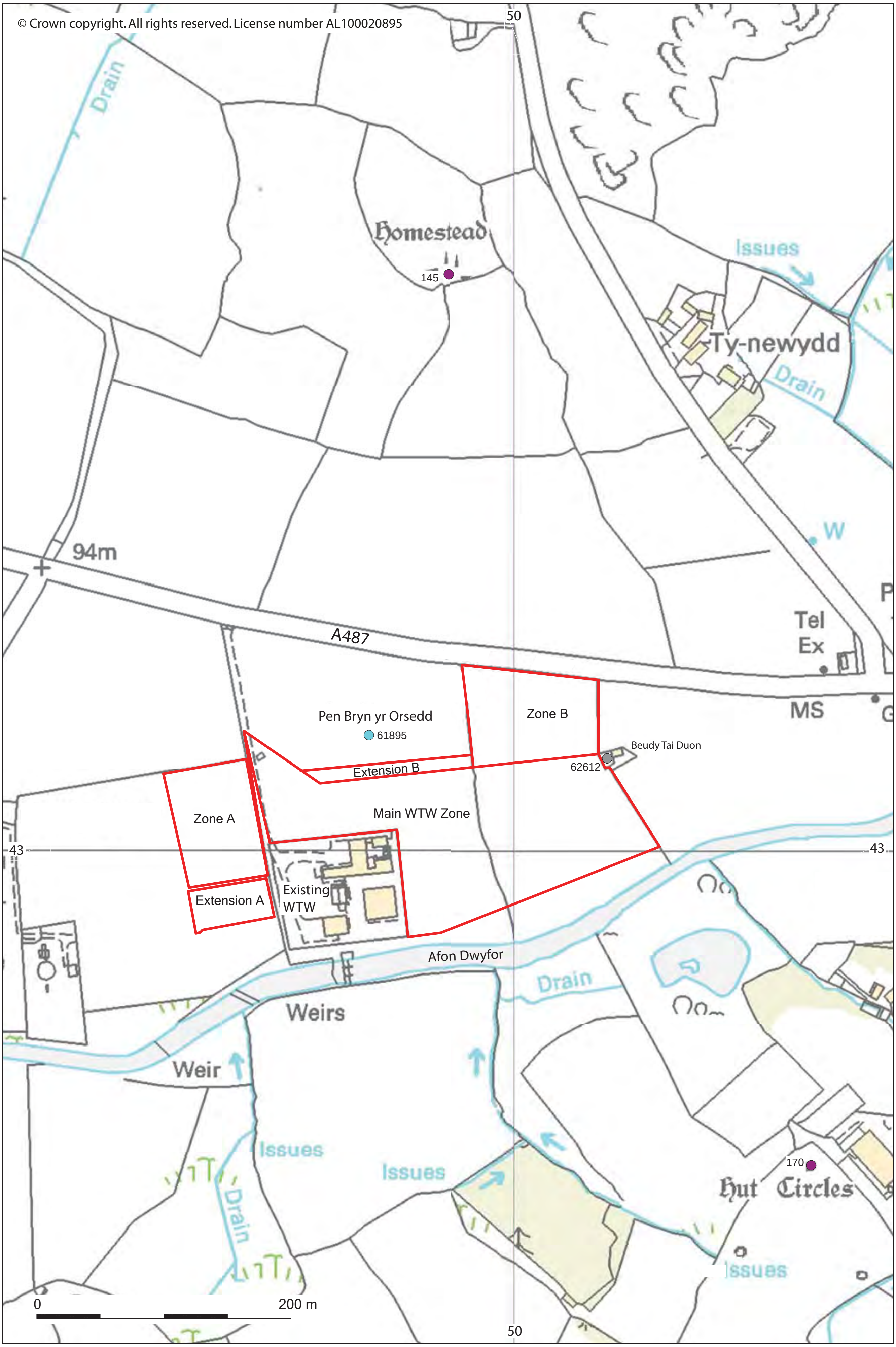


Figure 5. Areas investigated around the existing Dolbenmaen WTW

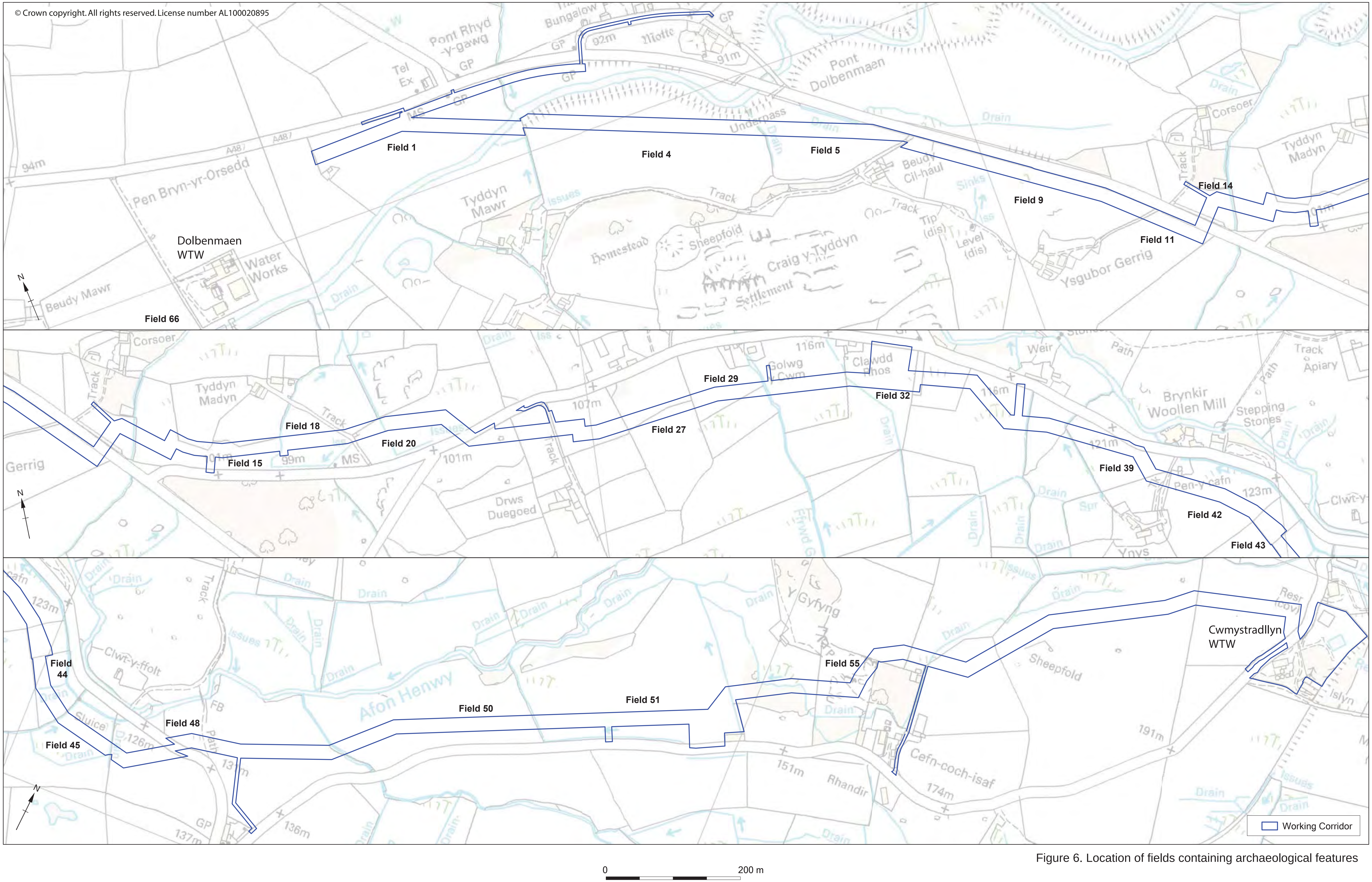


Figure 6. Location of fields containing archaeological features

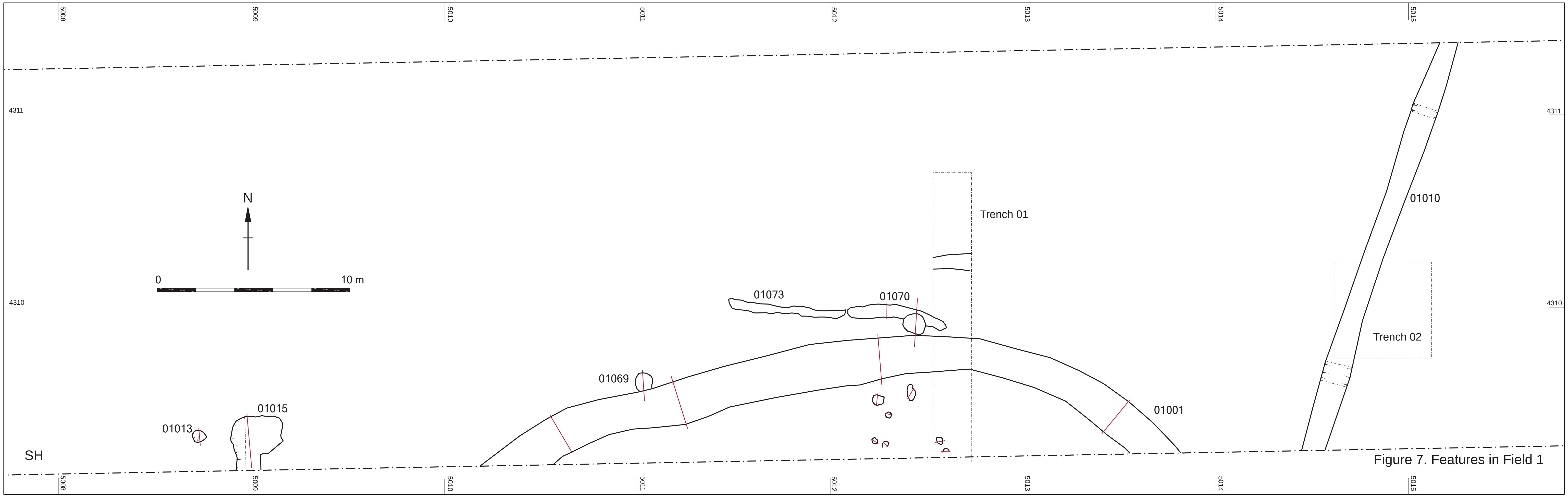


Figure 7. Features in Field 1

Key

Working Corridor

Section lines

Evaluation trenches and sondages

Natural features

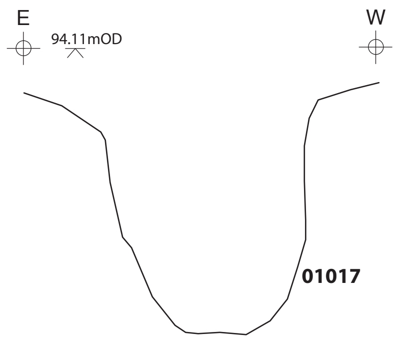


Figure 9. North facing profile of posthole **01017**

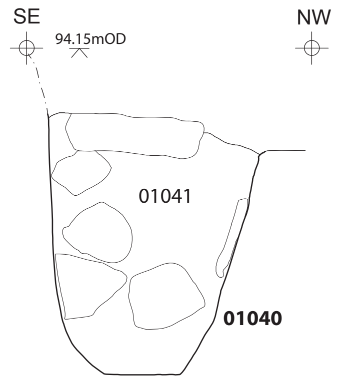
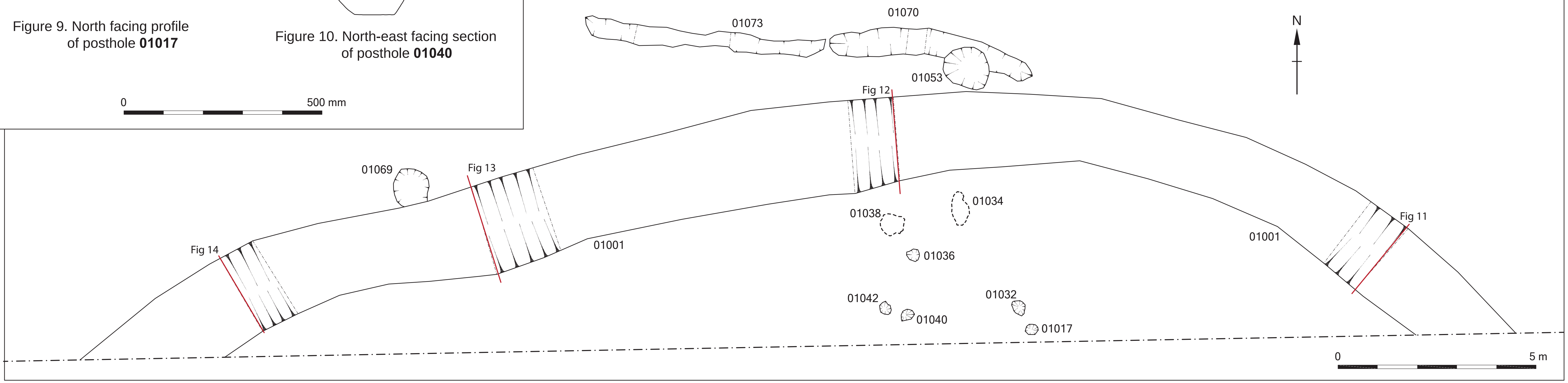


Figure 10. North-east facing section of posthole **01040**

0 500 mm

Figure 8. Ditch **01001** and related features, probably representing the edge of an Iron Age settlement



Figures 7 to 10

Figure 11: North-west facing section through ditch **01020** (part of **01001**)

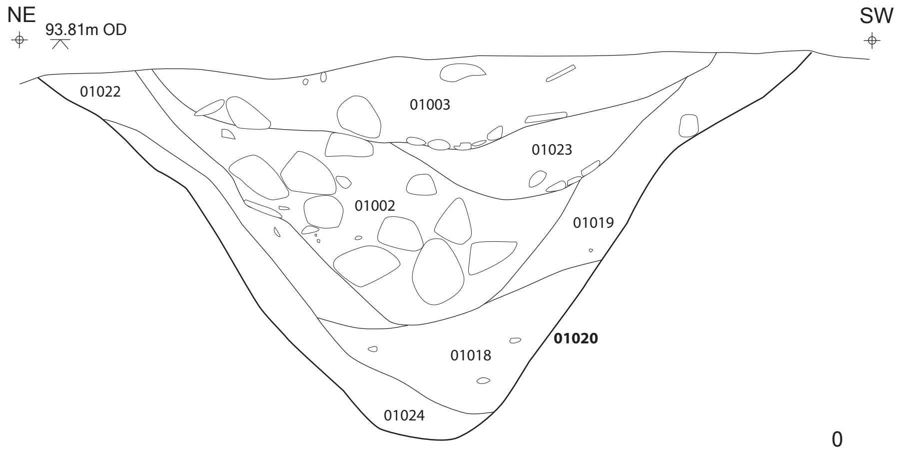
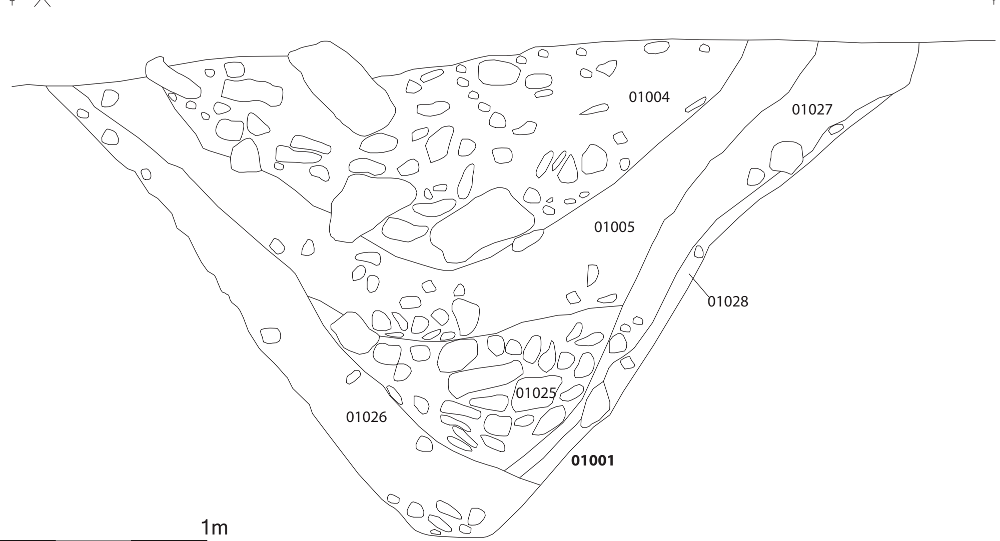


