Conservation Management Plan for the Blast Furnace Remains at Bealkelly, Co. Clare

History, survey and structural assessment

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1. Introduction

During the seventeenth and most of the eighteenth century the vast majority of iron used in Ireland was produced locally in blast furnaces. These monumental structures and their associated works would have dominated the landscape in the areas where they were active; economically, socially and visually. For a variety of reasons, Irish blast furnaces are preserved better than elsewhere and the surviving furnaces in the Sliabh Aughty area, on the Counties Clare and Galway shores of Lough Derg, present one of the finest collection of blast furnaces of that age anywhere worldwide.

The Sliabh Aughty Furnace Project was created in 2014 with the aim to study, conserve and educate about the iron industry in the Sliabh Aughty area.[1] In the Spring of 2015, a grant was obtained from the Heritage Council (Ref. CBH04830) to compose Conservation Management Plans for the four upstanding blast furnace remains in the Sliabh Aughty Mountains area. These Plans, consisting of the known historical information of the ironworks, detailed surveys of the structures and structural assessments of the same, the latter carried out by Architectural Conservation Professionals,[2] are seen as a first study of these furnaces and especially as documents which form the initial steps towards their future conservation.

This Plan concerns the blast furnace remains in the townland of Bealkelly (Eyre), Co. Clare.[3] Bealkelly is the best preserved of the four Sliabh Aughty furnace remains and possibly in the country. It is characterized by two parallel grooves which continue around the full furnace. Their function has not yet been satisfactorily explain but they very likely have held beams, either to support a platform around the top of the furnace or to re-enforce the top of the furnace. A deep hollow just next to the western wall likely represents the remains of its wheel pit. This furnace and the one at Derryoober, Co. Galway are the only two in the Sliabh Aughty area which have both their blowing and tapping arches preserved, which show interesting differences between both.

1 www.furnaceproject.org and https://www.facebook.com/pages/Sliabh-Aughty-Furnace-Festival/434485340026466
2 Grageen House, Cappanuke, Cappamore, Co. Limerick www.acpgroup.ie
3 Coordinates (ITM): 566245, 683060

2. Historical background

2.1 Iron smelting in Ireland in the 17th and 18th century

Until the late sixteenth century, iron ore in Ireland was exclusively smelted in so-called bloomery furnaces. These installations were generally clay-walled chimneys, about one to one and a half metres high with an internal diameter ranging between 30 and 60cm. In bloomery furnaces the heat was used to remove the oxygen from the iron oxides in the ore and to smelt the non-iron parts of the same, but the iron itself never became liquid. The products of these furnaces are known as blooms and weighed from 20 to 40kg.[4]

Around the thirteenth century, in an area stretching from Sweden over Germany to Switzerland, an altogether different type of furnace appeared. Now the bellows are no longer blown by hand but driven by water-power, the furnaces themselves are substantially larger stone-built square structures (side lengths and heights between 4 to 5m) and the product is now liquid iron. This liquid iron is characterised by a higher carbon content than bloomery iron.[5] The furnaces themselves are invariable equipped with two large arches, set in adjoining walls: one for the bellows ('blowing arch') and one for the removal of the iron and waste ('tapping arch'). The liquid state of the iron is not only due to a higher temperature as a result of the use of water-power, but also because of the use of more charcoal per fuel unit.

The liquid iron leaving the furnace could be poured into a mould resulting in cast iron objects. Because of their high carbon content, cast iron objects cannot be forged; they shatter upon being struck with a hammer. Alternatively, the iron could be cast into large bars of iron known as sows.[6] These sows are then brought to an installation known as a finery where the iron is re-melted in an oxidizing environment to remove the excess carbon. After further operations at the chafery (renewed reheating) and the hammer forge (shaping), so-called wrought iron is obtained which could then be further forged into a variety of shapes by the blacksmith. The finery, chafery and hammer forge all utilised water-power and were frequently part of the same plant.

As a blast furnace was expensive to build, required highly specialised labour and had a high

4 Rondelez 2014: 245-246. Water-powered bloomeries could produce substantially larger blooms.
5 Iron produced in the bloomery can have a low carbon content or a medium one. In that latter case it can be considered as steel. In the blast furnace the iron has to be converted to wrought iron (low carbon content) after which carbon needs to be added to obtain steel.
6 From the late 18th century these are known as pigs of iron

strategic value, it spread only very slowly outside of its original heart-land. Only at the very end of the fifteenth century are the first installations of this kind built in England, in the south-eastern Weald counties of Kent and Sussex. Only when the woods in that area could no longer provide sufficient fuel for the furnaces, around the middle of the sixteenth century, did blast furnaces spread further afield, into northern and central England and Wales. This is the period when the Plantation of Ireland got under way and already in the 1560s we hear of proposals of establishing a blast furnace in the area around Carrigaline, Co. Cork as part of the Kerrycurrihy Plantation.[7]

It is unclear if this furnace was ever built and for the rest of the sixteenth century the sources mention only further proposals and unspecified ironworks working in Ireland, all in Counties Cork and Waterford. The earliest definite evidence of a blast furnace in Ireland is the one built by Sir Thomas Norris in Mallow, Co. Cork which operated from 1583 to 1589.[8] In beginning of the seventeenth century, during several decennia of relative calm, multiple blast furnaces were built in Ireland. Among the most proliferous were the ventures of Sir Richard Boyle, First Earl of Cork, in Co. Waterford and by Sir Charles Coote's ironworks in County Laois and those built by both in Leitrim.[9]

Many of these furnaces were destroyed during the Civil Wars of the 1640s but already in the 1650s new ones were built and those that survived brought into production again. This is the period when the long-lasting works at Enniscorthy, Co. Wexford are constructed.[10] In the 1660s and 70s, William Petty established a substantial iron-producing industry in County Kerry,[11] but it was especially in the 1680s that new plants were started up, many in areas with no previous recorded blast furnaces, such as Counties Cavan, Mayo and Galway. In the eighteenth century we have many references to blast furnaces active all over Ireland, but the limited source material together with little research on the subject means that we cannot yet present a clear picture of the industry at that time. Many ironworks closed down around the middle of that century, with a handful continuing production up till about 1780. These then close down due to lack of fuel and competition from abroad.

