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Evaluation of metallurgical residues  
from N7 Road-Widening and  
Interchanges Scheme: Site 48,  
Blackchurch, Co. Kildare (03E1607)

# Evaluation of metallurgical residues from N7 Road-Widening and Interchanges Scheme: Site 48, Blackchurch, Co. Kildare (O3E1607)

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## Abstract

*The assemblage from Blackchurch, Co. Kildare comprises 110kg of archaeometallurgical residues which are thought to derive exclusively from ironworking (smithing). Area B appears to have been the focus of metallurgical activity with over 90% of the residues being recovered from this area. Indeed the focus of the activity seems to be an area of, approximately, just 20m x 10m, where residues occur in a variety of pits and gullies. Smithing residues are dominantly in the form of smithing hearth cakes with a mean weight of 629g (range 108-2450g), with approximately 19% of examples weighing above 1000g.*

*Close comparison can be made with the assemblages from Parknahown 5 (Co. Laois) and Navan (Co. Meath). At Parknahown there was a small amount of iron smelting slag, indicating some primary production, but otherwise, these sites appear to have been working iron that had been produced elsewhere. The few examples of large (2-3kg) SHCs on these probably represent the working of relatively unconsolidated blooms brought in from elsewhere.*

*In contrast to this concentration of material, residues from areas A, D and J are mainly from furrows, and include a few examples of slag apparently from coal-fuelled blacksmithing. The advent of coal as fuel for blacksmithing is not well documented and varies by area, but is likely to be indicative of later post-medieval smithing.*

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## Methods

All investigated materials were examined visually using a low-powered binocular microscope where necessary. All materials were summarily described and recorded to a database (Table 1). As an evaluation, the materials were not subjected to any high-magnification optical inspection, not to any other form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

## Results

### Description of materials

#### Smithing Hearth Cakes (SHCs)

The SHCs from Blackchurch are mainly fairly small, but are variable in terms of morphology and structure with a mean weight of 629g (range 108g – 2450g; Figure 1).

A variety of textures were represented ranging from dense well formed 'thick crust' cakes, to 'thin crust' cakes with lower bowls and upper surfaces composed of iron rich material and charcoal inclusions and moulds. Also present are smaller, less well formed 'prilly cakes' and small, relatively flat oval shaped 'tongues'.

The basic mode of formation of an SHC is broadly the same across all these morphologies – when the work-piece is placed in the hearth it will undergo some superficial oxidation, and occasionally more serious breakage, which results in iron metal and iron oxides

being lost to the hearth. Here the iron oxides will be fluxed by molten ceramic material from the hot tip of the tuyère and possibly by deliberate additions of sand flux too, with the resulting iron silicate melt forming the slag. The common origin means that SHCs typically have a bowl-like form. They generally form within a small area of contact between the slag bowl and the ceramic tip of the tuyère or the hearth wall. This zone of contact may have enhanced reaction, leading to a particularly dense slag (the burr).

The size and density of the SHC will be controlled by the amount of iron lost, the temperature the hearth is being run at, the rate of loss of the tuyère, the period of working and the way in which the smith manipulates the hearth.

Some of the SHCs show some evidence for the manner of their removal from the hearth: some had visible tool marks indicating their extraction with a tongs or poker while they were still soft, while other examples suggested that the SHC had been deformed or folded on extraction while still hot and pliable.

The majority of SHCs contained charcoal moulds and/or inclusions, however a few examples of fragments of SHCs from two areas (D & J) contain small amounts of coal rather than charcoal.

The SHC assemblage from Blackchurch is derived from a wide variety of contexts. Approximately 80 examples are either complete, or complete enough for an estimation of original weight to be made. The weight distribution of the SHCs is presented in Table 2 where it is compared with other Irish iron-working sites.

#### *Indeterminate slags*

This category includes the pieces of slag that were too fragmented to identify as well as pieces that are of non-diagnostic shapes and textures.

It is very likely that much of this material is derived from smithing and may include less diagnostic fragments of SHC and slag which formed within the hearth but outside the main SHC. It may potentially include slag from within the fuel bed, slag from around the blowhole and also lining slags generated from melted ceramic.

#### *Technical ceramics*

A number of small fragments of tuyère were identified. In most cases the fragments were too small to allow for an estimation of their dimensions, however a few examples appeared to have an elliptical cross section, with approximate radius sizes between 50 – 80 mm.

Also present were a number of small fragments of hearth lining, much of which was vitrified.

#### *Iron*

Approximately 660g of corroded iron was also present. Much of this was composed of nail fragments as well as two possible small hooks and two pieces of plate iron.

### **Distribution of material**

Approximately 100kg of the total 110kg submitted for assessment was uncovered from Area B. SHCs or identifiable fragments of SHCs comprise approximately 94kg of the 100kg. This material derived mostly from an area of approximately 10m x 20m (Figure 2)

Just over 2kg was retrieved from possible metallurgical features, the remainder was recovered from gullies, furrows and ditches.

### **Possible metallurgical features**

The following features in Area B were all tentatively described as furnaces or combustion pits and are possible locations for smithing hearths:

#### *Group 36 (Part)*

**Feature [C914]** was described as a furnace (*Subgroup {174}*) which ran under the baulk, hence its full shape is unknown. Its sides were vertical with a gradual break of slope and a slightly rounded base. It measured 0.14m deep, 1.39m long and 0.87 m wide. It contained one deposit with a small quantity of indeterminate slag (approx. 46g). This feature lies in the north of Area B, outside the main area of iron working residues.

#### *Group 37 (Part)*

**Feature [C921]** was described as a combustion pit (*Subgroup {175}*), 0.18m deep, 1.60 m long and 0.90-0.65 m wide, which appeared to have had low intensity heat compared with other so-called furnaces on the site. It was figure of eight in plan with slightly convex sides and a gradual break of slope and undulating base. It contained almost 1.5 kg of metallurgical residues which included fragments of SHC, indeterminate slag and two small pieces of corroded iron.