Figure 12: West facing section through ditch **01001**



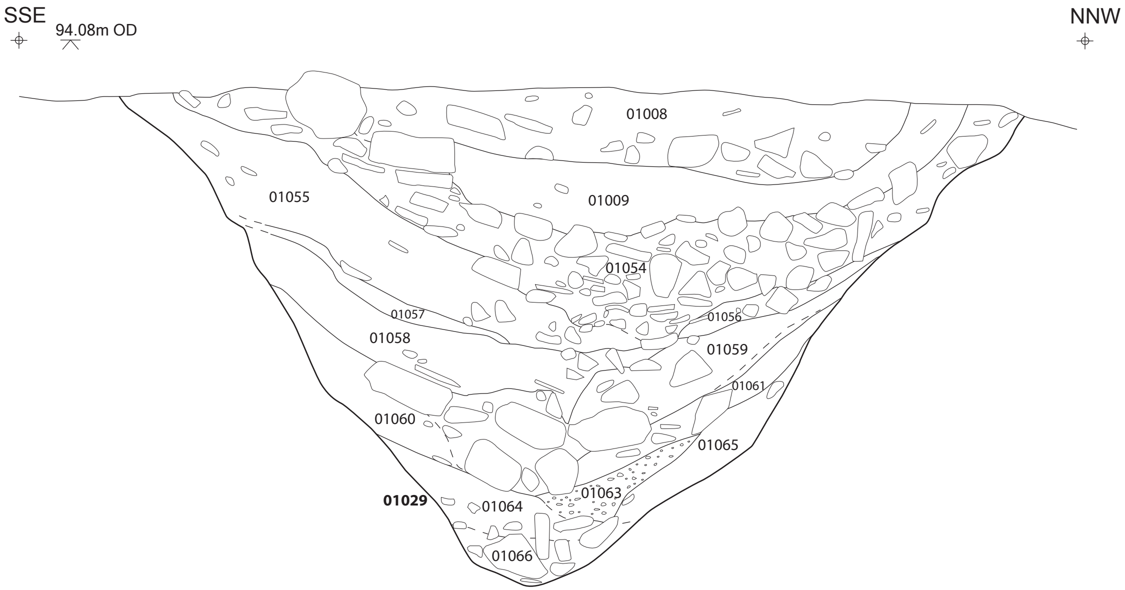


Figure 13: East-north-east facing section through ditch **01029** (part of **01001**)

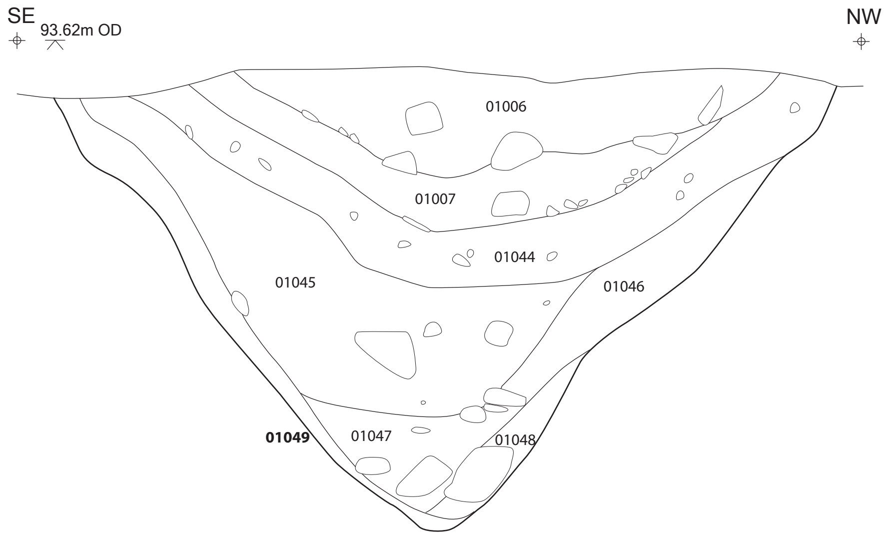


Figure 14: North-east facing section through ditch **01049** (part of **01001**)