In the Sliabh Aughty area, ironworks were active over a period of well over a hundred years (Fig. 1). The earliest furnace, at Ballyvannan, Co. Clare, possibly dates to before 1610.[12] The first furnace for which we have solid evidence is the one built in 1630 at Scarriff, Co. Clare by English

7 BL, Cotton Titus B/XII f.10, Rondelez 2014: 99
8 Rondelez 2014: 108
9 Rondelez In Press
10 Barnard 1985
11 Barnard 1982
12 See the Conservation Management Plan for Ballyvannan furnace, Co. Clare (Rondelez et al. 2015a)

merchants. After legal problems and the onset of the civil wars of the 1640s, the same merchants crossed the Atlantic and were involved in the first functioning blast furnace in the Americas at Saugus, Massachusetts. Back in Ireland, the iron industry along Lough Derg was only started up again in the 1680s, in Scarriff and in Woodford, Co. Galway. About a decade later, a furnace was built near Feakle. We are badly informed about the eighteenth century, but it would seem likely that the remaining furnaces were built during the earlier part of that century. We know that Whitegate furnace was in use in 1760.[13] If Lewis is correct, the industry in the Sliabh Aughty area ended in the late 1770s with the closure of the Woodford ironworks.[14]

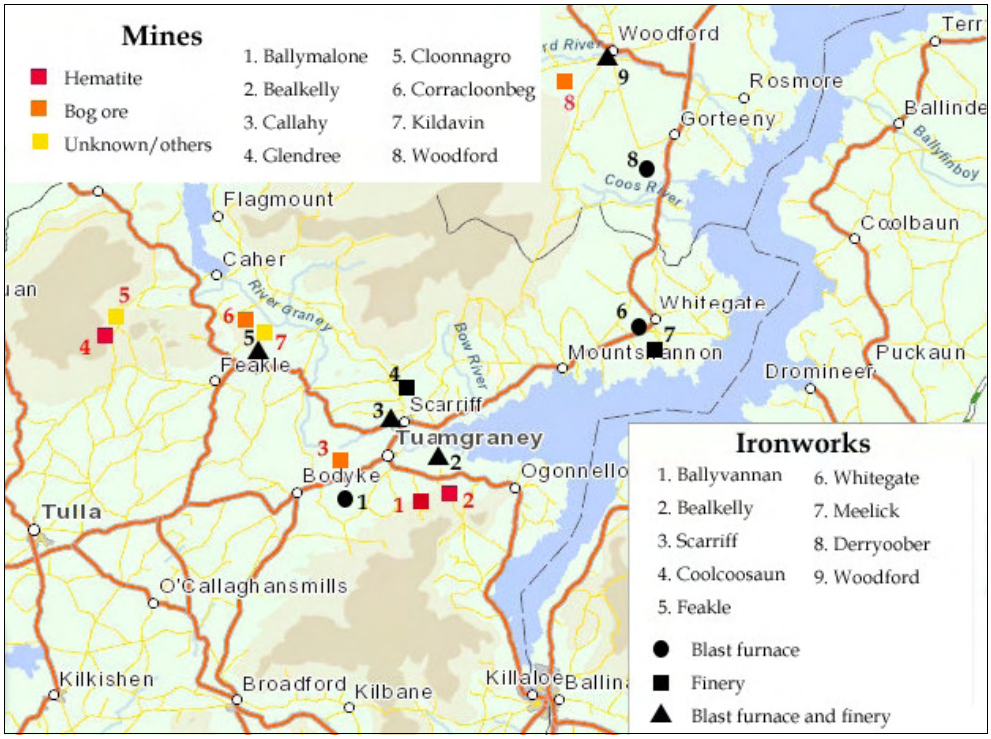

Fig. 1. The Sliabh Aughty ironworks and associated iron mines

13 See the Conservation Management Plan for Furnace, Whitegate, Co. Clare (Rondelez et al. 2015c)
14 Lewis 1837 Vol. II: 724

2.2 Historical background of Bealkelly Furnace

Geologist G. H. Kinahan15 records that this ironworks was said locally to have belonged to the Brady family and this could be related to a Captain Brady owning iron mines, likely those in Bealkelly itself and/or those at nearby Ballymalone, in 1696.16 At that time, Brady's mines were supplying Scarriff furnace and no ironworks were recorded at Bealkelly in the same correspondence which does mention the one at Feakle, Co. Clare and others further afield. Kinahan mentions that the mill for making bar iron was preserved next to Bealkelly furnace in 1870.[15] This is very likely the building depicted near the furnace on the 1830s and 1910s Ordnance Survey maps (Figs. 2 and 3). The elongated shape of the furnace on the latter map could indicate that another structure was then present adjoining the furnace itself.