To the south of this lay a spread [**F955**] (*Subgroup {176}*), measuring 0.05m deep, 0.50m long and 0.30m wide. This was described as a possible hammerscale area, however this cannot be confirmed, as no hammerscale was submitted for analyses.

This feature lies within the main concentration of iron-working residues.

#### *Group 38*

**Feature [C320]** - 0.30 m deep, 0.95 m long, 0.37-0.25 m wide – keyhole shaped, gradual break of slope at base, flat bottom – low intensity in-situ burning. This feature contained no residues.

This was associated with pit [**C980**], described as a pit 0.20m deep, 0.26m long and 0.18 m wide – circular in plan, vertical sides, slightly concave on south, sharp break of slope, a rounded base – possible anvil setting.

It was also associated with pit [**C318**] – rectangular in plan, 0.33-0.27 m deep, 1.82m long and 0.80 m wide – sharp break of slope at base – flat base. It was interpreted as a possible trough or quenching pit.

This feature lies in the centre of the main concentration of iron-working residues.

## **Interpretation**

The residues from Blackchurch show that the metallurgical activity being undertaken was iron working (smithing) – there is no evidence for iron smelting. The SHC assemblage is suggestive of blacksmithing (the end use of iron for the manufacture or repair of artefacts) rather than bloomsmithing (the refining of raw blooms) as the primary activity. A

number of large SHCs (2-3kg in weight) may indicate that iron reached the site, at least in part, as relatively unconsolidated blooms. Whether the source of the blooms was another area adjacent to this site, or a completely different locality, is not known.

The constrained area of occurrence of the residues provides evidence for the location of the early medieval smithy. Convincing identification of the precise location, however, is much less certain.

When interpreting metallurgical features several things must be taken into account including the general size and morphology of the feature, as well as the nature of the deposits therein. One would usually expect evidence of some degree of in-situ burning as well as some residual debris even if the hearth or furnace is being cleared out intermittently. Macroscopic slag is often not a good indicator of a hearth, unless convincingly in-situ, because it is typically cleared from the hearth and disposed of elsewhere. Microresidues including hammerscale may be a better indicator of feature use, but unfortunately microresidue samples were not available for this site.

Accordingly, several of the features initially described as 'furnaces' in the stratigraphic report can be discounted as such with some degree of confidence, particularly when they occur away from the main distribution of archaeometallurgical residues.

Feature [C320] has a rather odd morphology for a smithing hearth and contained no residues. Associated features only contained slag in post-abandonment fills. It is deemed unlikely, but not impossible, that this is a smithing hearth.

Features [C914] and [C921] have dimensions appropriate for early floor level smithing hearths, which typically measure a metre, or slightly more, by rather less than a metre and are essentially similar in size to a recent blacksmiths hearth.

Feature [C914] lay outside the main distribution of smithing residues and contained only a tiny quantity of indeterminate slag, that may not even have been metallurgical. It is not, therefore a strong contender as a metallurgical hearth.

Feature [C921] contained residues in the form of SHCs and indeterminate slag. It has been suggested that spread [F955] which had a possible association with [C921] was hammerscale rich. This cannot be confirmed due to lack of material, however if it were the case, then it would further strengthen the likelihood that [C921] functioned as a smithing hearth. This is probably the most likely of the features to have been a smithing hearth.

While the Blackchurch is substantial (approx. 110kg), given the large area excavated, the total quantities of residues are not very great. Quantification of blacksmithing activity is always difficult as the assessment of the degree of completeness of remains is impossible. Thus, only a minimum level of activity can be calculated. In this case it may be estimated that somewhere between 100-150 smithing sessions are represented, however the actual level of activity will have been higher. None-the-less, despite the relatively substantial assemblage, the metalworking activity may only have been intermittent or short-lived.

The SHC assemblage shows similar characteristics to smaller assemblages from other early medieval sites such as Carrigoran, Co. Clare (Young 2005a; which

also showed evidence for smelting); Navan, Co. Meath (Young 2007), Moneygall, Co. Offaly (Young 2008a) and Parknahown 5, Co. Laois (Young 2009a; also evidence for smelting) – all of which have been interpreted as being involved with blacksmithing rather than bloomsmithing as the primary activity.

The residues are concentrated in various features, particularly gullies and small ditches that are likely to have been contemporary with the smithing activity. The amounts of residue per context are generally rather low, suggesting a background level of slag distribution, rather than deliberate disposal into particular dumps. The low proportion of pieces of tuyère in the assemblage may reflect that style of disposal, where reworking has tended to fragment the more fragile ceramic materials.

Evidence for the use of coal in areas D and J is in strong contrast with the charcoal-rich material from the rest of the site. Although the onset of coal varies regionally, in most areas away from the coast and the coalfields there seems to be little coal use before the advent of mass transportation (canals and railways) from the late 18<sup>th</sup> century onwards. It is likely therefore that the furrows in these areas contain a small quantity of post-medieval slag in addition to the material derived from the underlying early medieval deposits.

## Evaluation of potential

The assemblage from Blackchurch forms a good example of the residues from an early medieval rural smithy. It is recommended that the assemblage be retained for the future on this basis. At present, the lack of identification of the smithing hearth(s) itself and the lack of associated microresidues, mean that further detailed analysis would be unlikely to provide further information that would enhance site interpretation significantly. In the future, establishing patterns of iron distribution through investigation of the SHCs, in particular the larger examples, may prove possible, and further analyses of the materials may then be beneficial. At present, analysis of such an assemblage is not of the highest priority, so no further detailed analysis is recommended at present.