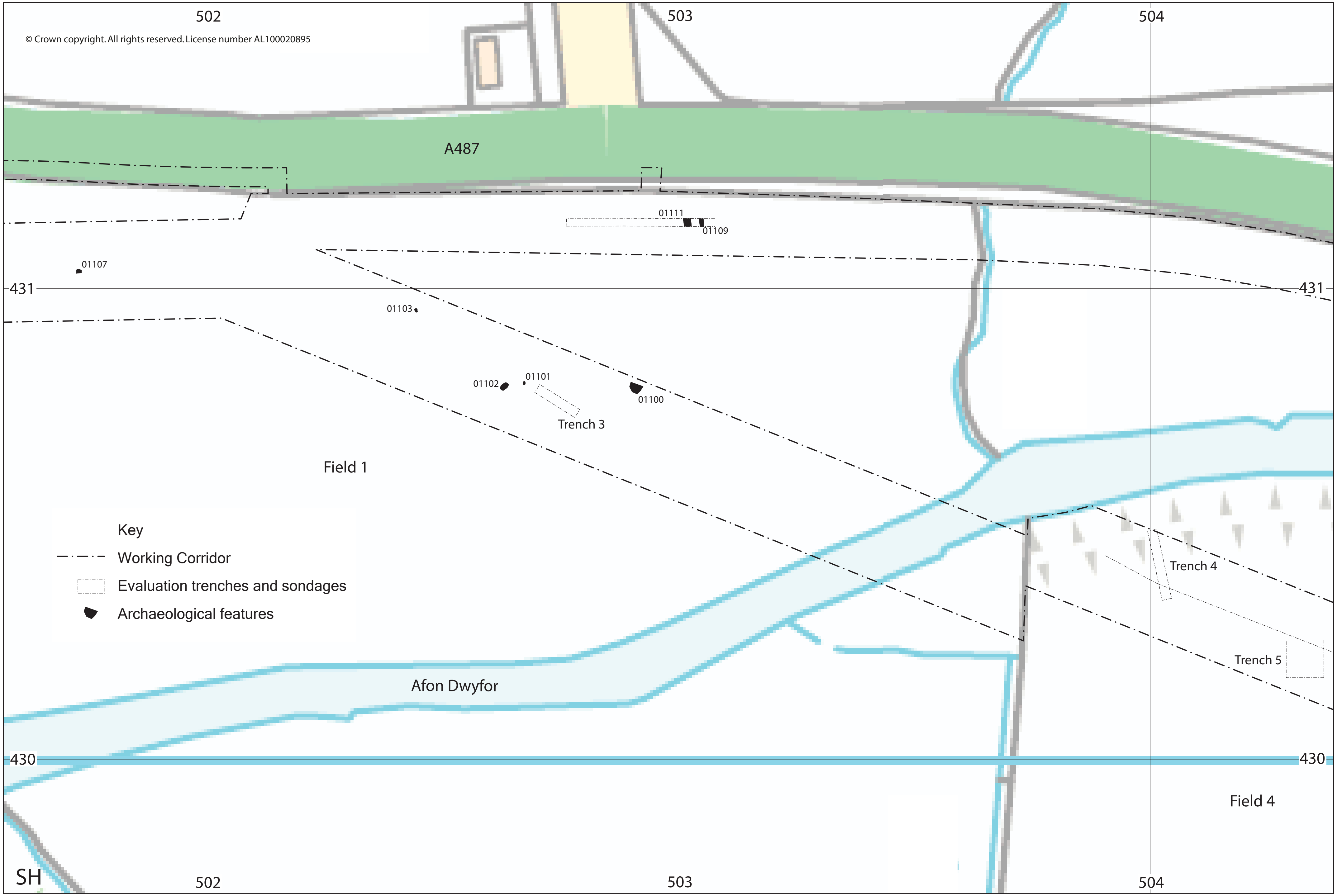


Figure 15. Features in eastern part of field 1 and western part of field 4

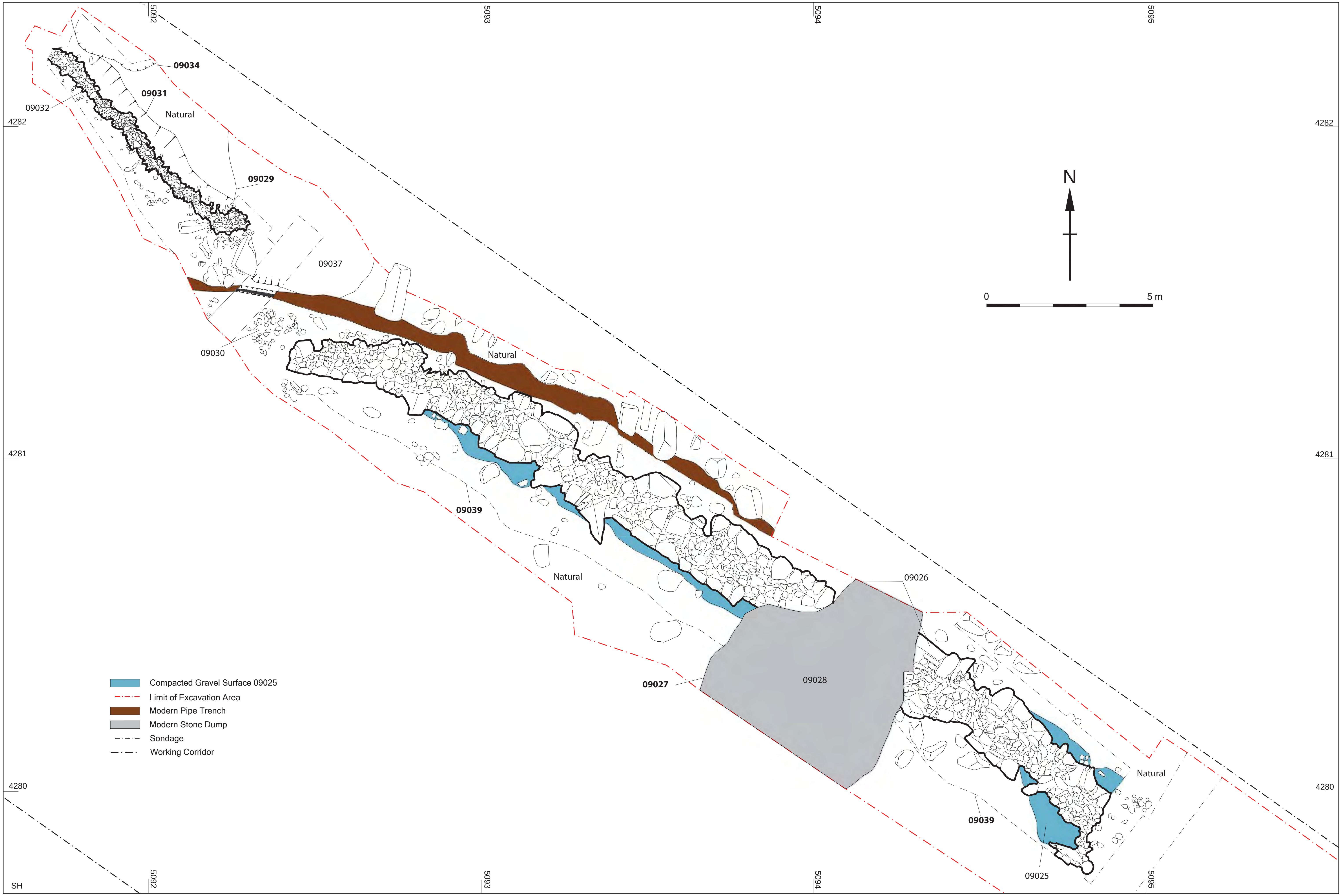


Figure 16: Main features in field 9

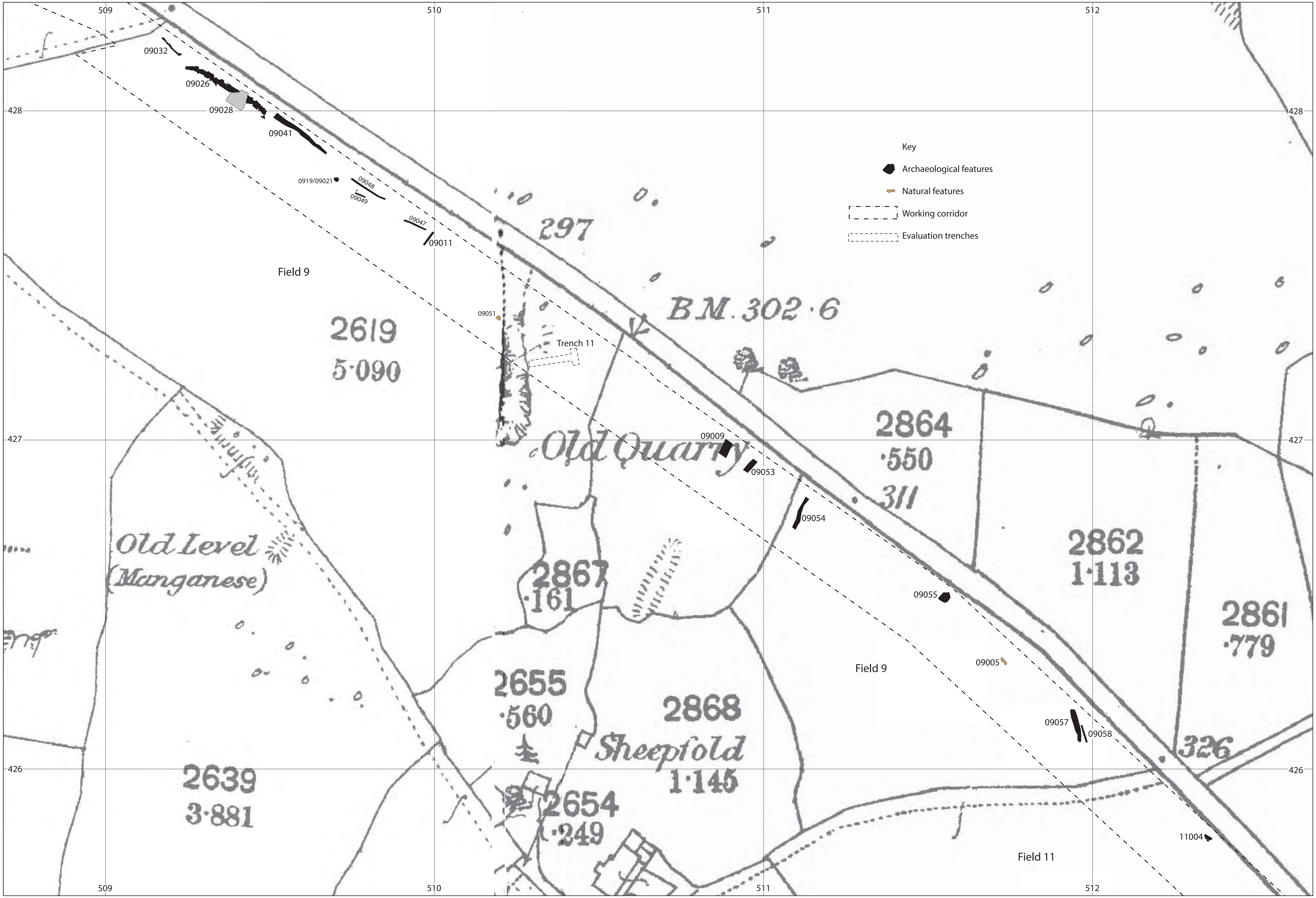


Figure 17. Features found in field 9, overlaid on 1889 25 inch OS map

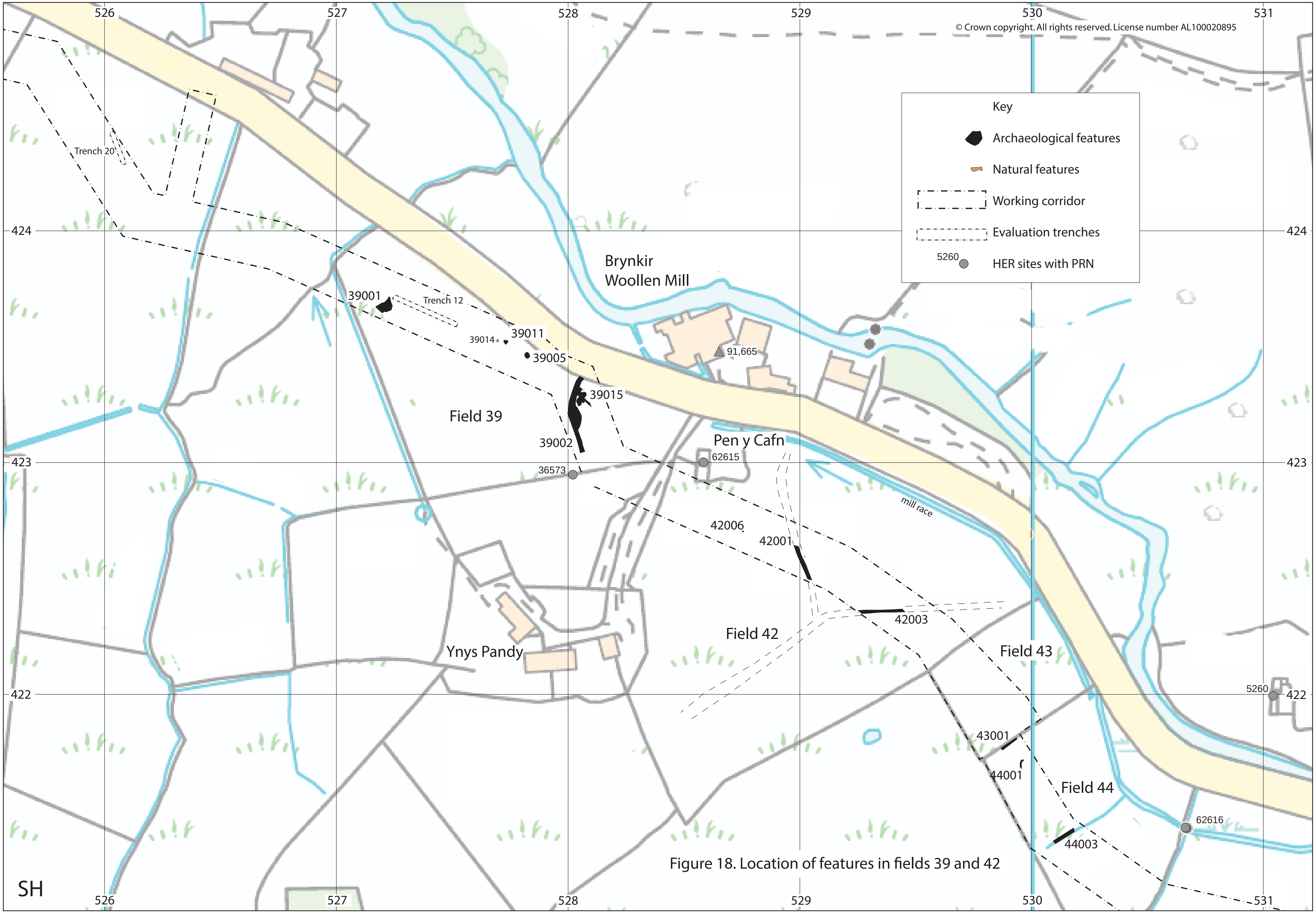


Figure 18. Location of features in fields 39 and 42

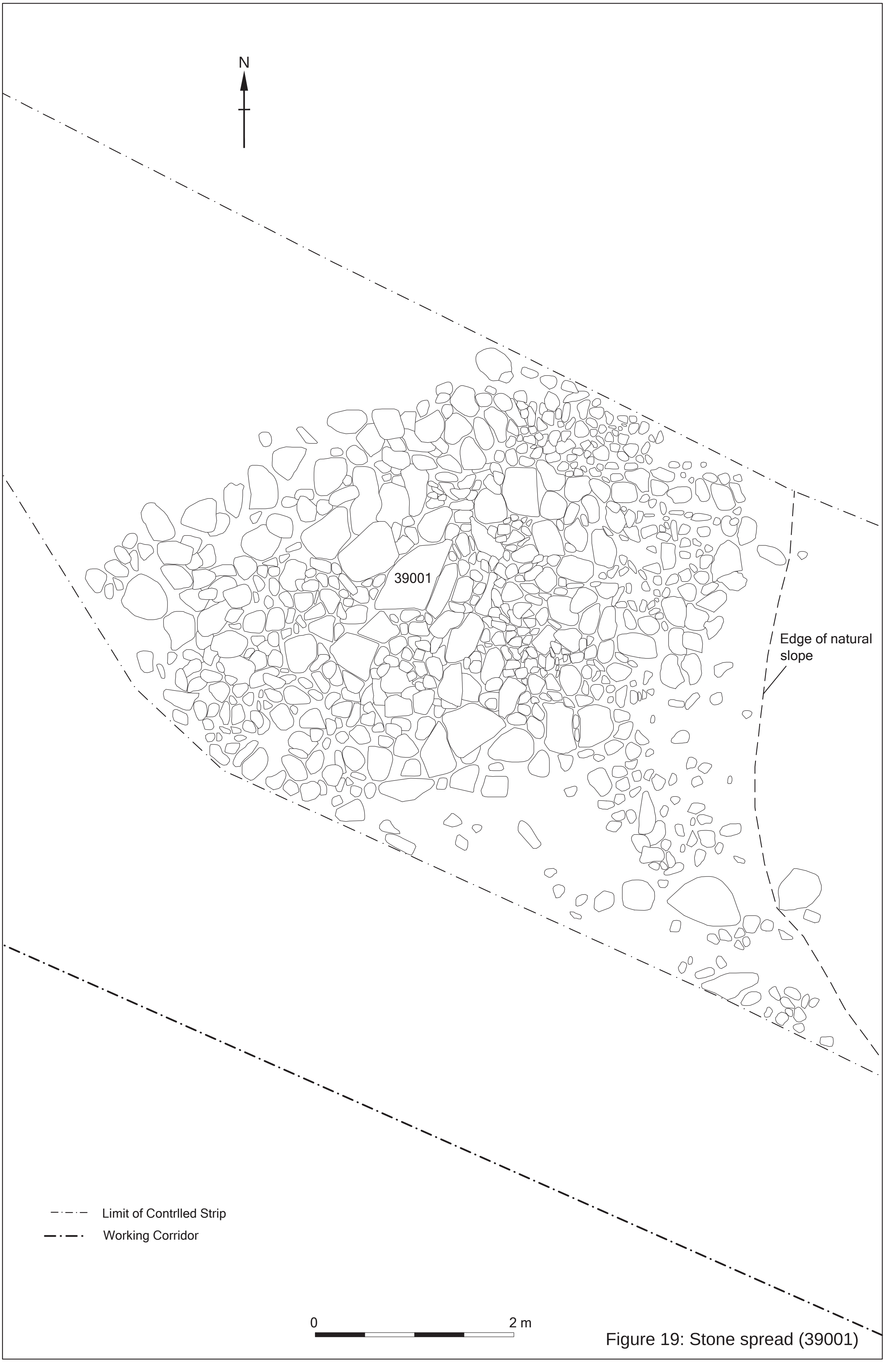


Figure 19: Stone spread (39001)