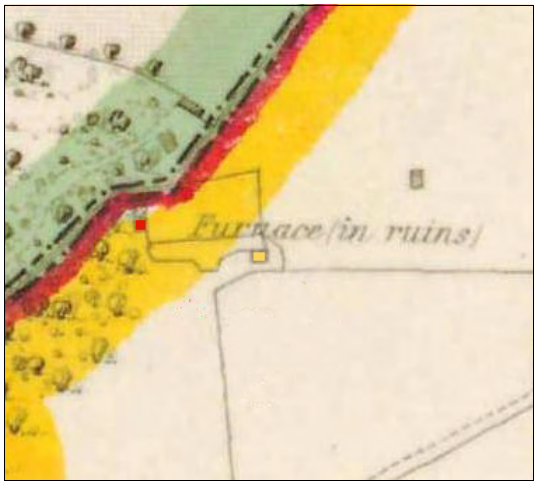

Fig. 2. Bealkelly furnace (red) and finery (yellow) on the 1830s OS map.

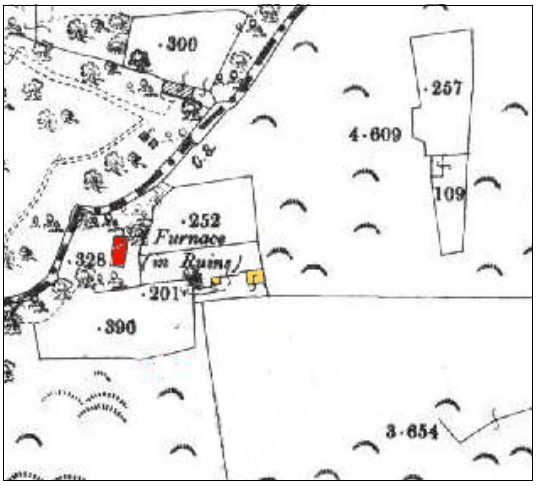

Fig. 3. Bealkelly furnace (red) and finery (yellow) on the 1910s OS map.

15 Kinahan 1870: 461

3. Survey of Bealkelly furnace

Bealkelly is the best preserved of the Sliabh Aughty furnaces and possibly in Ireland. It is a square building with side lengths just under 7.0m and a height of about 4.8m (Fig. 4). The west wall is higher as its base is set in the wheel pit. The hearth area is an irregular rectangular area with a long axis of just under 2.4m and perpendicular axes of just over and just under 2m. There is a narrow (about 7cm) ledge within the hearth area at a height of just over 2m.

On its exterior, Bealkelly furnace has two parallel horizontal recesses in its top part. Both are about0.25m high and 0.2m deep. The function of these is unclear but could be related to a platform built around the top of the furnace. Also unusual is a buttress placed against its north wall at a later date than its construction. This was likely done to prevent the cracks visible in the west wall expanding further.

A filled-in channel can be distinguished in the field leading towards the furnace, very likely supplying the water for its bellows, and the pond itself might have been the same one that provided power for a saw mill which is still visible on early Ordnance Survey maps next to the Killaloe road. According to local information, the finery building just next to the furnace was bulldozed in the 1960s and the material piled up next to the south wall of the furnace. Wall fragments can still be seen in that material.

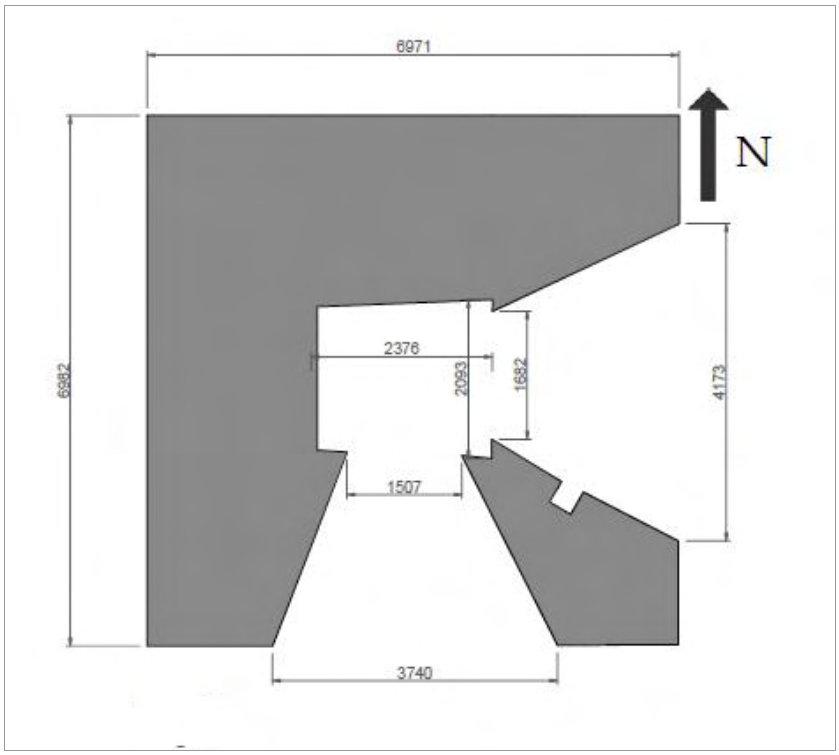

Fig. 4. Ground plan of Bealkelly furnace

3.1 East wall

The east wall is the setting for the casting arch (Figs. 5 and 7). This arch is just less than 4.2m wide and 2.4m high at its front and forms a square area with side lengths of about 1.7m where it meets the hearth area. In the southern arch wall, broadly in its middle, is a rectangular recess with a length of 0.3m, a height of 0.2m and a depth of 0.25m (Fig. 6). This is very reminiscent of the recess in nearby Derryoober furnace.[16] Its function is unknown but strikingly the northern arch wall has signs of burning exactly opposite this recess.