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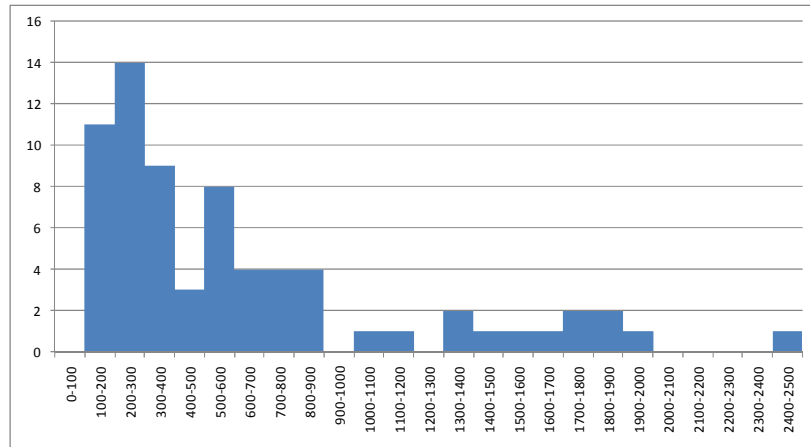


Figure 1: Numbers of examples of smithing hearth cakes (SHCs) per 100g weight interval



Table 1. Catalogue of residues from Blackchurch, Co. Kildare

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
<b>AREA A</b>							
A			103	151	1 fragment of weathered rock		
A			103	39	10 fragments of corroded iron, most of which are nails		
A	F35	furrow	24	40	1 small fragment of oxidised lining		
A	F92	furrow	1	17	1 fragment of lining slag		
A	F520	furrow	54	400	c. 33 small fragments of corroded iron, most of which are nails;		
A	F520	furrow	54	175	1 small and 1 large fragment of plate iron; 1 small glazed ceramic sherd - pale yellow with thin brown stripes; 3 fragments of indeterminate slag with small amounts of lining attached		
A	F578	Post-use backfill of ditch	152	76	5 small fragments of corroded iron; 1 larger (50g) flat fragment of iron, small quantity of concretion attached.		
A	F634	Fill of gully c633	260	101	2 small fragments of SHC		
A	F736	Fill of ditch c1537	324	45	1 small fragment of indeterminate slag		
<b>AREA B</b>							
B	F111	Fill of gully c110	254-8	875	3 fragments of SHC, largest is 290g; 1 small fragment of stone; 1 burr		
B	F111	Fill of curved gully c110	507	275	fragment of dense SHC, approximately 100mm in diameter, 20mm deep. 1 fragment of natural stone		
B	F113	Fill of furrow c112	136	755	1 large fragment of SHC (140x80x30mm); 3 smaller fragments of SHC - all very worn		
B	F115	Fill of ditch c114	247	74	2 fragments of indeterminate slag with occasional small charcoal moulds		
B	F115	Fill of ditch c114	247	176	1 small complete SHC	100	176
B	F117	Fill of furrow c116	158	305	2 fragments of SHC, largest with flowed texture around one edge is 250g		
B	F118?		433	420	5 small fragments of SHC, largest 125g; 2 small fragments of lining (40g) oxidised on one side; 1 fragment of blebby slag, multiple small charcoal moulds; 3 small fragments of indeterminate slag		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F124	Fill of furrow c123	135	650	5 fragments of SHC (average 70x40 mm), 4 smaller amorphous fragments		
B	F124	Fill of furrow c123	135	212	fragments of SHC (broken in two)	80	265
B	F124	Fill of furrow c123	135	255	1 fragment of SHC, possible tool marks on base		
B	F124	Fill of furrow c123	135	1150	fragments of natural stone		
B	F126	Fill of gully c125	29	226	1 almost complete SHC	90	251
B	F126	Fill of gully c125	233	230	1 complete of SHC with charcoal rich base (95x70x20mm)	100	230
B	F126	Fill of gully c125	233	180	1 natural stone; 4 fragments of blebby slag		
B	F126	Fill of gully c125	252	550	1 fragment of dense thick crust (40mm) SHC (80x50x40mm), charcoal and iron rich concretion on upper surface		
B	F126	Fill of gully c125	252	228	3 fragment of SHC, 1 has small sharp slag protrusions and occasional charcoal moulds		
B	F126	Fill of gully c125	252	398	small folded SHC	90	442
B	F126	Fill of gully c125	222	325	1 fragment of partially oxidised, partially vitrified lining; 2 thin crusts from SHCs; 1 indeterminate fragment of slag		
B	F126	Fill of gully c125	229	279	2 fragments of SHC, 1 rusty appearance on upper surface (225g); 6 fragments of indeterminate slag		
B	F129	Fill of pit c474	226	37	8 small fragments of indeterminate slag		
B	F133	Fill of furrow 132	140	710	1 fragment of plano convex SHC (120x45x75mm), charcoal moulds on upper surface	100	710
B	F133	Fill of furrow 132	140	966	2 fragments of plano convex SHC (160x130x70mm), rough upper surface with charcoal and iron rich concretion	70	1380
B	F133	Fill of furrow 132	140	575	5 fragments of indeterminate smithing slag		
B	F133	Fill of furrow 132	140	150	1 fragment of hearth lining		
B	F133	Fill of furrow 132	140	105	3 small fragments of slag, one contains small amounts of charcoal and pebbles		
B	F133	Fill of furrow 132	140	125	3 fragments of weathered stone		
B	F139	Fill of furrow 138	357	479	4 fragments of plano convex SHC, largest is 280g , rusty appearance on upper surface		
B	F157	Fill of gully 193	306	210	1 fragment of slag, multiple charcoal moulds on lower surface, small area of upper surface shows evidence that is was molten		
B	F159	Fill of pit c158	291	126	1 small fragment of probable SHC; 1 small fragment of partially oxidised lining		
B	F159	Fill of pit c158	289	500	1 fragment of thin crust SHC (110x100x30mm)		
B	F164	Fill of furrow c163	276	89	2 fragments of SHC, 1 with some lining attached with organic moulds; 1 small fragment of slaggy concretion		
B	F164	Fill of furrow c163	276	236	1 small complete SHC	100	236