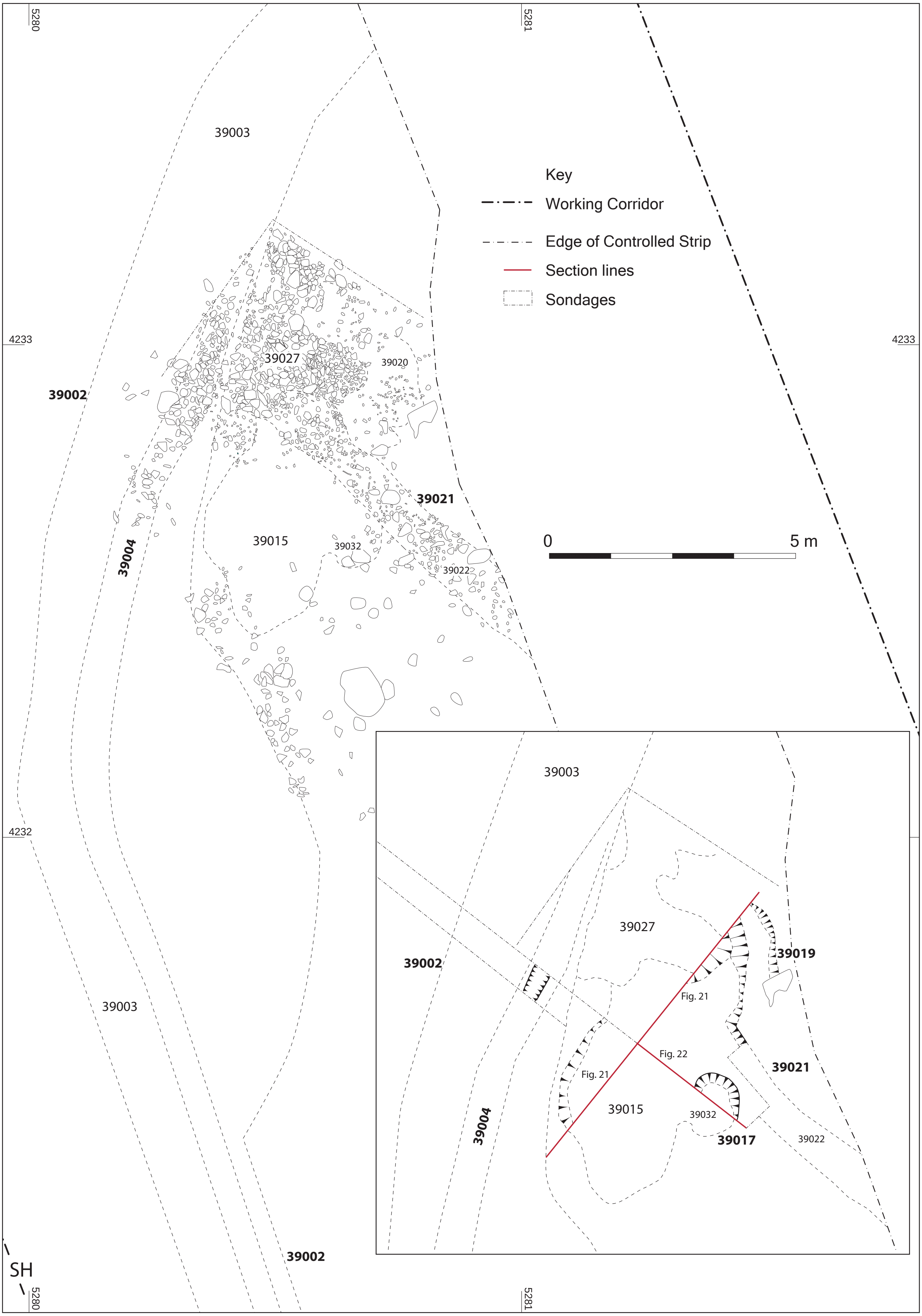


Figure 20. Burnt mound cut by land drains with inset showing excavated pits

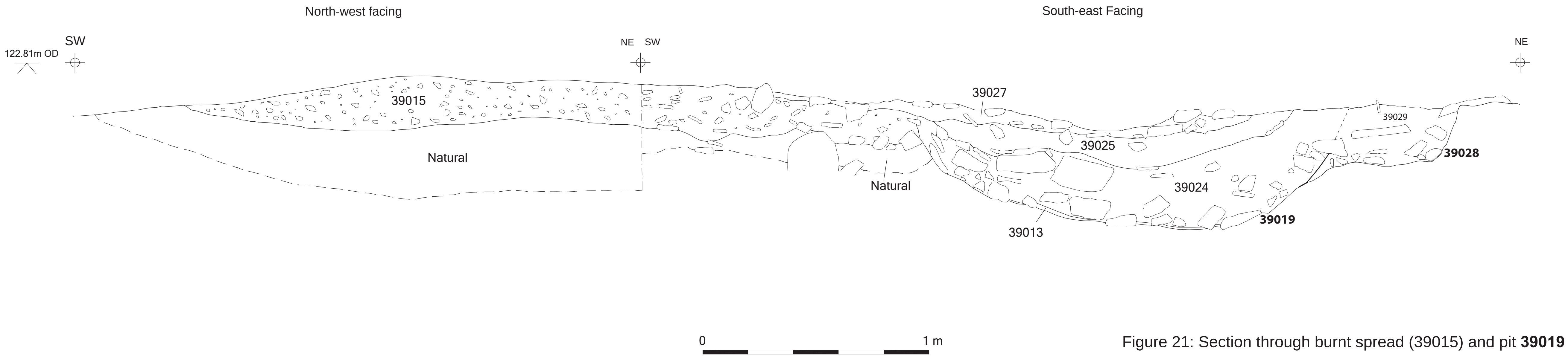


Figure 21: Section through burnt spread (39015) and pit **39019**

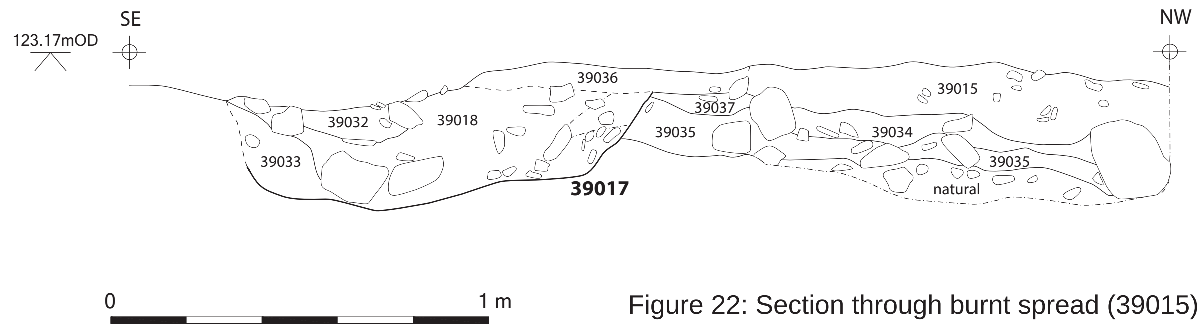


Figure 22: Section through burnt spread (39015) and Pit **39017**

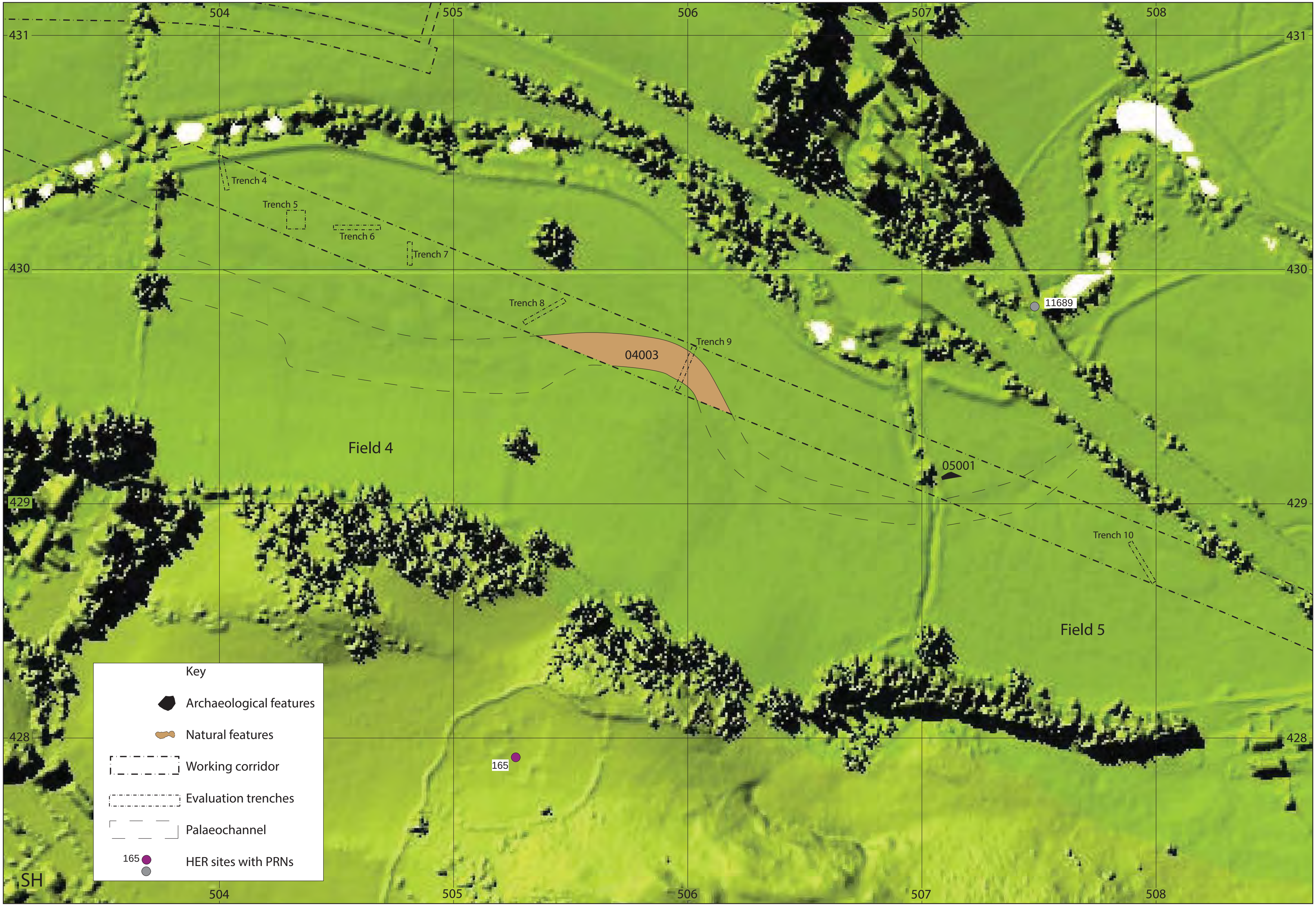


Figure 23. Location of peat deposit (04003) overlaid on lidar data showing palaeochannel

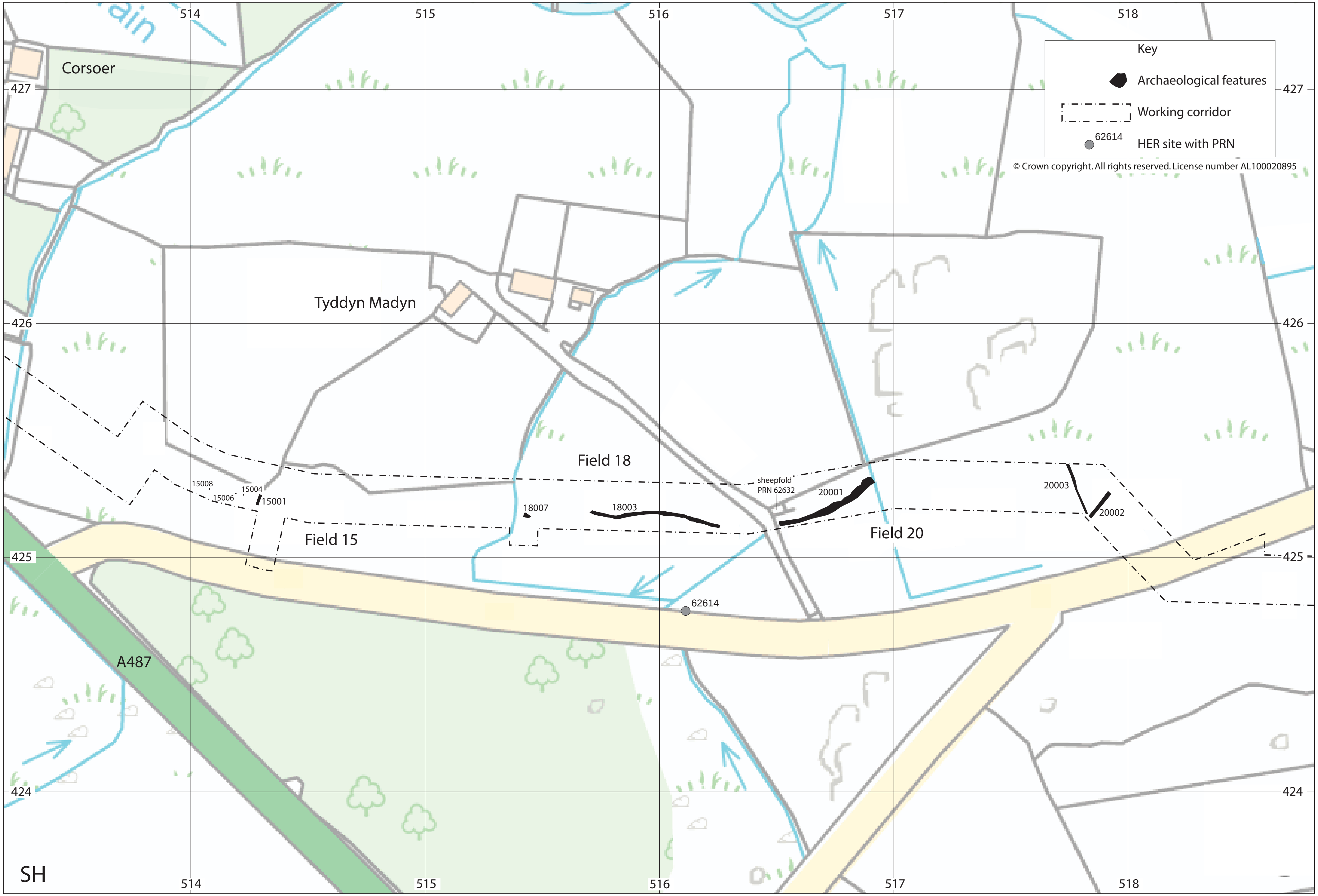


Figure 24. Location of features in fields 15, 18 and 20

Figure 25. Location of features in fields 27, 29 and 32

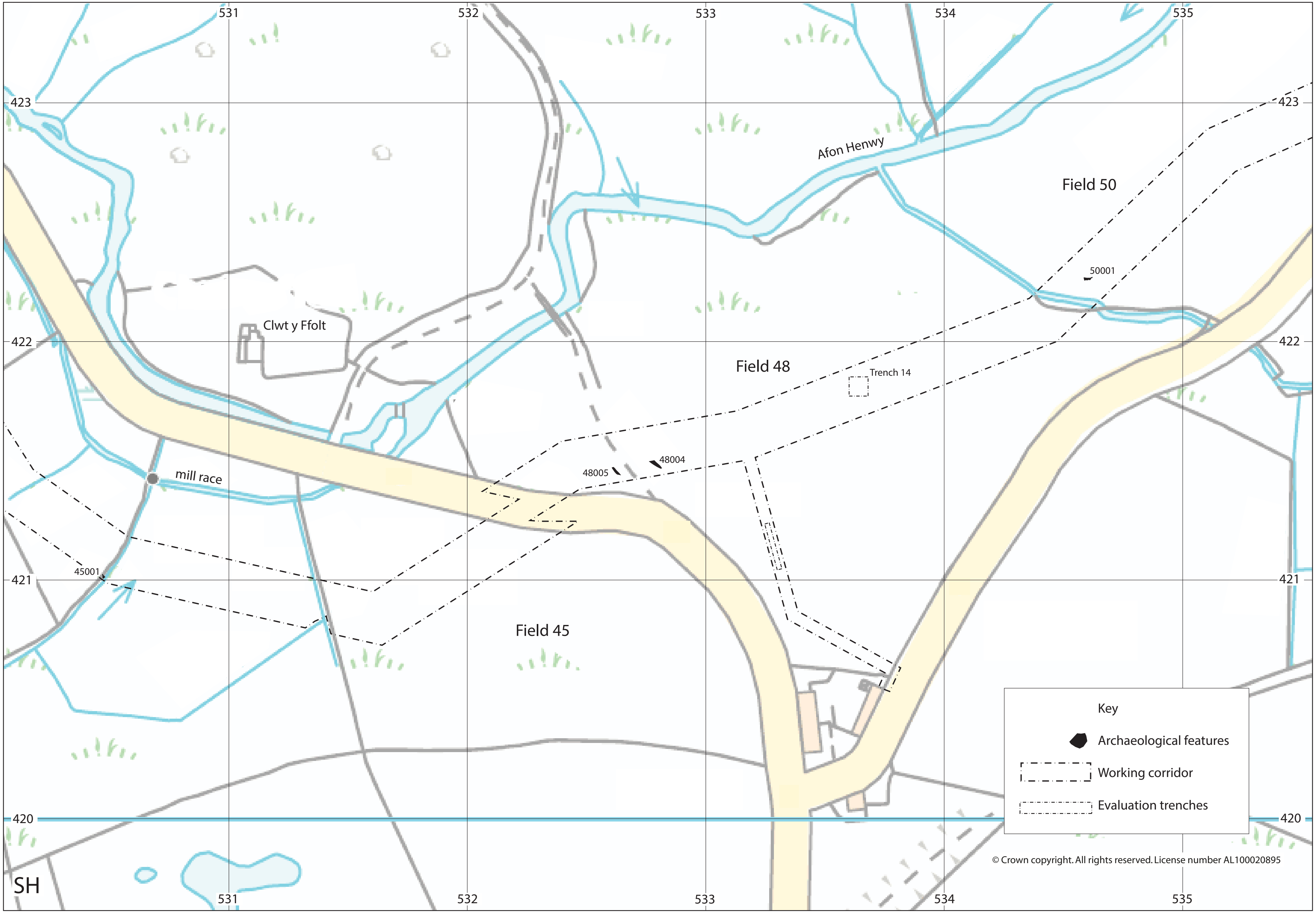
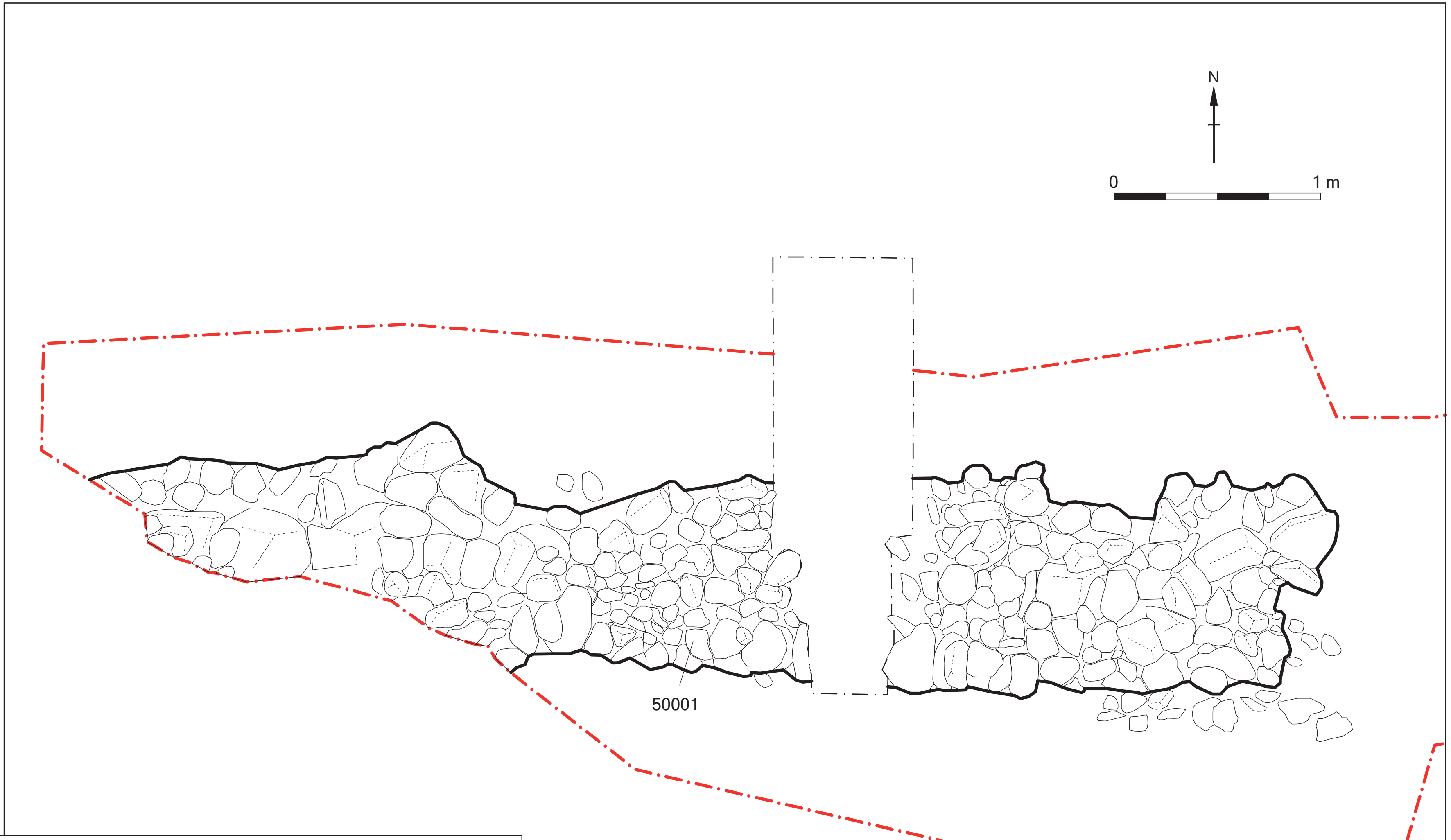


Figure 26. Location of features in fields 45, 48 and 50



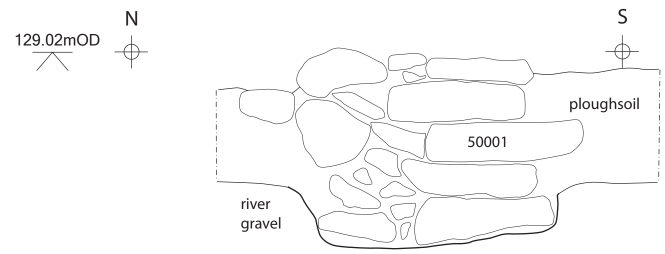


Figure 28: West facing section of wall (50001)

Figure 27: Stone Wall (50001)