Fig. 5. The east wall of Bealkelly furnace

Fig. 6. Recess in the southern tapping arch wall

16 See Rondelez et al. 2015b

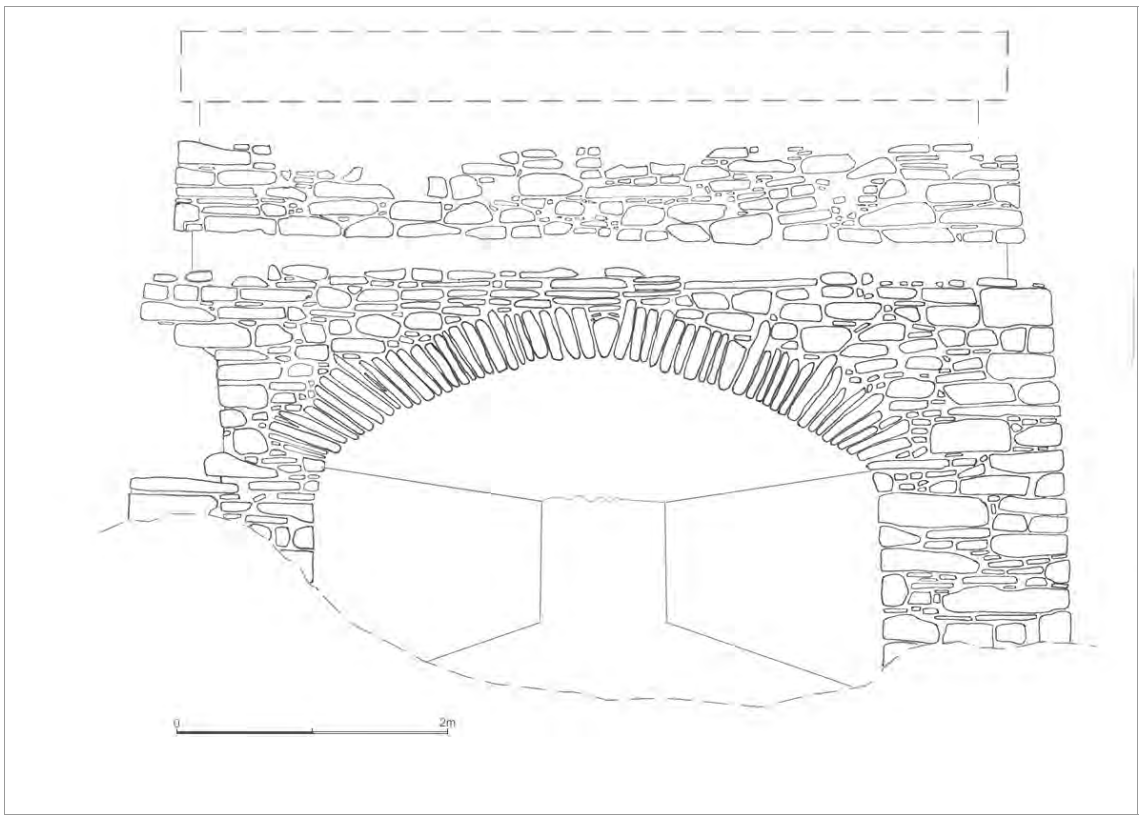

Fig. 7. Elevation drawing of the east wall

3.2 South wall

The blowing arch, which would have held the bellows, is located in the south wall (Figs. 8 and 9). Much of the base of south wall is obscured by the demolished finery building material piled up there. The arch is about 3.75m wide and over 1.4m high and it ends in a square area with side lengths of just over 1.5m at the hearth area. At its top, a large beam (about 0.6m high and deep) would have run horizontally across the full length of the south wall. This beam very likely functioned as a support for the bellows.

Fig. 8. Blowing arch in the south wall

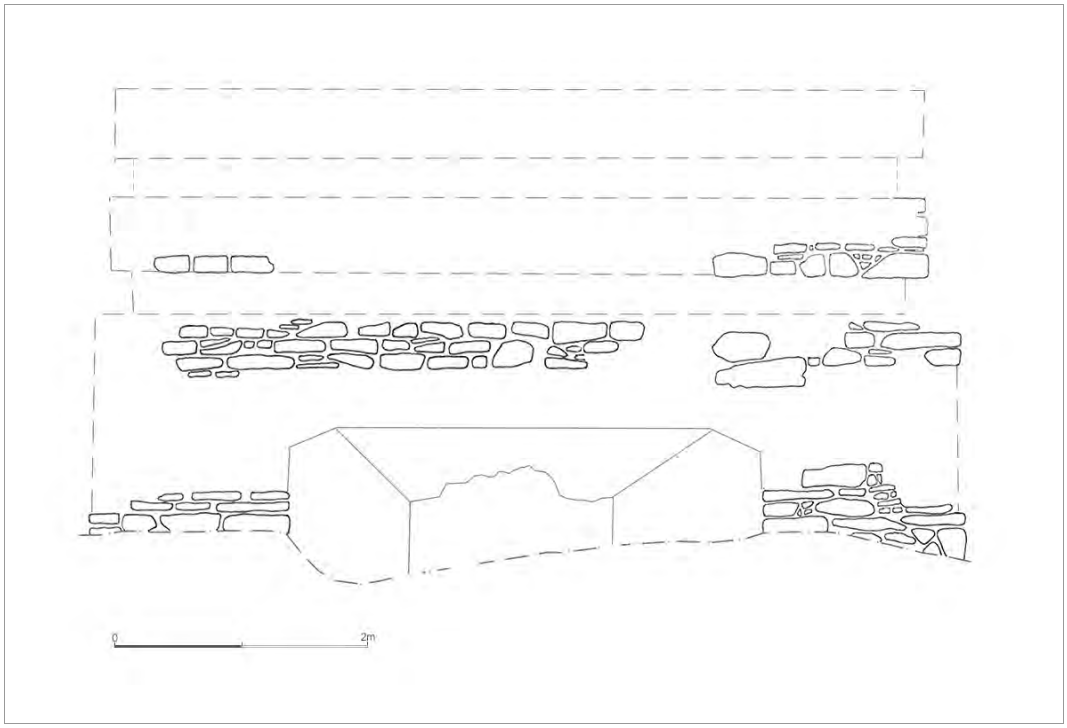

Fig. 9. Elevation drawing of the south wall

3.3 North wall

The north wall was seemingly originally a plain masonry structure but at a later date a buttress was built against it (Figs. 10 and 12). This buttress is over 2.9m high, 1.3m wide and just under 1m deep at its base. It has a reclining front face and near its top is stepped twice (Fig. 11).