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F194	Fill of gully c193	307?	1075	4 fragments of SHC, the largest measures 120x90x65mm. 2 of the smaller pieces contain numerous charcoal moulds, the third has pebbly concretion on upper surface		
B	F194	Fill of gully c193	412	1025	large fragment of dense plano-convex SHC (130x90x50mm)	70	1464
B	F194	Fill of gully c193	412	850	13 fragments of slag, possibly also derived from SHC but difficult to confirm		
B	F194	Fill of gully c193	412	380	1 fragment of dense SHC (70x60x42mm)		
B	F194	Fill of gully c193	412	558	almost complete SHC (125x100x20mm), gravelly upper and lower surfaces	100	558
B	F194	Fill of gully c193	412	596	fragment of plano convex SHC, small stones attached, rusty appearance on upper surface	105	568
B	F194	Fill of gully c193	412	330	1 fragment of dense SHC (90x60x35mm)		
B	F194	Fill of gully c193	412	249	fragment of heterogeneous SHC, charcoal moulds on interior	90	277
B	F194	Fill of gully c193	412	203	fragment of SHC (90x60x20mm)		
B	F194	Fill of gully c193	412	180	2 fragment of probable SHC		
B	F194	Fill of gully c193	412	130	curved fragment of tuyère (radius changes from 50-70mm), slagged on one side (interior)		
B	F197	Fill of gully c945	302?	60	3 small fragments of slag; 1 gravelly concretion		
B	F197	Fill of gully c945	322	102	1 indeterminate fragment of smithing slag		
B	F216	Fill of gully c490	150	275	1 fragment of small circular, plano convex SHC (80x85x20mm), rusty appearance on base	100	275
B	F216	Fill of gully c490	224	310	1 large, 1 small fragment of thin crust weathered fragments of SHC, largest is 300g (110x70x20mm), occasional charcoal moulds and gravelly in areas		
B	F216	Fill of gully c490	240	41	1 fragment of partially flowed hearth slag		
B	F251	Fill of ditch c250	329	420	fragment of SHC, flat base with rough upper surface with medium sized charcoal moulds and small pebbly concretions		
B	F251	Fill of ditch c250	336	575	1 fragment of SHC (100x80x30mm) rusty appearance on base, possibly 60% of complete cake		
B	F217	spread	231	143	1 fragment of iron rich SHC, pebbly external crust (110g); 5 smaller fragments of slag and pebble concretions		
B	F218	Fill of pit c867	150?	825	1 fragment of plano convex SHC (111x112x30mm), some lining attached to the base	80	1031
B	F218	Fill of pit c867	150?	455	1 fragment of plano convex SHC (110x70x25mm)	80	569
B	F218	Fill of pit c867	150?	175	1 small fragment of SHC		
B	F218	Fill of pit c867		230	5 small fragments of indeterminate slag; 1 fragment of bone		
B	F233	Fill of gully c234		26	1 small fragment of gravelly lining slag		
B	F235	Fill of well? c444	149	45	1 fragment of indeterminate slag		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F251	Fill of ditch c250/450	408	255	1 fragment of charcoal rich SHC		
B	F251	Fill of ditch c250/450	418	1175	1 large fragment of plano-convex SHC, (almost complete 140x120x30mm),	75	1567
B	F251	Fill of ditch c250/450	418	500	fragment of SHC, layer of sediment visible towards the base, looks somewhat like a burr, charcoal rich concretion on upper surface		
B	F251	Fill of ditch c250/450	418	911	1 small fragment of oxidised lining; 7 fragments of indeterminate slag, 2 with gravel concretions		
B	F251	Fill of ditch c250/450	424	1452	14 fragments of SHC, varying sizes, largest fragment of dense well formed cake 242g, (bowl 20mm deep), smooth top with impressed charcoal		
B	F255	Alluvial spread	345	400	2 very small indeterminate fragments		
B	F255	Alluvial spread	345	310	small SHC (100x80x55 of which 40mm bowl)	100	310
B	F255	Alluvial spread	345	326	small SHC (75x80x45 of which 30mm bowl, 15mm upper lining rich layer)	100	326
B	F271	Fill of slot c270	267	498	1 fragment of SHC (275g), charcoal moulds in upper surface; 3 fragments of indeterminate slag; 1 fragment of charcoal rich material		
B	F271	Fill of slot c270	283	775	2 fragments of thin crust SHC ; 6 small indeterminate fragments		
B	F271	Fill of slot c270	283	525	fragment of almost complete SHC (120x90x40mm)		
B	F271	Fill of slot c270	283	825	11 randomly shaped fragments of SHC		
B	F271	Fill of slot c270	283	25	1 small fragment of lining, partially oxidised on one side		
B	F271	Fill of slot c270	283	505	4 fragments of SHC, largest 200g; 5 fragments of indeterminate slag, possibly hearth slag		
B	F271	Fill of slot c270	284	59	lump of fired clay, vitrified in one area, occasional charcoal inclusions		
B	F273	Fill of gully c272	292	1195	7 fragments of SHC, 1 of which is very dense; 5 small fragments of indeterminate slag; 1 natural stone		
B	F273	Fill of gully c272	292	392	1 small complete SHC	100	392
B	F273	Fill of gully c272	292	180	1 small complete SHC	100	180
B	F273	Fill of gully c272	292	2100	11 fragments of SHC, varying sizes, largest is 625g (125x95x25mm), smallest 50g (70x60x10)		
B	F278	Fill of gully c280	305	700	small SHC (110x90x30 mm), relatively flat base and upper surface, small occasional charcoal moulds on upper surface	100	700
B	F278	Fill of gully c272	305	500	fragment of SHC, occasional charcoal inclusion in one area		
B	F278	Fill of gully c272	320	52	2 small fragments of vitrified lining; 1 fragment of lining slag		
B	F279	Fill of gully c969	372	245	2 highly vesicular, low density slag, probably derived from smithing hearth		
B	F281	Fill of gully c280	228	1375	2 large fragments well formed of SHC (1025g), 1 fragment of less well formed SHC (145g), 3 indeterminate fragments of slag, possibly also SHC fragments		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F285	Fill of gully c284	321	39	fragments of corroded iron		
B	F285	Fill of gully c284	321	1072	2 fragments of SHC, one has large stone attached		
B	F285	Fill of gully c284	321	802	15 fragments of indeterminate slag, many of which are likely to be fragments of SHC, however are too small for certainty; 1 natural stone		
B	F285	Fill of gully c284	321	156	1 small circular SHC	100	156
B	F285	Fill of gully c284	321	128	1 small SHC (almost complete)	100	128
B	F285	Fill of gully c284	383	55	3 fragments of partially oxidised lining with slag attached		
B	F293	Fill of gully c969	442	500	1 large fragment of thin crust SHC 140 x 110 x40 mm, occasional small charcoal moulds on base, rough upper surface		
B	F293	Fill of gully c969	442	575	5 probable fragments of SHC, two of which contain small charcoal moulds		
B	F293	Fill of gully c969	442	122	1 small SHC	100	122
B	F293	Fill of gully c969	442	1480	7 weathered fragments of SHC (average 80x60mm)		
B	F293	Fill of gully c969	442	50	1 small fragment of tuyère (55x35mm), small pebble concretions on one side, oxidised fired on the other		
B	F293	Fill of gully c969	442	1250	1 sub circular fragment of SHC (425g) (90x90x30mm); 1 fragment (possibly 1 half) of well formed plano convex SHC (120x70x45mm); 1 fragment of heterogeneous charcoal rich SHC (250g)		
B	F311	Fill of furrow c310	301	490	2 fragments of SHC, 1 less well formed		
B	F311	Fill of furrow c310	301	604	SHC, will tool mark on one side	90	671
B	F319	Fill of trough c318	303	175	9 weathered nubs of indeterminate slag		
B	F355	Fill of gully C354	340	264	1 fragment of plano-convex SCH (80x60x30mm)	90	293
B	F355	Fill of gully C354		160	1 fragment of SHC		
B	F339	Fill of pit c338	366	276	2 small fragments of SHC, 1 fragment of probably fuel ash slag or lining slag, also 155g of bones and teeth		
B	F339	Fill of pit c338	373	166	1 fragments of SHC		
B	F339	Fill of pit c338	373	492	SHC	100	492
B	F339	Fill of pit c338	373	686	SHC	100	686
B	F339	Fill of pit c338	373	206	SHC	100	206
B	F347	Fill of pit c346	376	375	5 probable small fragments of SHC, 1 fragment of tuyère; two concretions on piece of iron		
B	F355	Fill of gully c354	377	1027	8 fragments of SHC, largest is 305g (120x80x20mm); 1 fragment of bone		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F375	Fill of gully c374	326	1325	1 large fragment of SHC with convex base and depression on upper surface with rusted area in the centre (170x120x30mm)	80	1656
B	F375	Fill of gully c374	326	570	1 small plano-convex SHC (almost complete 110x90x35mm); 1 small fragment of SHC; 1 indeterminate fragment	100	570
B	F375	Fill of gully c374	326	124	1 small fragment of SHC		
B	F375	Fill of gully c374	399	782	5 fragments of SHC; 1 bone fragment; 1 natural stone		
B	F375	Fill of gully c374	399	370	1 small complete SHC	100	370
B	F426	Fill of ditch c250/450	237?	30	3 small concretions - charcoal/slag/fired clay		
B	F426	Fill of ditch c250	333	875	well formed SHC 150x110x60 mm, iron rich concretion with occasional charcoal inclusions on upper surface	100	875
B	F430	Fill of gully c431	147	372	7 fragments of indeterminate slag, probable misc. smithing waste, 1 fragment of natural stone		
B	F430	Fill of gully c431	147	138	small tongue-like low density SHC top with smooth deep impressions	100	138
B	F430	Fill of gully c431	147	221	2 fragments of lining/fuel ash slag (80g); 5 fragments of low density indeterminate slag with small amount of lining attached (178g); 1 corroded iron object (possibly a hook) 10g		
B	F430	Fill of gully c431	147	1135	4 fragments of dense SHC with crystal terminations		
B	F448	Fill of pit c1024	362	78	1 small fragment of slag, rusty charcoal rich base		
B	F455	Fill of well? C444	220	3	3 very small fragments of fired clay		
B	F460	Fill of ditch c114	157	600	1 large fragment of SHC, small occasional charcoal moulds on base	100	600
B	F460	Fill of ditch c114	157	700	fragment of SHC, occasional hammerscale visible on upper surface	100	700
B	F460	Fill of ditch c114	157	400	3 fragments of SHC, 2 of which contain small occasional charcoal moulds		
B	F462-F480	Fill of ditch c114	251	370	sub circular plano convex SHC (85x80x30mm)	100	370
B	F485	Fill of ditch c1578	185	800	large fragment of SHC (possibly almost complete) 140x130x30 mm, convex base and rough upper surface with occasional charcoal moulds	95	842
B	F485	Fill of ditch c1578	185	425	small SHC (almost complete 100x75x40 mm), convex base with some lining and attached, rough, uneven upper surface	100	800
B	F485	Fill of ditch c1578	185	500	fragment of SHC (125x95mm), occasional charcoal moulds on upper surface		
B	F485	Fill of ditch c1578	185	630	2 joining fragments of thick crust SHC, olivine crystals visible in section (up to 20mm)	85	741
B	F485	Fill of ditch c1578	185	478	1 large fragment of SHC; 1 small nub of indeterminate slag		
B	F489	Spread	241	100	2 fragments of SHC, medium charcoal moulds on one side, small pebbles mixed with slag on the other		
B	F489	Spread	245	500	2 halves of almost complete plano convex SHC (90x90x30mm), 1 small fragment with pebbly concretion attached	90	556