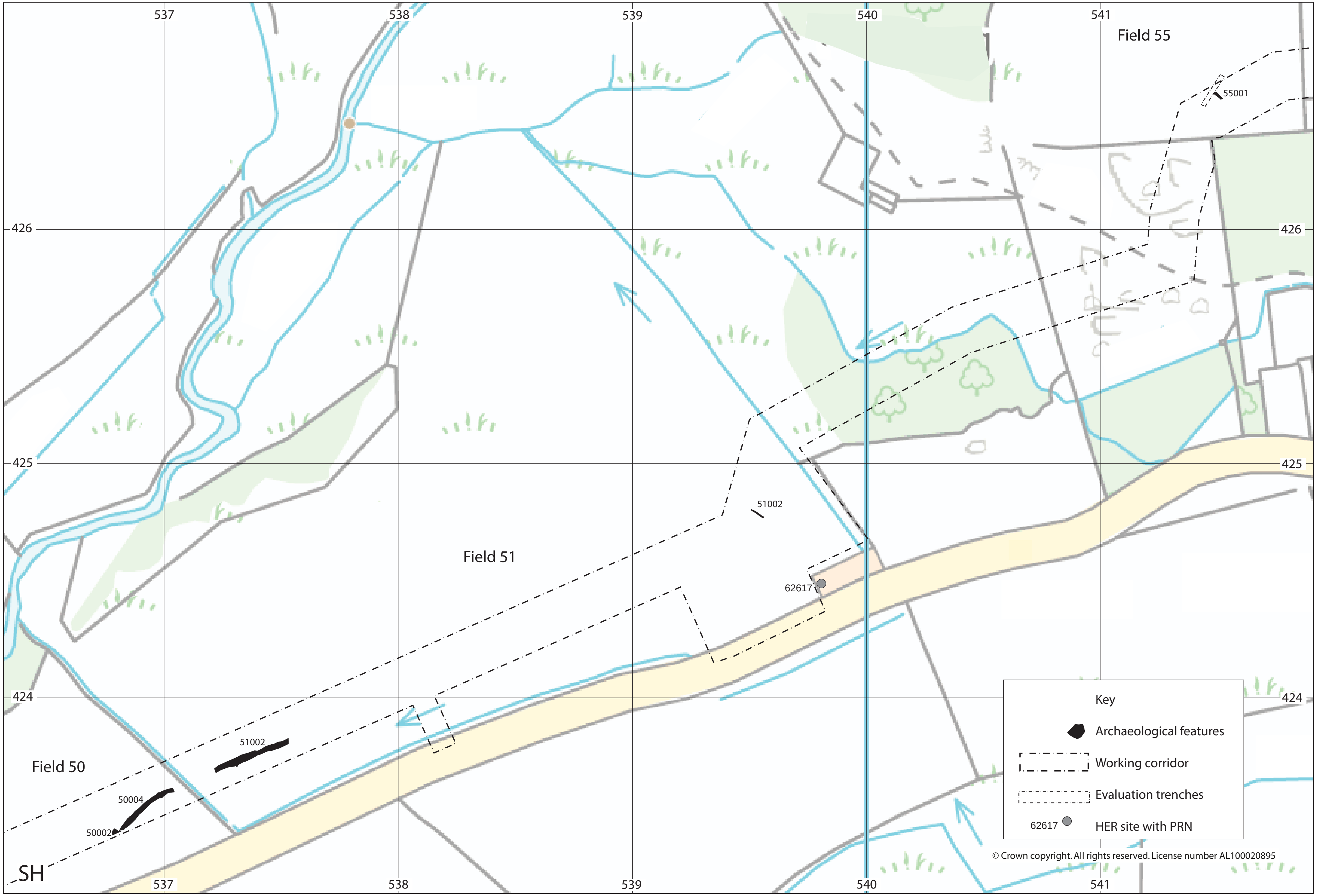


Figure 29. Location of features in fields 50, 51 and 55

Figure 30. Dolbenmaen Water Treatment Works showing the area investigated in advance of the extension of the works and a lidar image of Pen y Bryn Orsedd

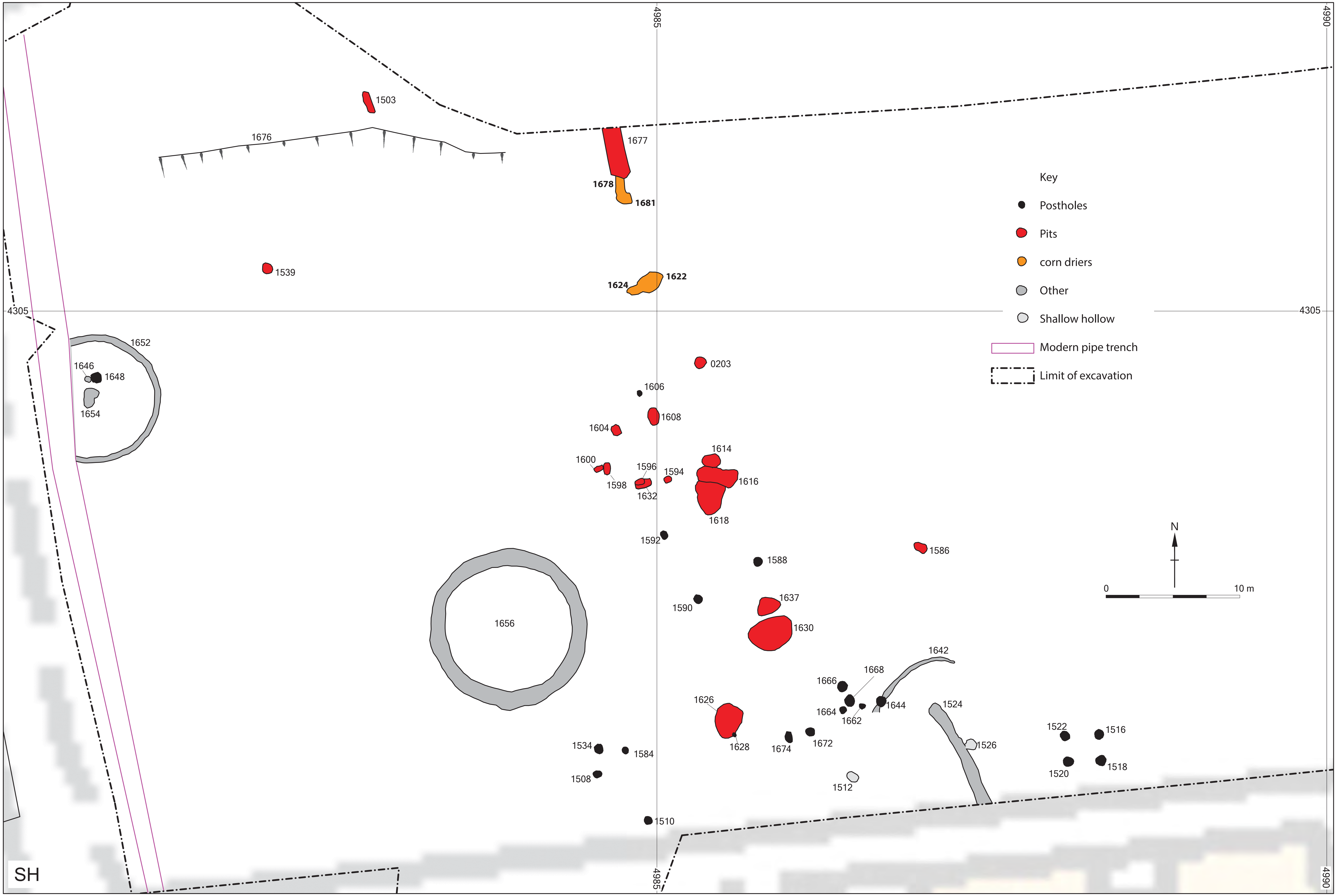


Figure 31. Plan of western part of the main zone at the Dolbenmaen WTW

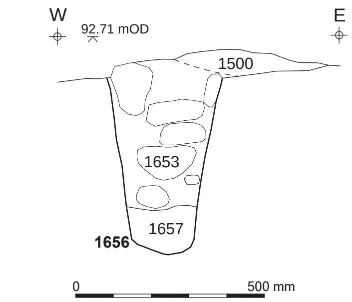


Figure 33. S facing section of ring ditch **1652**

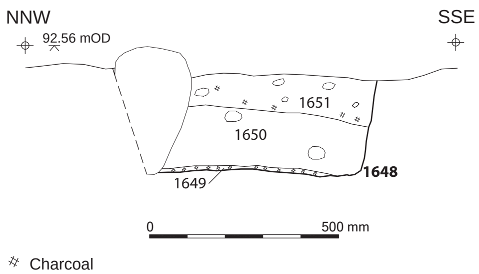


Figure 34. WSW facing section of pit 1648

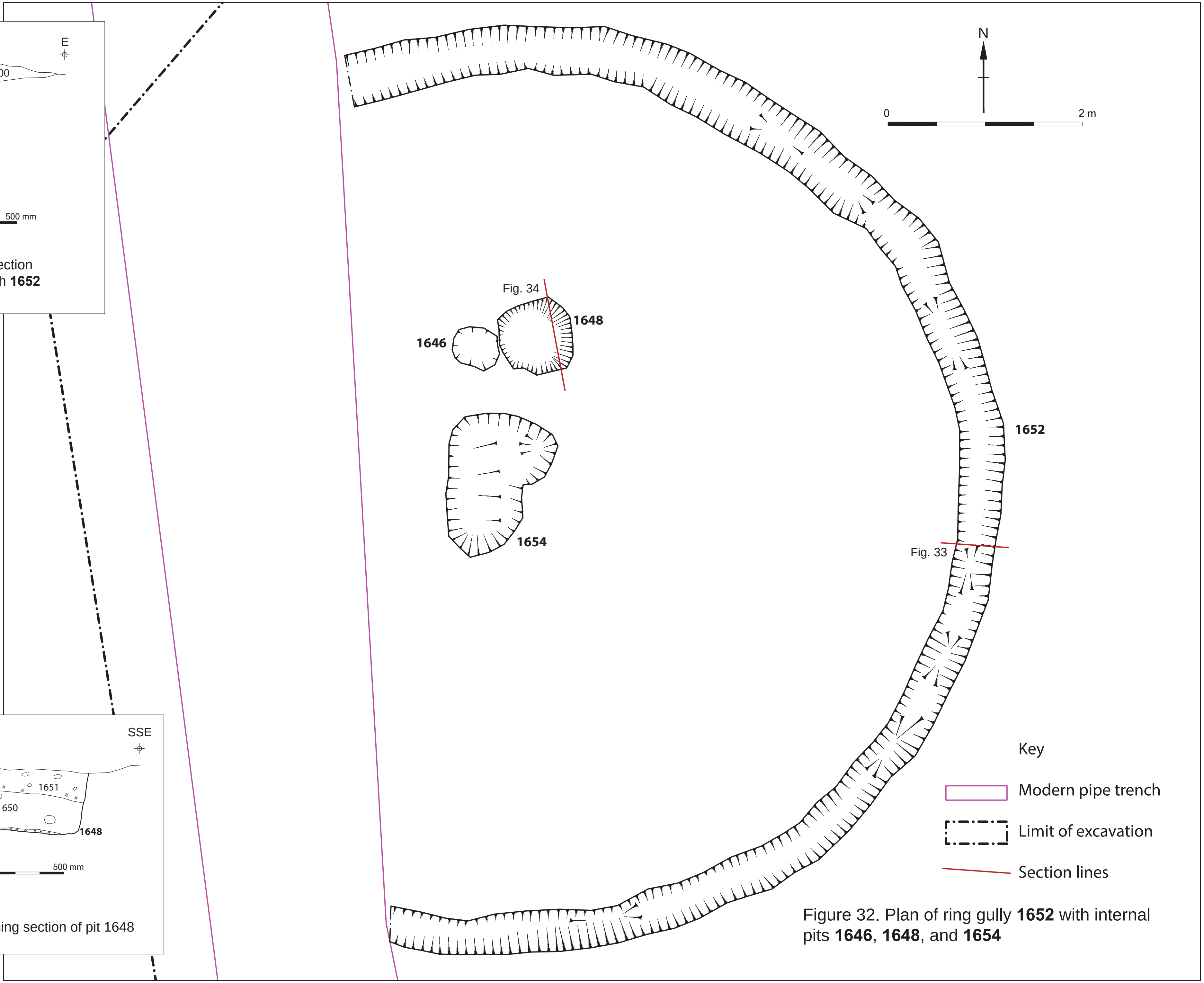


Figure 32. Plan of ring gully **1652** with internal pits **1646**, **1648**, and **1654**