Fig. 10. East side of the north wall

Fig. 11. Stepped buttress against the north wall

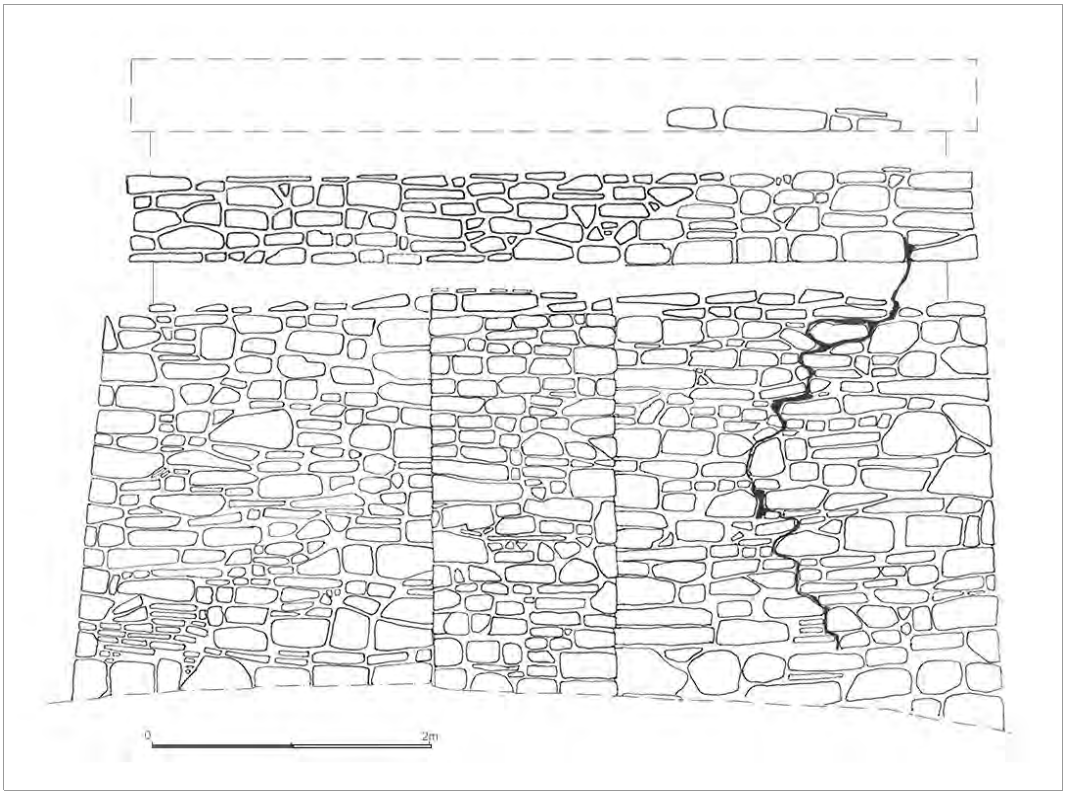

Fig. 12. Elevation drawing of the north wall

3.4 West wall

The west wall is a plain masonry structure set in the partly back-filled wheel pit (Figs. 13 and 14). This pit currently measures about 6m by 2.6m and is around 1.4m deep. Somewhat surprisingly there are no recesses in this wall which could have functioned as support points for the water wheel.