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F492	Fill of pit c491	227	52	5 fragments of corroded iron concretions, small amounts of flake hammerscale visible on two pieces		
B	F497	Fill of gully c125	221	550	3 small fragments of SHC, 1 possibly from plano-convex cake		
B	F497	Fill of gully c125	221	154	4 fragments of SHC, 2 fragments of indeterminate slag, 1 fragment of weathered bone		
B	F497	Fill of gully c125	221	146	small low density SHC	95	154
B	F497	Fill of gully c125	228	198	1 SHC, well flown on proximal side, slightly gravelly top	90	220
B	F497	Fill of gully c125	228	538	1 SHC	100	538
B	F497	Fill of gully c125	228	108	small SHC	100	108
B	F497	Fill of gully c125	228	287	1 large fragment of SHC, approx 100x90x60 mm, 750g - irregular in shape, possibly deformed on extraction. 1 smaller fragment with dimpled base; 2 joining fragments of tuyère - estimated radius 65mm (outside), 26mm diameter blowhole		
B	F497	Fill of gully c125	228	490	2 fragments of SHC, largest is 360g (110x50x45mm); 1 small fragment of lining (22g); 2 natural stones		
B	F497	Fill of gully c125	228	426	4 fragments of SHC, largest 198g (80x60x20mm); 3 smaller pieces of SHC with oxidised fired clay attached; 2 smaller fragments of indeterminate slag possibly from smithing hearth		
B	F497	Fill of gully c125	228	1900	1 large dense fragment of SHC 1150g (120x100x40-50mm), plano convex with rough upper surface; 8 smaller fragments of SHC (800g); 4 fragment of tuyère, oxidised fired on one side (25g)		
B	F497	Fill of gully c125	228	776	10 fragments of SHC, 1 is almost complete plano-convex cake (110x90x35mm)		
B	F497	Fill of gully c125	230	75	1 fragment of sandy lining, appears to be rich in mica; 1 natural stone; 3 small fragments of tuyère		
B	F497	Fill of gully c125	230	7	1 fragment of corroded iron object, probable nail		
B	F497	Fill of gully c125	230	52	3 small fragments tuyère - estimated radius 80mm; 1 fragment of indeterminate slag		
B	F498	Fill of gully c125	219	71	2 fragments of indeterminate slag		
B	F498	Fill of gully c125	253	280	1 almost complete thin crust SHC, relatively flat with hollow in upper surface (125x80x15mm)	100	280
B	F713	ditch c1537		17	small lump dominated by green corrosion product (copper based?), contains small quantities of coal		
B	F852	Fill of ditch c118	269	350	1 fragment of dense plano convex SHC, rusty appearance on one side (90x65x20mm)		
B	F854	Fill of ditch c118	270		the weight of this bag was initially recorded at 600g, this was all soil however with just two pieces of natural stone		
B	F862	Fill of pit c861	232	76	2 fragments of indeterminate slag; 1 small flow of slag; 1 natural stone		
B	F873	Fill of ditch c1578	248	350	fragment of SHC (90x80x25mm), prilly base	100	350
B	F886	Fill of ditch c250	238	950	2 fragments of SHC, 1 has charcoal rich area; 1 small plano-convex SHC 555g (90x80x30mm)		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F891	Fill of gully c893	274	1725	1 large well formed plano convex thin crust SHC, occasional charcoal moulds and inclusions on upper surface, (140x180x90 of which bowl 50mm)	90	1917
B	F891	Fill of gully c893	274	660	1 small fragment of composite SHC, several charcoal rich areas and small pebbly concretion in one area; 1 natural stone; 1 small charcoal rich concretion		
B	F891	Fill of gully c893	274	975	large plano convex SHC (135x120x45mm), rough upper surface		
B	F903	spread	264	190	double layer SHC, lower coalesced lobes dimpled, upper layer iron rich, rusty (lower layer - 50x80x25mm), (upper layer 55x55x15mm)	100	190
B	F912	Fill of furnace c914	272	46	5 fragment of low density indeterminate slag		
B	F922	Fill of figure of 8 burnt pit c921	285	22	2 corroded fragment of iron		
B	F922	Fill of figure of 8 burnt pit c921	285	725	11 fragment of indeterminate slag, 2 of which are probably fragment of SHC		
B	F924	Fill of figure of 8 burnt pit c921	296	450	3 fragments of smithing hearth slags		
B	F924	Fill of figure of 8 burnt pit c921	296	288	low density SHC, (70x95x65 of which prilly bowl = 30mm, upper part composed of lining slag		
B	F932	Fill of trough c318	300	35	1 small fragment of indeterminate slag		
B	F933	Fill of trough c318	298	360	fragment of plano convex charcoal rich, prilly SHC,		
B	F934	Fill of trough c318	299	748	5 fragments of SHC, largest is well formed and dense 249g, smallest is 62g		
B	F956	Backfill of trough c942	388	150	1 small fragment of thin crust SHC with gravelly base		
B	F958	Backfill of trough c942	327	160	1 fragment of SHC with charcoal inclusions on interior		
B	F958	Fill of trough c318	327	456	1 small SHC (almost complete 110x90x20 mm), roughly plano-convex in form	100	456
B	F958	Fill of trough c318	439	32	possible lining slag?		
B	F960	Fill of gully c959	311	8	corroded fragment of iron nail		
B	F960	Fill of gully c959	311	352	6 fragments of indeterminate slag, likely to be smithing debris		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F1037	Fill of gully c1065	367	100	1 indeterminate lump of slag with occasional blebby protrusions		
B	F1037	Fill of gully c1065	413	55	1 quite dense and flowed fragment of slag		
B	F1037	Fill of gully c1065	413	86	1 almost complete tongue/SHC		
B	F1037	Fill of gully c1065	413	142	1 complete SHC		
B	F1050	Fill of small pit c1055	379	230	1 SHC 230g	100	230
B	F1050	Fill of small pit c1055	379	19	1 small fragment of indeterminate slag; 1 natural stone		
B	F1051	Fill of posthole c1052	?	348	5 fragments of thin crust SHC, largest 160g		
B	F1072	Fill of trough c1069	396	324	large fragment of SHC, smooth blown top, maroon tinge	90	360
B	F1072	Fill of trough c1069	396	576	3 fragments of SHCs, 2 of which have occasional charcoal moulds, 1 fragment is plano-convex in shape and shows evidence for a once molten upper surface, 1 indeterminate fragment		
B	F1097	Fill of pit c1096	414	2450	unconsolidated 'double' SHC, smooth glassy proximal end, charcoal material at distal end, with fairly well developed burr	100	2450
B	F1097	Fill of pit c1096	414	2150	3 fragments of dense SHC (1125g), with protruding basal crust; 9 fragments of slag possibly derived from SHCs; 1 small fragment of lining		
B	F1097	Fill of pit c1096	414	1150	1 large SHC (almost complete 150x130x70mm) convex base with depression in upper surface		
B	F1097	Fill of pit c1096	414	500	1 fragment of SHC (100x80x55mm), convex base, rough upper surface		
B	F1097	Fill of pit c1096	414	150	2 small fragment of SHC, 1 contains multiple charcoal moulds		
B	F1097	Fill of pit c1096	414	1300	1 well formed dense plano-convex SHC, 150x120x70 (of which bowl is 45 mm)	100	1300
B	F1097	Fill of pit c1096	414	1200	large fragment of well formed dense SHC with large tubular vesicles and possible tool marks on base (fragment measures 150x100x30 mm)		
B	F1097	Fill of pit c1096	414	1675	1 large fragment of SHC with second SHC crust attached to the base	90	1861
B	F1097	Fill of pit c1096	414	516	1 complete SHC	100	516
B	F1113	Fill of gully c1112	425	210	55g of vitrified lining - quite sandy; 1 small fragment of SHC (50g); 3 small fragments of indeterminate slag		
B	F1118	Fill of gully c1117	433	112	3 fragments of indeterminate slag; 2 fragments of tuyère		
B	F1118	Fill of gully c1117	449	1548	6 fragments of SHC, largest weighs approx 500g, several have rusty appearance on upper surfaces and occasional charcoal moulds		
B	F1118	Fill of gully c1117	449	245	1 small complete SHC	100	245
B	F1118	Fill of gully c1117	449	212	1small complete SHC	100	212
B	F1118	Fill of gully c1117	451	7	2 fragments of corroded nails		
B	F1118	Fill of gully c1117	451	75	8 fragments of tuyère, 1 possible radius of 80mm, 1 natural stone		
B	F1118	Fill of gully c1117	451	260	1 small SHC	100	260