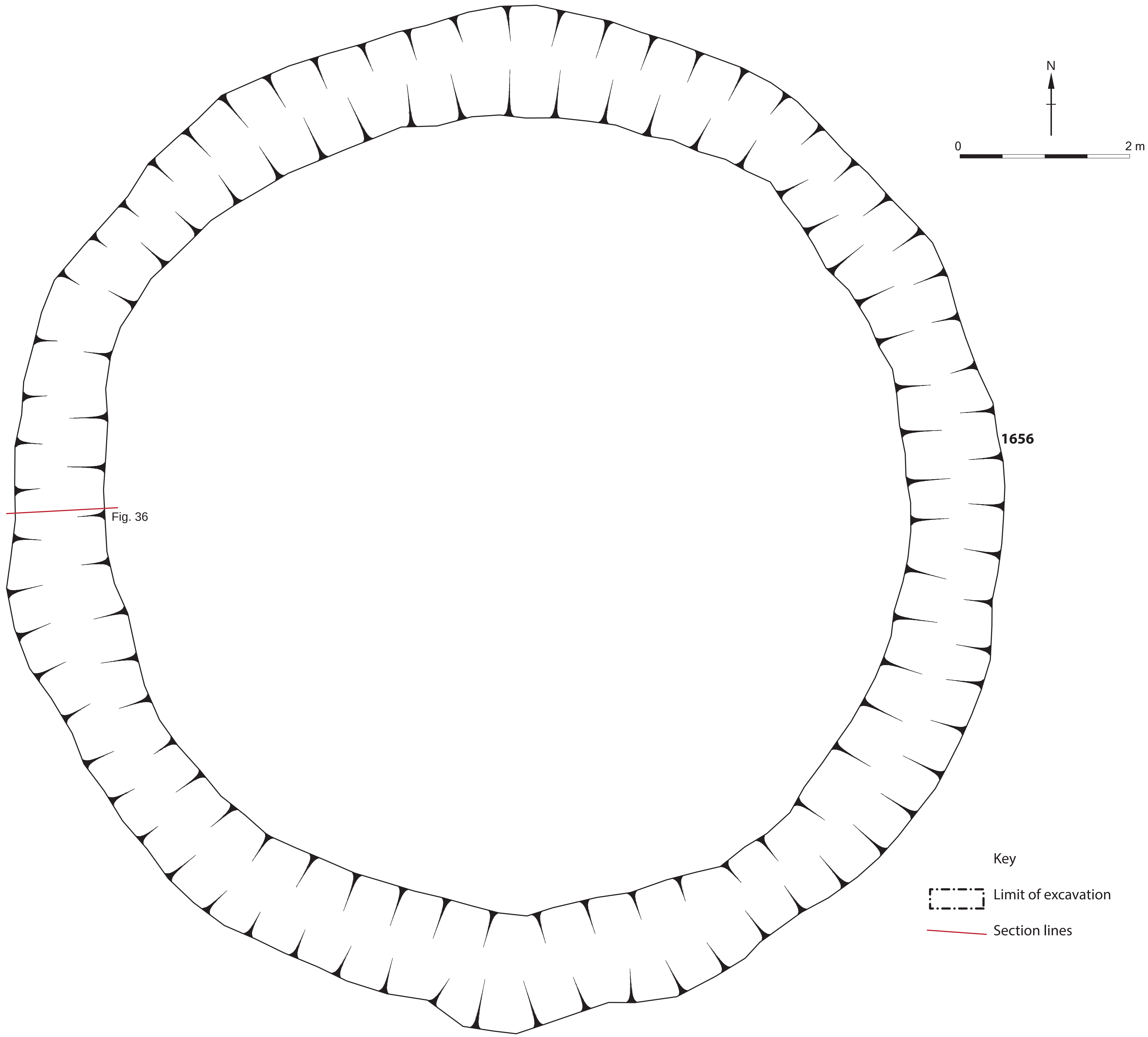


Figure 35. Plan of ring ditch **1656**

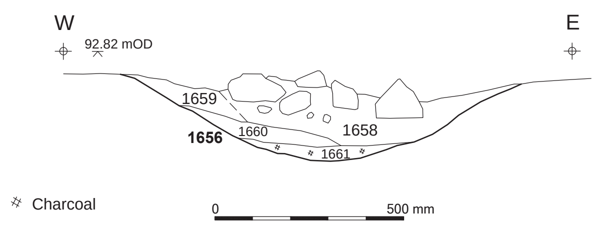


Figure 36. S facing section of ring ditch **1656**

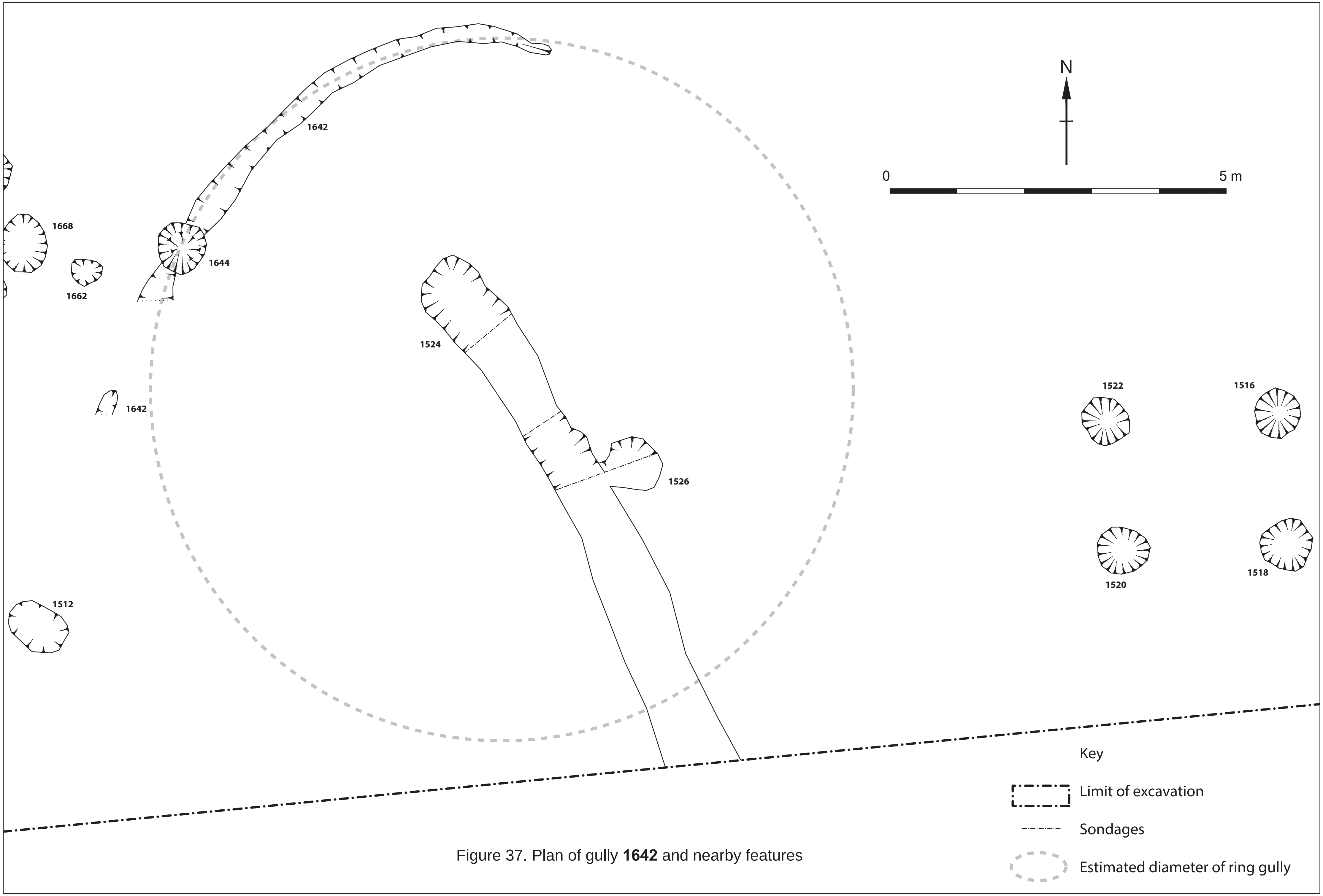


Figure 37. Plan of gully **1642** and nearby features

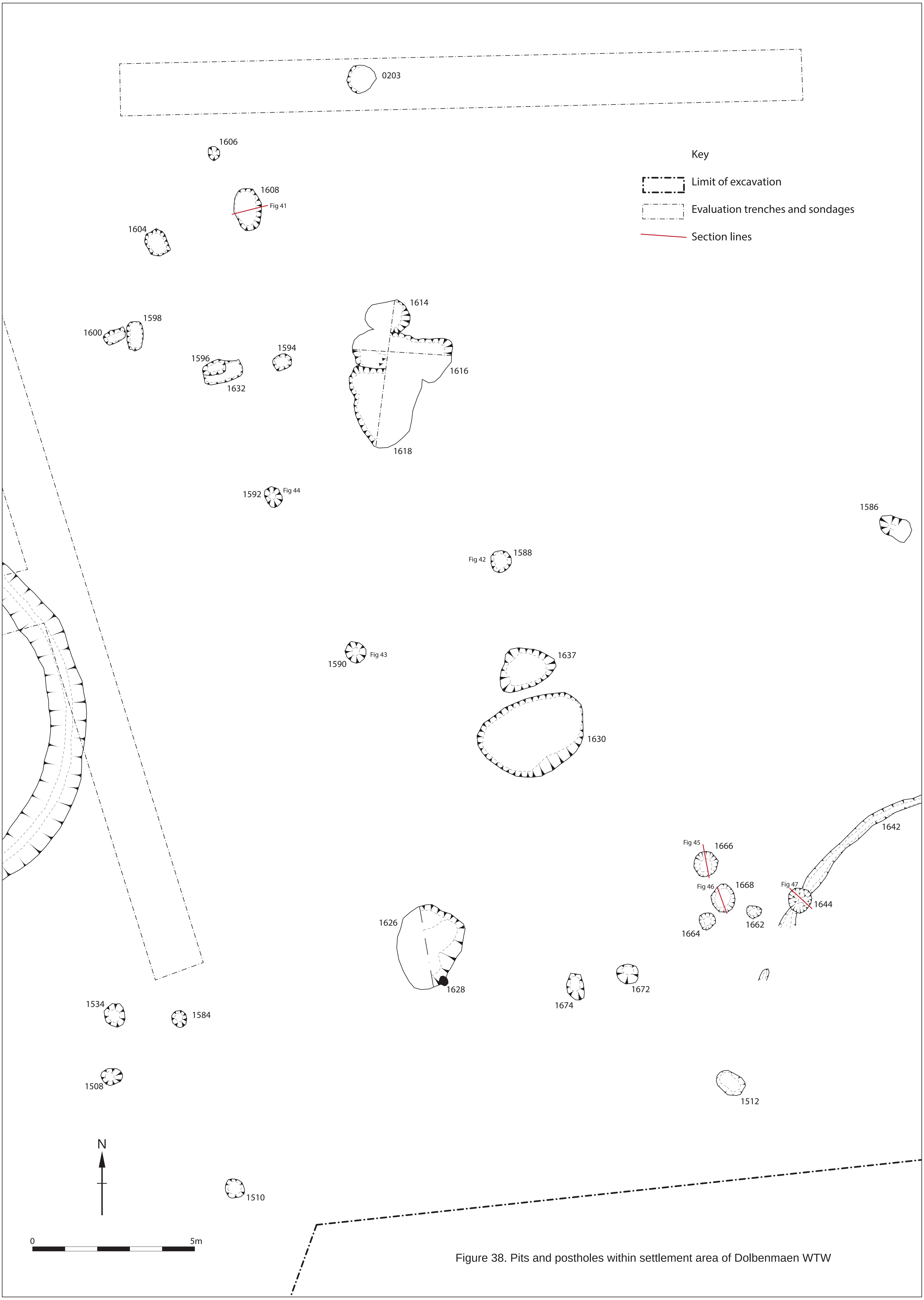
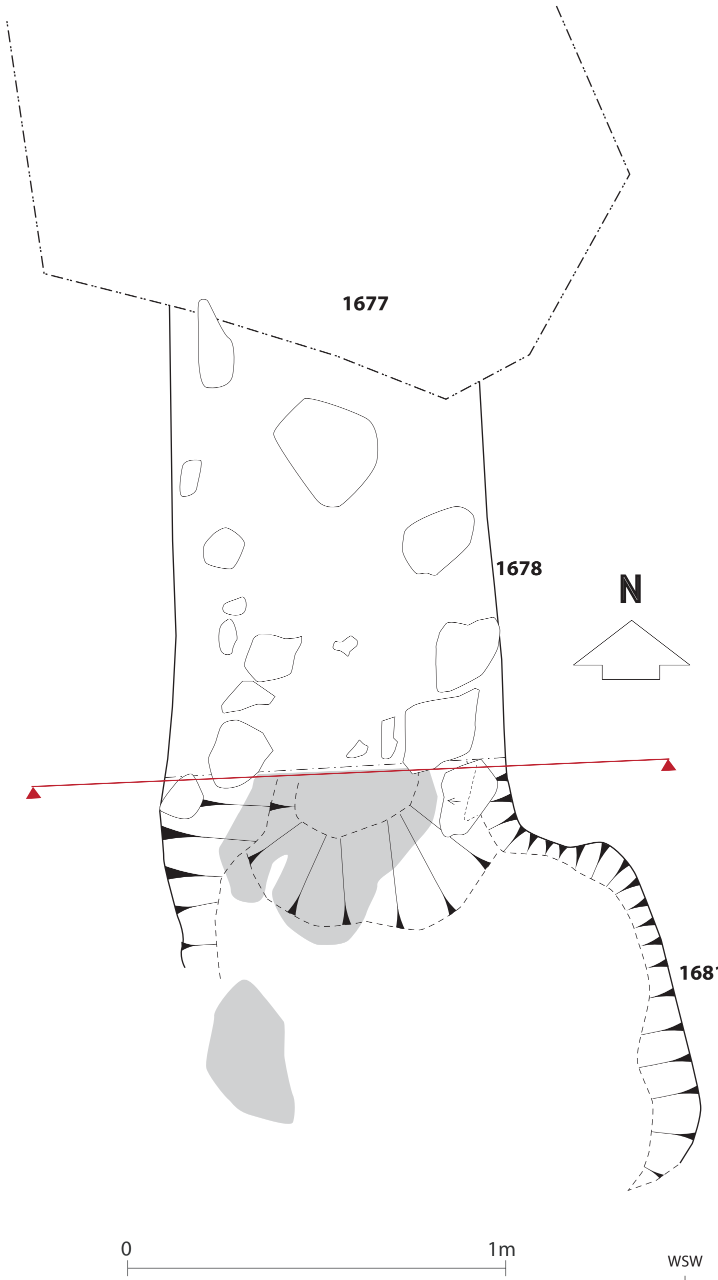


Figure 38. Pits and postholes within settlement area of Dolbenmaen WTW



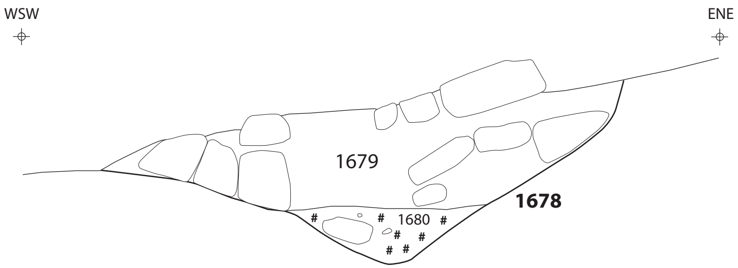


Figure 39. Plan and section of corn drier **1678**

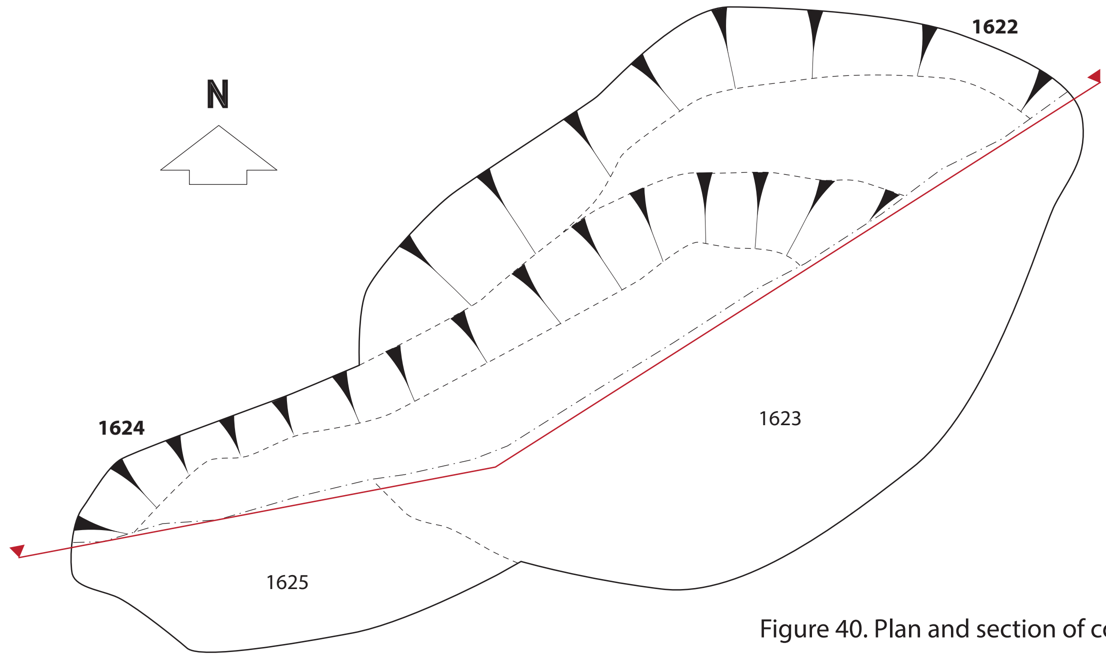
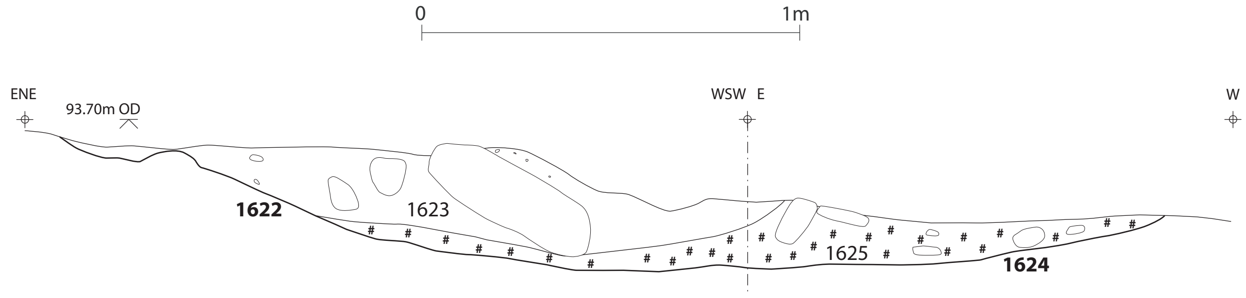
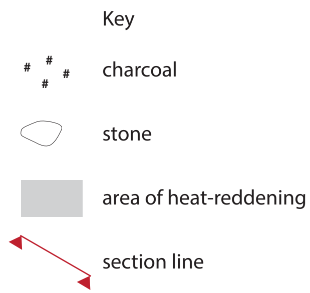