Fig. 13. West wall, looking down into the wheel pit

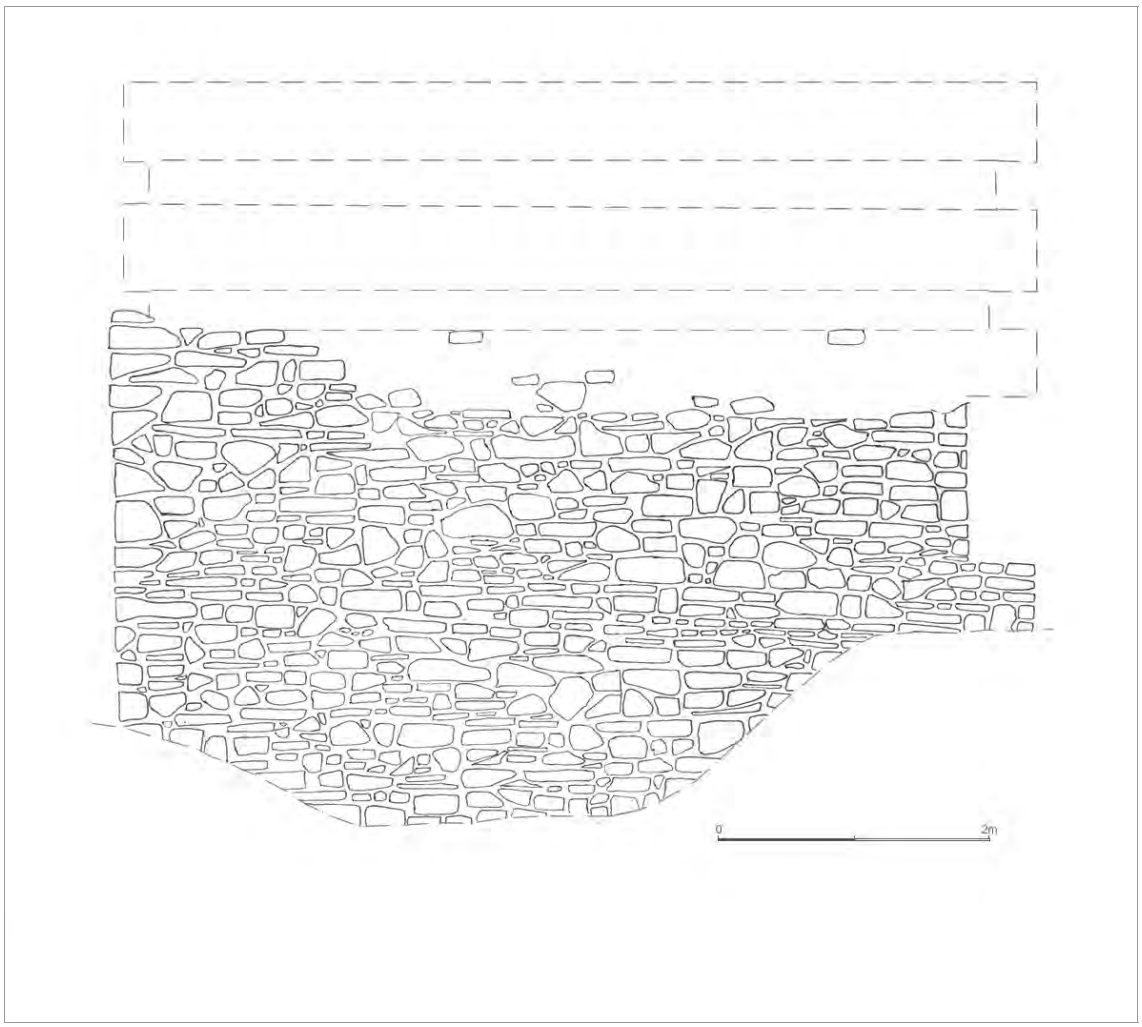

Fig. 14. Elevation drawing of the west wall

4. Structural Assessment of Bealkelly furnace[17]

The survey involved the visual inspection of each of the furnace structure and fabric elements within the site.[18] The purpose of the inspection is to identify works required to make the structure safe and to prevent further deterioration of the fabric. A more detailed assessment would be required to identify further works.

The data sheet assesses the condition of each building into five categories as follows:

> **Dangerous** – Serious health and safety issue. Immediate work required to be carried out for the safety of the fabric and users/public.
> **Poor -** Health and safety issue. Urgent work required to prevent active deterioration of fabric, and safety of users/public
> **Fair** – Necessary work needed. Work could be carried out at a later stage.
> **Good** – There is no necessary work needed. Desirable work maybe carried out for aesthetic reasons or adaptive use.
> **Excellent** – There is no work needed but item should be kept under observation

4.1 East wall

Dangerous	
Poor	✓
Fair	
Good	
Excellent	

There is a large crack formed in the arch of the East elevation. The crack begins at the bottom of the arch and extends approx 1m above the top of the arch. The arch is also badly damaged on its rear elevation (Fig. 15). Stone has been robbed out of the back of the arch exposing the inner arch stones and wall infill. The recessed section features some loose stones in risk of falling. The top section is covered by vegetation.

17 The information for this chapter was compiled from the relevant report composed by Architectural Conservation Professionals (Humphreys and Collins 2015)

18 The structure was surveyed on the 8th August 2015. The following schedules set out the survey notes of the individual buildings/elements. It must be noted that no opening up was carried out on walls etc., and that this report is based on a visual inspection. We can only comment on those items which were both visible and accessible at the time of our inspection. (ACP)

Works Required: Urgent

The crack in the arch should be monitored for further movement (Fig. 16). The rear of the arch should be repaired to match existing to prevent further collapse to the back of the arch. Any sections of loose or washed out masonry should be re-pointed with lime mortar to prevent further deterioration of the fabric. The recessed section should be re-pointed as necessary to prevent any loose stones from falling.