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	F1118	Fill of gully c1117	451	1600	3 fragments of well formed SHC (880g), the remainder is comprised of random fragments much of which contains small amounts of charcoal and charcoal moulds - likely to be misc. smithing debris		
B	F1119	Fill of gully c1117	450	1800	1 large approx. plano-convex SHC with occasional charcoal moulds and inclusions	100	1800
B	F1120	Fill of gully c1117	434	280	1 fragment of SHC (120g), iron rich charcoal concretion on upper surface, charcoal moulds on lower surface; 8 smaller fragments of indeterminate slag probably also derived from smithing; 2 fragments of bone		
B	F1120	Fill of gully c1117	436	170	3 fragments of partially oxidised lining; 1 fragment of lining slag; 4 fragments of indeterminate slag		
B	F1120	Fill of gully c1117	440	376	1 fragment of SHC, charcoal moulds on base, rough upper surface - possibly complete but formed predominately from lining slag		
B	F1122	Fill of gully c1117	452	675	small almost complete SHC with convex base and rough upper surface (100x90x50mm)	100	675
B	F1122	Fill of gully c1117	452	130	small almost complete SHC	100	130
B	F1122	Fill of gully c1117	452	91	2 joining fragments of tuyère, possible elliptical cross-section, this fragment has radius of approximately 60mm but variable		
B	F1122	Fill of gully c1117	452	910	2 fragments of indeterminate slag, one is blebby, the other is quite weathered; 2 possible fragments of SHC		
B	F1128	Fill of pit c1127		800	sub-circular SHC, (150x140x30mm), upper surface has lobed texture with numerous medium sized charcoal moulds	100	800
B	F1128	Fill of pit c1127		1250	5 fragments of SHC, 3 of which have lower crusts, topped with less dense slag. 1 contains corroded iron.		
B	F1129	Fill of gully c1117	432	250	4 fragments of SHC, rusty appearance in places; 5 fragments of indeterminate slag (130g); 1 fragment of lining slag; 1 fragment of corroded iron		
B	surface finds		263	49	1 small fragment of slag, probably from SHC		
B	surface finds		350	1550	1 large fragment of SHC (150x130x55mm), dense slag towards the base and charcoal rich upper surface	90	1733
B	surface finds		350	500	small plano-convex SHC (80x70x40mm), thin charcoal rich deposit on upper surface	100	500
B	surface finds		350	344	small complete SHC	100	344
B	surface finds		350	1182	5 fragments of SHC, the largest measures 140x80x30mm		
B	surface finds		350	825	6 fragments of slag, 2 of which have pebble concretions attached		
B	surface finds		304?	380	corroded nail fragment (5g); 4 small fragments of probable SHC; 1 fragment of lining slag		
B	surface finds			3.4	1 small corroded iron object, possibly fragment of a hook		
B	surface finds			3.8	corroded fragment of iron		
B	surface finds			31	concretion around fragment of iron		