Figure 40. Plan and section of corn drier **1622**





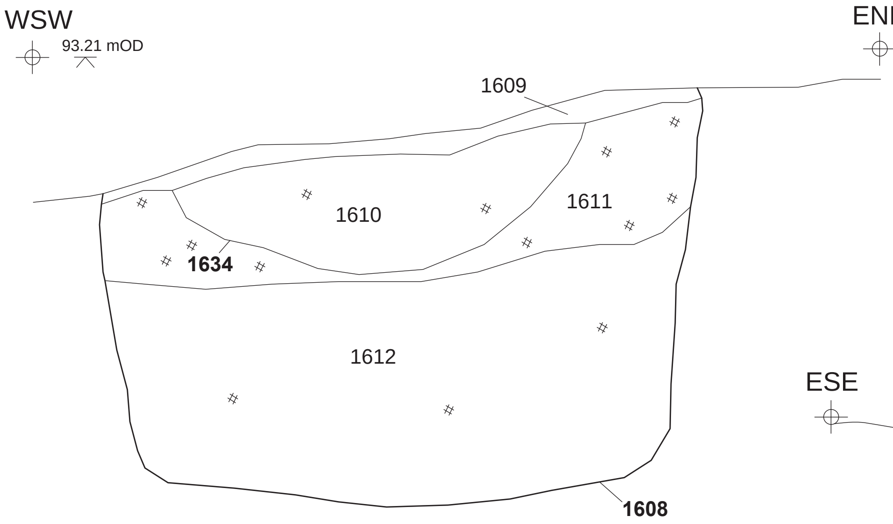


Figure 41. NNE facing section of pit **1608**

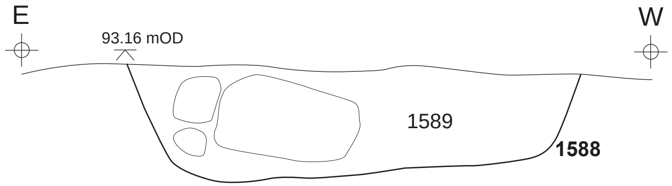


Figure 42. N facing section of posthole **1588**

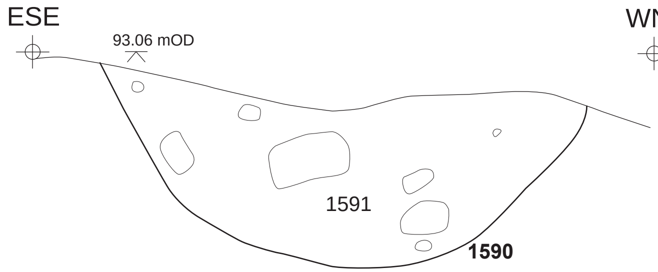


Figure 43. NNE facing section of posthole **1590**

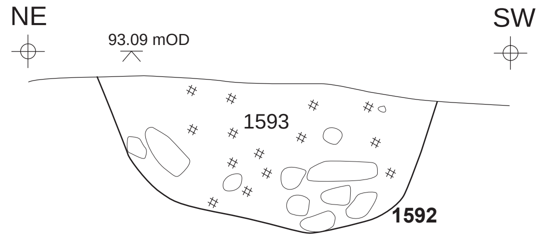


Figure 44. NW facing section of posthole **1592**

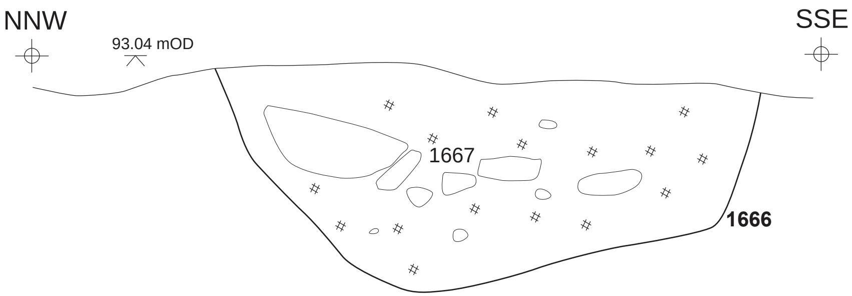


Figure 45. WSW facing section of posthole **1666**

Charcoal

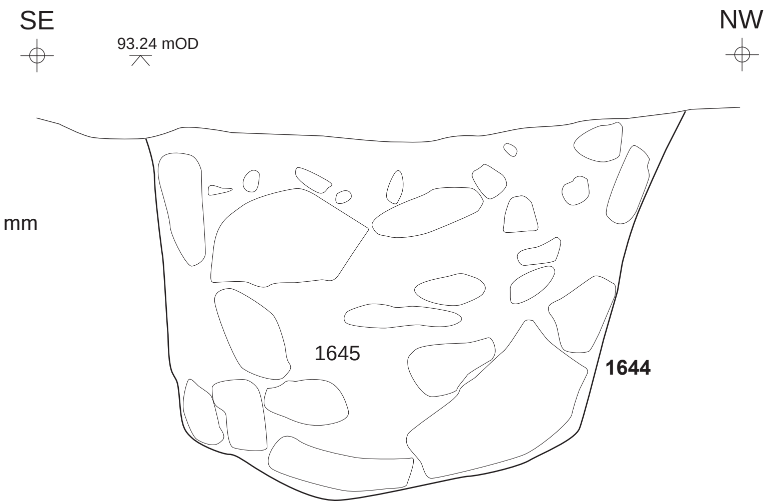


Figure 47. NE facing section of posthole **1644**

Figure 46. WSW facing section of posthole **1668**

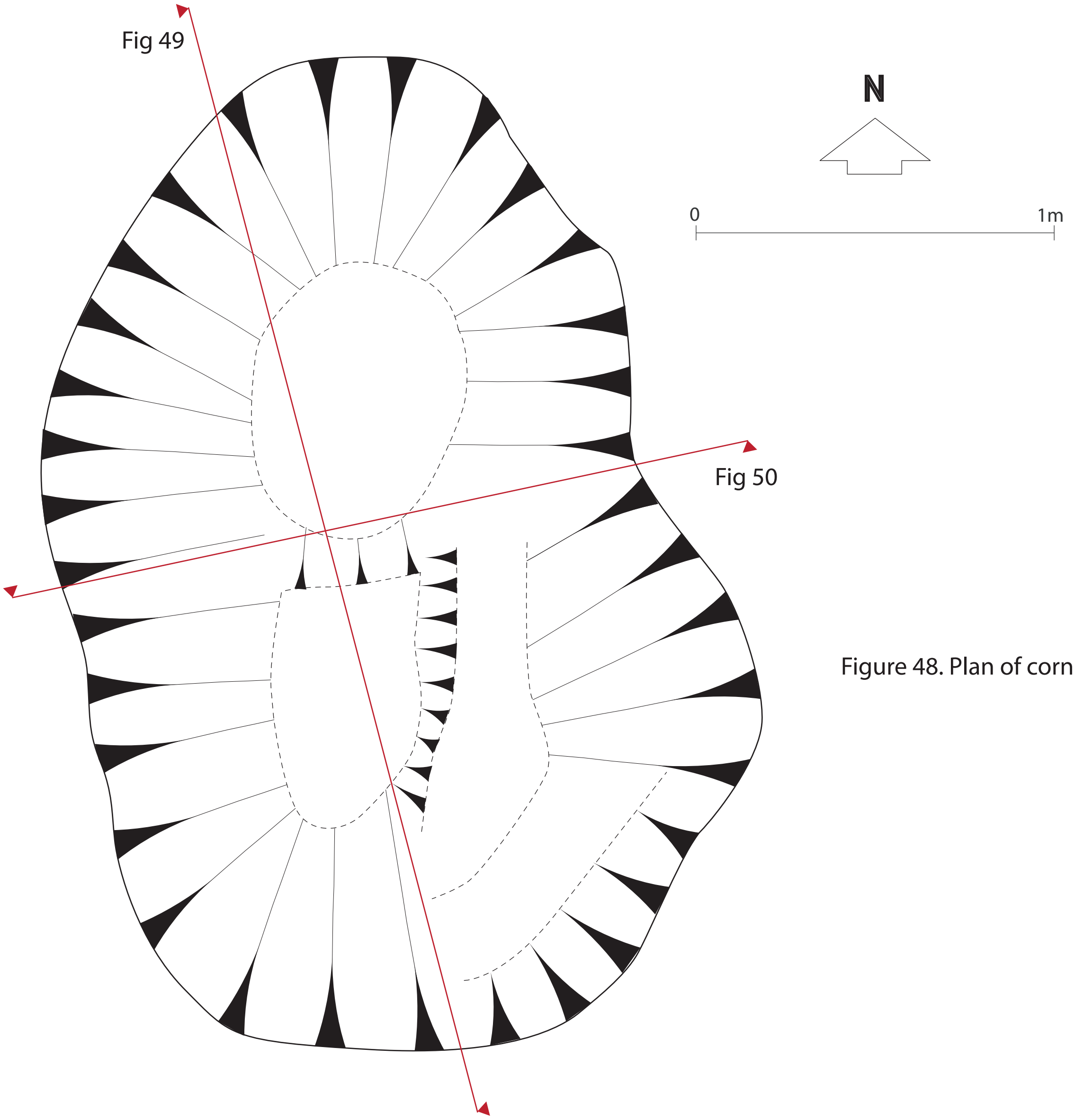


Figure 48. Plan of corn drier **1547**

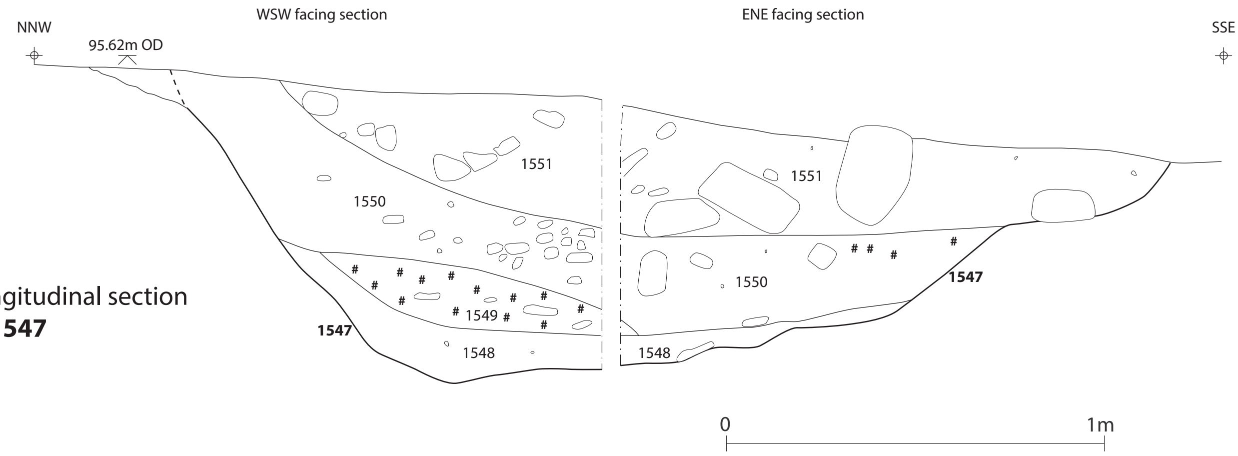


Figure 49. Longitudinal section of corn drier **1547**

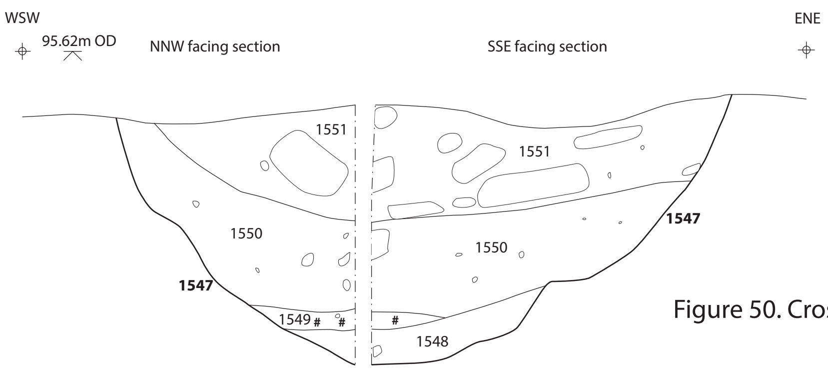


Figure 50. Cross section of corn drier **1547**

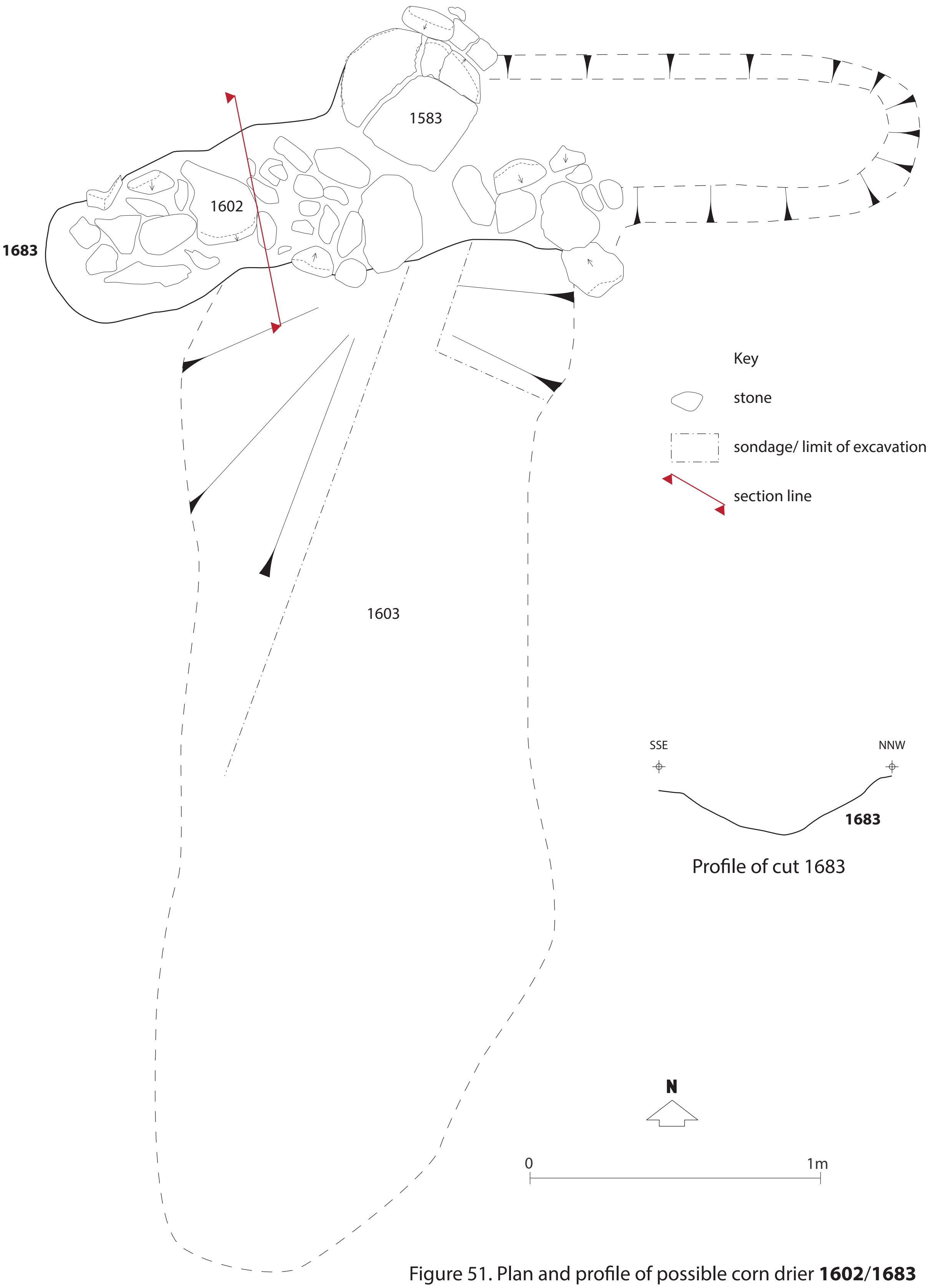


Figure 51. Plan and profile of possible corn drier **1602**/**1683**

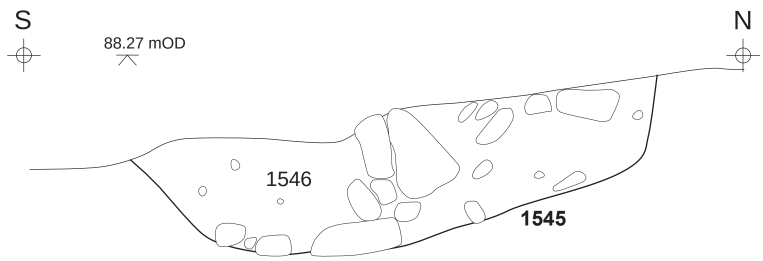


Figure 52. E facing section of burnt stone pit **1545**

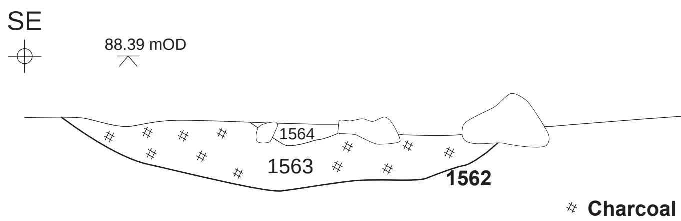


Figure 53. NE facing section of burnt stone pit **1562**

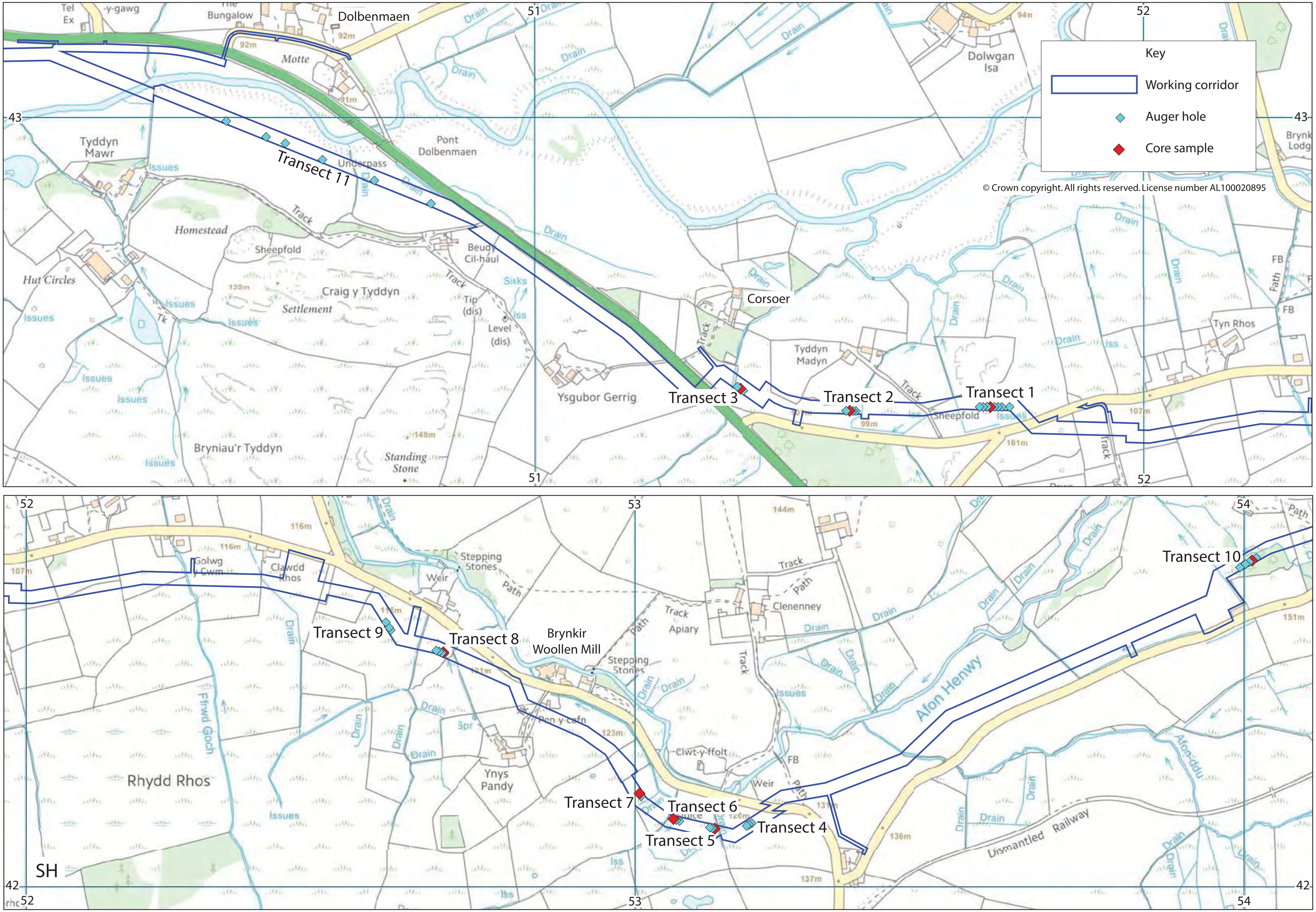


Figure 54. Location of auger transects and core samples

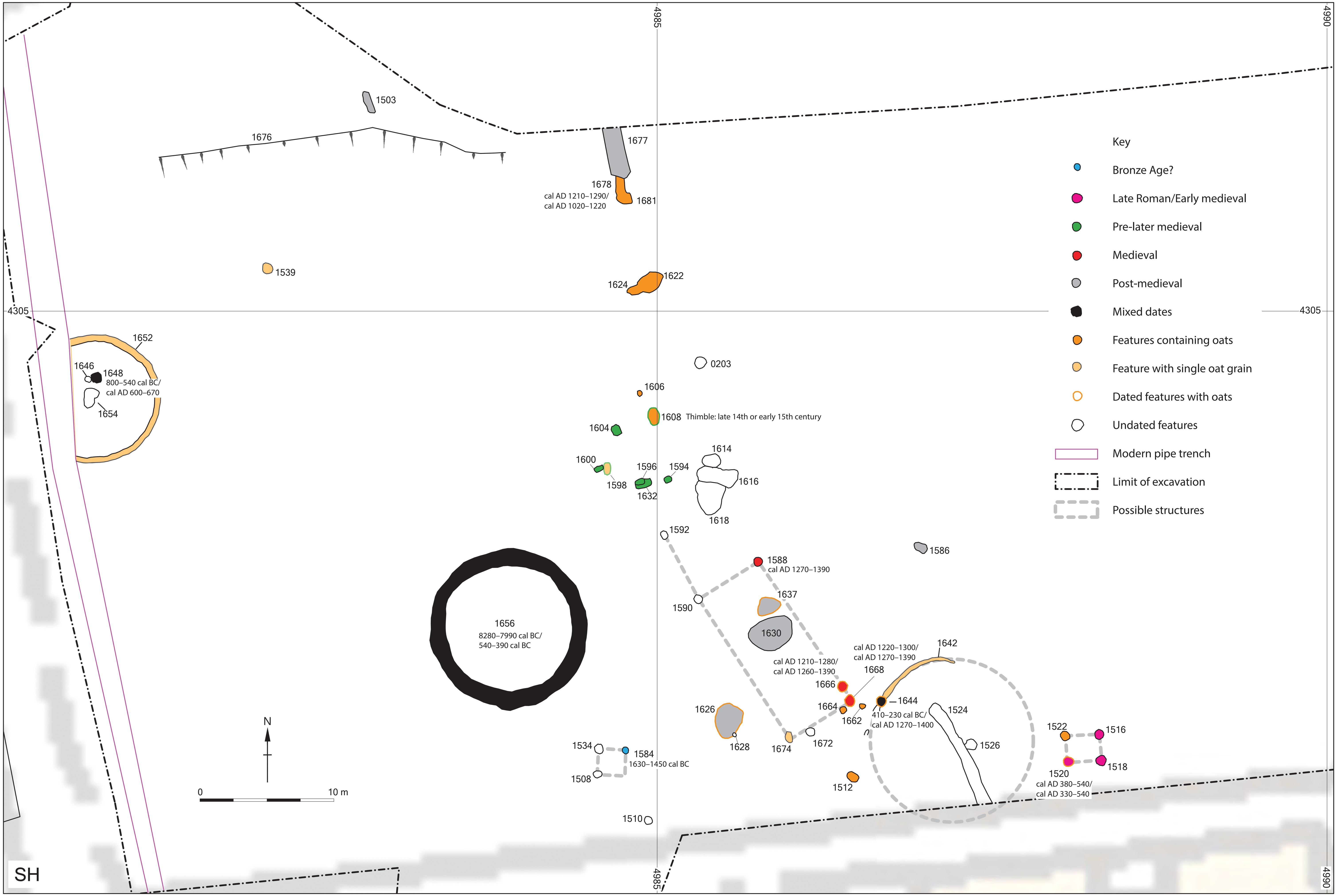


Figure 55. Western area of the site showing dated features and speculation about possible structures

Plate 1: Enclosure ditch **01001**. View from the WNW

Plate 2: ENE facing section through enclosure ditch **01001**

Plate 3: Postholes **01017** and **01032**. View from the northeast

Plate 4: Postholes **01040** and **01042**. View from the NNE

Plate 6: Cobbled road **09026** (southeast side). View from the southeast

Plate 5: Stone wall **09032**. View from the southeast

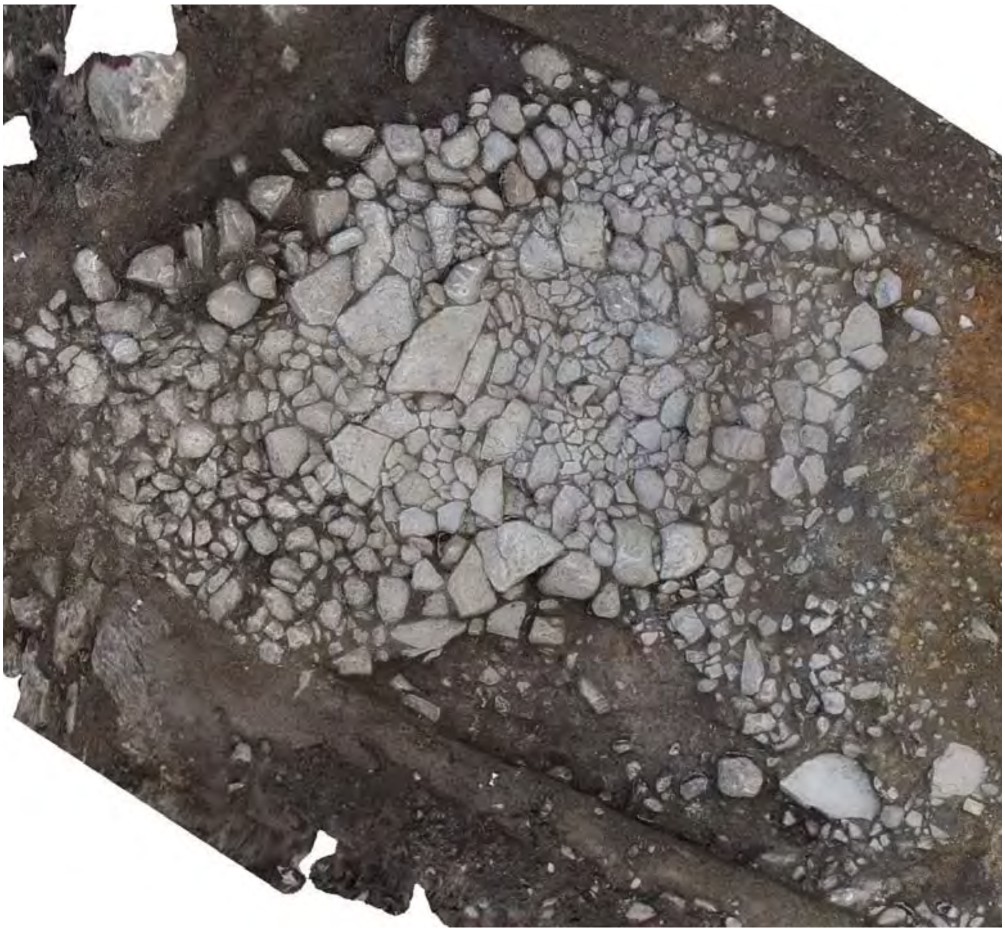


Plate 7: Stone platform (39001). Digitally rectified vertical view

Plate 8: Burnt mound (39015]) View from the northeast before excavation, showing drain **39021** cutting through it

Plate 9: Burnt mound (39015), partially excavated. View from the north-east

Plate 10: Section through pit **39017** and burnt mound deposit (39015). View from the north-north-east

Plate 11: Section through pit/hollow **39019** showing stones (39027) sealing it. View from the south-east

Plate 12. Palaeochannel (04003) from the west

Plate 13. Palaeochannel (04003) from the west

Plate 14. Stone spread forming rough trackway (05001)