Fig. 15. Damaged interior of the East arch

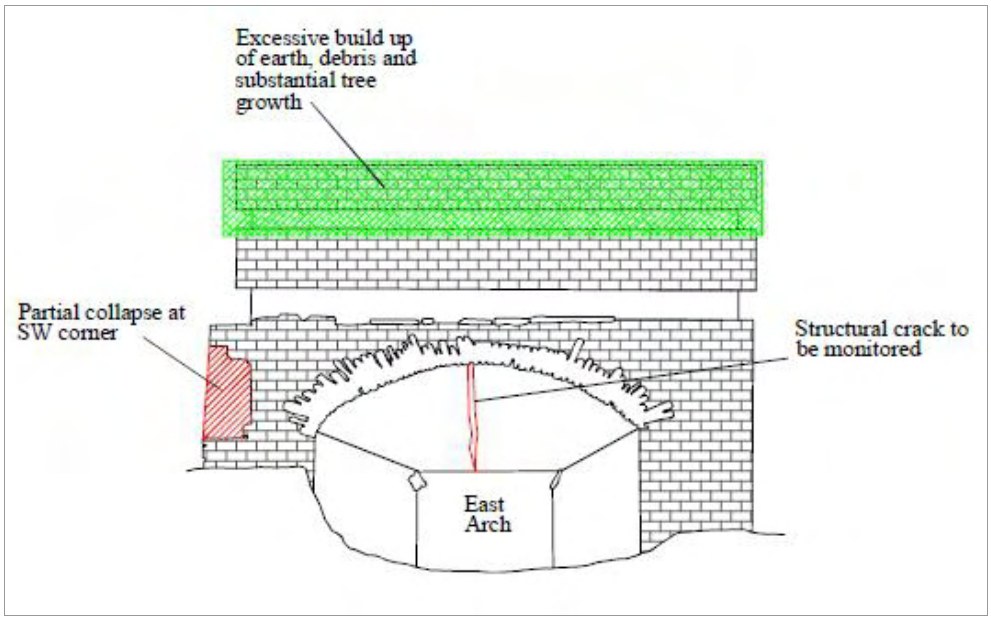

Fig. 16. Problem areas on the east wall

4.2 South wall

Dangerous	✓
Poor	
Fair	
Good	
Excellent	

The South elevation is in a poor condition as there has been much damage done to the arch (Fig. 17). There is a significant build up of stone and debris against the base of the wall obstructing the arch. Significant ivy growth is causing the displacement of masonry directly over the arch. The recessed section above the arch is filled with debris and vegetation. The bottom of the arch is also damaged and missing some stone (Fig. 18). The top section of the South elevation is covered by vegetation and not visible.

Works Required: Urgent

Urgent works are required to consolidate the arch and masonry overhead (Fig. 19). Re-pointing in lime mortar should be carried out to help prevent further collapse of stone from over and beneath the arch. Replacing the missing structural timber should be considered as a long term solution to this major structural problem.

Fig. 17. South Elevation Arch

Fig. 18. Internal damage to South arch

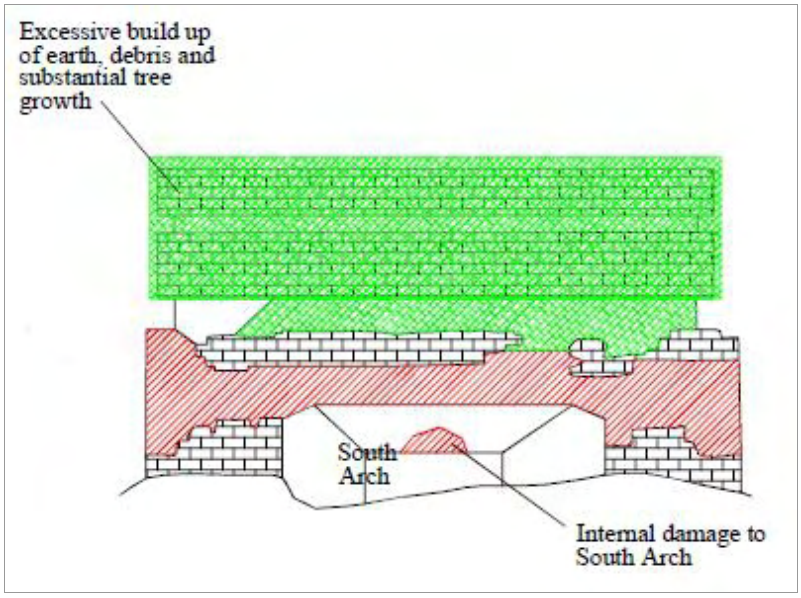

Fig. 19. Problem areas on the south wall

4.3 North elevation

Dangerous	
Poor	✓
Fair	
Good	
Excellent	

The North elevation is in a reasonably good condition apart from the wall top where vegetation and

tree growth is displacing masonry which may be in danger of falling (Fig. 20). The North walls features a strong stone buttress. There are two minor cracks on the wall either side of the buttress which should be monitored.

Works Required: Urgent

Removal and treatment of the trees and vegetation from the furnace top to prevent further displacement of masonry (Fig. 21). After the trees and vegetation are removed any loose stones along the wall tops should be re-bedded in lime mortar. Crack monitors should be installed on both cracks to investigate any present movement and action taken if necessary.

Fig. 20. North Elevation

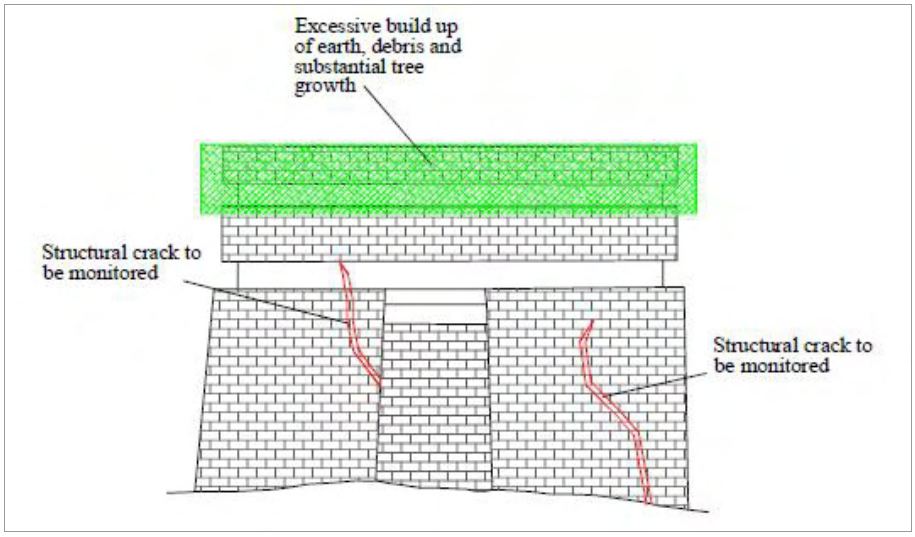

Fig. 21. Problem areas on the north wall

4.4 West elevation

Dangerous	
Poor	
Fair	✓
Good	
Excellent	

The West elevation in a generally good condition apart from the risk of falling stones from the wall top due to vegetation and tree growth (Fig. 22). There is extensive ivy growth on the top section of the wall.