area	context	type	find	wt (g)	notes	SHC details	
						% of orig.	orig. wt.
B	surface finds			50	1 stone, 1 fragment of slate		
B	surface finds				1 fragment of bone		
B	surface finds			62	3 small fragments of tuyère oxidised on one side		
B	surface finds			376	1 probable fragment of SHC, 9 fragments of slag likely to be misc. smithing waste		
B	Topsoil		406	425	2 fragments of weathered SHC, 1 with quartz rich pebble concretion on one surface		
B	Topsoil		196	32	1 natural stone; 2 small fragments of iron rich material, rusty appearance with occasional charcoal moulds		
B	Topsoil		35	30	2 small fragments of indeterminate slag, rusty in places, occasional charcoal moulds		
B	Trowel back		166	190	1 small SHC, dimpled base with small charcoal moulds	100	190
B	Trowel back		166	110	2 small fragments of indeterminate slag, also likely to be smithing waste		
B	Trowel back			108	2 fragments of indeterminate slag		
B	Trowel back		194	434	2 small fragments of indeterminate slag; 1 very weathered fragment of igneous rock; 1 large fragment of weathered slag with small stones attached		
B	Trowel back		174	69	3 small fragments of smithing slag, with bearing small coal moulds		
B	Trowel back		60	110	1 fragment of slag possibly from SHC contains iron; 1 natural stone		
B	Trowel back		96	630	1 fragment of thick crust plano convex SHC 425g (100x65x37mm); 1 weathered stone; 1 very small fragment of dense SHC		
B	Trowel back		73	28	1 natural stone (quartz rich)		
B			330	960	large dense plano convex SHC	55	1745
B			330	90	5 small fragments of indeterminate slag		
<b>AREA D</b>							
D	F1139	Fill of ditch c1516	475	37	1 fragment of hearth/lining slag		
D	F1509 C1508	Fill of ditch c1508	319	500	1 fragment of plano-convex SHC (130x80x30mm)		
D	F1523	Fill of furrow c1522	523?	250	1 fragment of SHC containing iron and coal inclusions (130g); 1 small fragment of possible coal dirt; 1 small fragment of SHC with coal inclusions (63g)		