Plate 15. Stone structure in ditch side probably the support for a bridge related to trackway (05001)

Plate 16. Stones (14001) in Field 14

Plate 17. Stone structure (18007) over a spring in Field 18

Plate 18. Trackway (20001) from the west

Plate 19. Slate footbridge at north-east end of trackway (20001)

Plate 20. Remains of sheepfold in Field 20

Plate 21. Stone structure around spring (45001)

Plate 22. Wall foundation (50001)

Plate 23. Stone-lined field drain (51003)

Plate 24. Circular gully **1652** before excavation. View from the north.

Plate 25. Circular gully **1652** fully excavated. View from the north.

Plate 26. Pits **1646** and **1648** within circular gully **1652** fully excavated. View from the north

Plate 27. Circular ditch **1656** fully excavated.

Plate 28. Section of circular ditch **1656**.

Plate 29. Stone **1658** in ring ditch **1656**

Plate 30. Pre-excavation view of curving gully **1642**. View from east

Plate 32. Curving gully **1642** fully excavated. View from north-east

Plate 32. Possible corn drier **1678** from the south, with **1681** fully excavated and a section across **1678**

Plate 34. Corn drier **1622** half excavated, from the south-west

Plate 33. Possible corn drier **1678**, half excavated showing straight sides and burning in the base

Plate 35. Pit **1608** half sectioned

Plate 36. Pits **1596** and **1632** half sectioned showing large stone

Plate 37. Pits **1596** and **1632** fully excavated

Plate 38. Pits **1598** and **1600** fully excavated

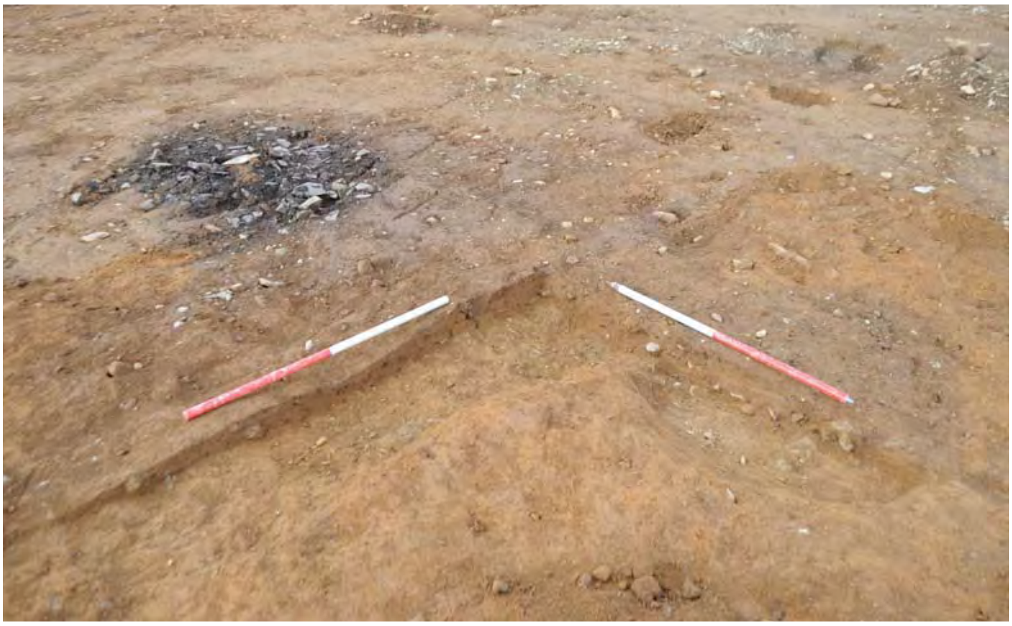


Plate 39. Pits **1614**, **1616** and **1618**, from the NE

Plate 40. Stone-filled pit **1626**, from the E

Plate 41. Stone-filled pits **1630** and **1637**, from the W

Plate 42. Posthole **1668** fully excavated

Plate 43. Posthole **1508** half excavated

Plate 44. Four Post Structure fully excavated. Postholes **1516**, **1518**, **1520**, and **1522**. View from the North.

Plate 45. Section of corn drier **1547** showing burning in the base

Plate 46. Corn drier **1547** partially excavated

Plate 47. Possible corn drier **1602**/**1683** from the west

Plate 48. Possible corn drier **1683** from the west, with sections through **1602** and **1603**

Plate 49. Burnt stone pit **1545** half excavated

Plate 50. Burnt stone pit **1562** half excavated

Plate 51. Sondage through ditch **1530**, from north

Plate 52. Sondage through ditch **1528**, from north

Plate 53. Sondage through ditch **1556**, from WSW

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