Works Required: Urgent

Removal and treatment of vegetation and tree growth on the top section of the wall and wall top (Fig. 23). Localised re-pointing of washed out joints.

Fig. 22. West Elevation

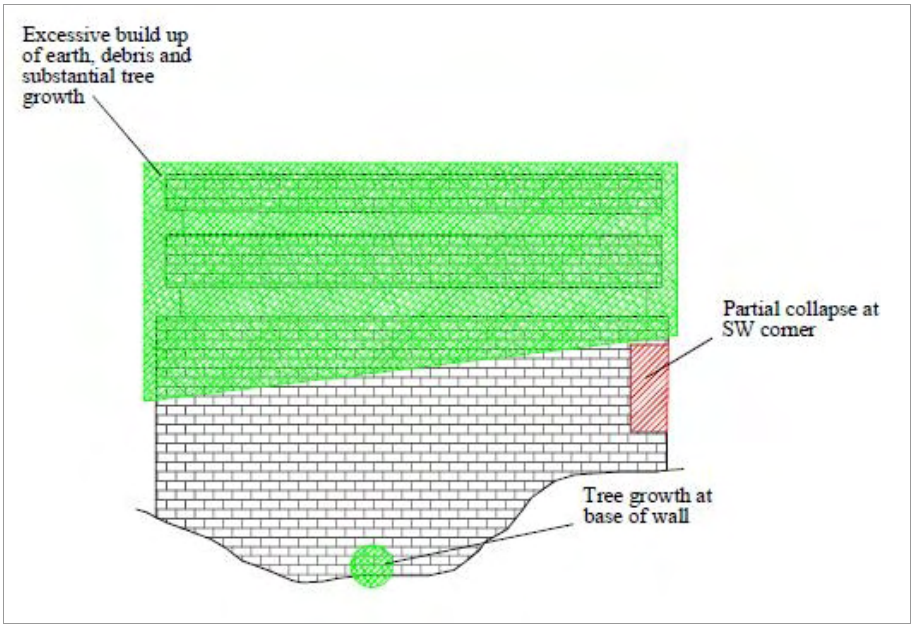

Fig. 23. Problem areas of the west wall

4.5 Furnace interior

Dangerous	✓
Poor	
Fair	
Good	
Excellent	

The interior of the furnace is in a fair condition with much of the original flue lining still existing (Fig. 24). There is much evidence of use in the form of soot and burned materials. The inside of the South and East arch are damaged.

Works Required: Urgent

Removal and treatment of vegetation and tree growth on the top section of the chimney opening. Consolidation works should be carried out to the damaged arches to prevent further structural failure.

Fig. 24. Inner chimney looking up

4.6 Recommended and Urgent Repair Works

The following works are required to prevent any further deterioration of the structures fabric and prevent also any further structural failures.

Urgent

- Securing of all loose and dislodged stones from the wall tops and inner chimney areas. The removal of some stones may be necessary to remove excessive vegetation. The trimmed back vegetation should be treated prior to the stones being re-bedded in lime mortar.
- Removal and treatment of the trees growing on the furnace top. Further investigations are necessary prior to removal of any tree to be certain it is not providing any structural support to the stone structure.
- Re-point and make good the damaged East and South arches to prevent further structural failure. The replacement of the South arch structural timber beam should be considered.
- A crack monitor should be placed on the crack in the East arch and both cracks on the North elevation. These monitors should be checked periodically over a number of months and action taken to stitch the cracks if necessary.

Necessary

- Re-pointing in lime mortar of the two recessed sections around the furnace upper section to prevent further deterioration of the fabric.

5. Bibliography

Nott. Arch.: Nottinghamshire Archives

Barnard T. 1982 Sir William Petty as Kerry Ironmaster. *Proceedings of the Royal Irish Academy. Section C: Archaeology, Celtic Studies, History, Linguistics, Literature* 82C:1-32.

Barnard T. 1985 An Anglo-Irish Industrial Enterprise: Iron-Making at Enniscorthy, Co. Wexford, 1657-92. *Proceedings of the Royal Irish Academy. Section C: Archaeology, Celtic Studies, History, Linguistics, Literature* 85C:101-144.

Humphreys D. and Collins S. 2015 *Structural Assessment Report For Blast Furnace at Bealkelly, Co. Clare* Architectural Conservation Professionals Ltd., Unpublished report.

Kinahan G. H. 1870 On the Ancient Iron Trade of Ireland. *Scientific Opinion* 3:460-461, 480-481, 501-502.

Lewis S. 1837 *A Topographical Dictionary of Ireland*. London, Samuel Lewis & Co.

Rondelez P. 2014 *Ironworking in late medieval Ireland, c. AD. 1200 to 1600*. Unpublished PhD thesis, Department of Archaeology, University College Cork.

Rondelez P. In Press The metallurgical enterprises of Richard Boyle, First Earl of Cork. In Edwards D. (ed.). *Proceedings of the 'The World of Richard Boyle, 1st Earl of Cork, 1566-1643' Conference, University College Cork, 21-22 June 2013*. Manchester, Manchester University Press

Rondelez P., Humphreys D. and Collins S. 2015a *Conservation Management Plan for the Blast Furnace Remains at Ballyvannan, Co. Clare*. Unpublished report, The authors.

Rondelez P., Humphreys D. and Collins S. 2015b *Conservation Management Plan for the Blast Furnace Remains at Derryoober, Co. Galway*. Unpublished report, The authors.

Rondelez P., Humphreys D. and Collins S. 2015c *Conservation Management Plan for the Blast Furnace Remains at Whitegate, Co. Clare*. Unpublished report, The authors.