<i>area</i>	<i>context</i>	<i>type</i>	<i>find</i>	<i>wt (g)</i>	<i>notes</i>	<i>SHC details</i>	
						<i>% of orig.</i>	<i>orig. wt.</i>
D	F1662	Fill of ditch c1661	543	1050	1 large fragment of SHC, convex base, rough upper surface (160x135x70 with 50mm bowl)	90	1167
<b>AREA J</b>							
J	F1221	Fill of gully c1220	825?	9	small fragment of indeterminate slag		
J	F1230	Fill of furrow c1229	800	56	1 small fragment of blebby slag with small coal inclusions; fragment of corroded iron nail (5g)		
J	F1351	Fill of ditch c1357	910	358	3 small fragments of SHC (average 100g each), charcoal rich concretion on upper surface	90	398
	No context info		378?	575	fragment of limestone, partially de-calcified rich in fossils; 1 fragment of gravelly slag, 4 fragments of indeterminate slag		

Table 2. Comparison of the Blackchurch assemblage with other Irish smithing assemblages.

	Coolamurry	Navan	Moneygall	Carrigoran	Parknahown 5	Blackchurch (site 48)	Trumra 4	Clonmacnoise (NG)	Ballykilmore	Woodstown 6	Clonmacnoise (WWS)	Clonfad	AR36 Borris	Lismore/ Bushfield 1
date	C10-12	E. Med.	E. Med- Med.	C9-11	C5-C10?	C5-10?	C5/6	C7-10	C10-15?	C9-10	C10?	C7-9	C7-9?	E. Med?
SHC count	41	17	22	18	89	70	57	258	30	140	38	381	88	23
SHC min. wt		60	114		86	108	92	54	94	68		60	154	426
SHC max. wt	2588	2990	1800	3866	2898	2450	3163	7815	4033	6310	5540	11000	7440	4390
SHC mean wt	386	507	527	553	567	629	727	762	1022	1060	1087	1302	1618	1737
% <500g	83%	82%	55%	72%	70%	53%	47%	52%	47%	40%	39%	30%	22%	4%
% <1000g	95%	88%	95%	89%	84%	81%	75%	78%	73%	71%	68%	61%	41%	39%
% >1000g	5%	12%	5%	11%	16%	19%	25%	22%	27%	29%	32%	39%	59%	61%
% >3000g	0%	0%	0%	6%	0%	0%	2%	3%	10%	7%	8%	9%	16%	13%
Modal 100g interval	100-200	100-200	200-300	100-200	400-500	200-300	100-300	200-300	200-300	200-300	300-400	300-400	200-300	500-600

Assemblages ordered by mean weight.

Coolamurry from Young, 2006a; Navan Site 1 from Young 2007; Moneygall from Young 2008a; Carrigoran from Young 2005a; Parknahown from Young 2009a; Blackchurch, this study; Trumra 4 from Young 2008d, Clonmacnoise New Graveyard site from author's unpublished data Ballykilmore from Young 2009b; Woodstown from Young 2006b; Clonmacnoise Waste Water Scheme from Young 2005c; Clonfad from Young 2005b; Lismore/Bushfield 1 from Young 2008b.

The assemblages from Coolamurry, Navan, Moneygall, and Carrigoran are interpreted as being dominantly blacksmithing residues. The assemblages from Trumra, Clonmacnoise, Ballykilmore, Woodstown, Clonfad and Lismore/Bushfield are interpreted as including bloomsmithing residues.

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