

Archaeology Wales

Raby's Furnace, Furnace, Llanelli

Archaeological Watching Brief



By

Philip Poucher

Report No. 1192



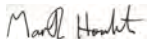
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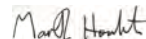
Archaeology Wales

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Non-Technical Summary

In September/October 2013 Archaeology Wales Ltd carried out an archaeological watching brief during essential repair works on a collapsed section of culvert at Raby's Furnace, Llanelli. The culvert is part of a modern water-management system, but also lies within Scheduled Ancient Monument Cm219. The watching brief was commissioned by Natural Resources Wales (NRW) and undertaken in accordance with the conditions of the Scheduled Monument Consent for the scheme, which was granted to NRW by Cadw prior to the start of works.

Raby's Furnace is a late-18th to early 19th century ironworks lying within a narrow, steep-sided, valley in Furnace, on the north side of Llanelli. Along with its owner, Alexander Raby, the site formed a key part of the early development of industrial Llanelli. The stone culvert is believed to have been constructed at the turn of the 19th century.

The collapse of the culvert opened a hole, c.5m square and at most 4.1m deep. Subsequent water scouring removed all remains of the culvert, but its downstream (southwards) continuation was visible in section, as were overlying deposits. The repair works included the partial excavation of an access ramp, the clearing of an area around the collapse, the straightening of the sides of the collapse, and the insertion of shoring to allow a new metal pipe to be placed across the collapsed area to join with the remaining stone culvert to the south.

No features or deposits of archaeological interest were noted during the excavation of the access ramp or the clearing of the area around the collapse. Material overlying the western side of the valley and surface deposits in the base of the valley appeared to consist of imported or disturbed modern material. The depth of the collapse and the unstable sides of the resulting hole restricted accurate measured recording of the culvert and overlying deposits, although descriptions of features, photographs and roughly measured sketch drawings were made.

The culvert itself was built of lime-mortared slate blocks. It had an arched roof and was 1.3m wide and 1.1m high. Originally built level with the surrounding natural deposits, it was subsequently covered by c.1.5m of material, including waste from ironworking processes. A subsequent re-cut to access the culvert was made, either for repair or maintenance work, or possibly during the construction of an adjacent manhole. This too was backfilled with waste material from ironworking processes. No finds were recovered from these deposits, which lay under 1.0m to 1.5m of modern topsoil and disturbed ground. It appears that, from the point of the collapse southwards, the culvert survives in a relatively good condition. However, to the north of the point of collapse, little remains. Surrounding deposits appear to contain little of archaeological value.

1 Introduction

- 1.1 In September 2013 Natural Resources Wales (NRW) commissioned Archaeology Wales Ltd (AW) to undertake an archaeological watching brief during repair work being undertaken at the site of Raby's Furnace, in Furnace, Llanelli.
- 1.2 Raby's Furnace is the site of 18th and 19th century industrial remains associated with iron-working and lies within a steep-sided narrow valley in Furnace, to the north of Llanelli (NGR SN 50381 01574). The site is fed from the north by the Cille Stream, which flows through a series of stone culverts originally associated with the industrial activity. The site, encompassing the culverts, is designated as a Scheduled Ancient Monument (SAM Cm219).
- 1.3 NRW has responsibility for the upkeep of the water management system associated with the culverts. Regular repairs to the culverts are required to maintain the system. Previously, a section of culvert had collapsed and was repaired, while a recent CCTV survey revealed that a

further section to the south of this had also collapsed. Both sections are within the Scheduled Ancient Monument. As a consequence of the recent collapse, Scheduled Ancient Monument Consent was granted by Cadw for essential repair works at the site. This was subject to several conditions, including requirements:

1. that the applicant shall appoint a suitably qualified and experience archaeological contractor for the project
2. that the archaeological contractor shall work with the engineers and provide archaeological input into the details of the proposed works, in order to minimise the historic environment impact of the scheme
3. that an archaeological written scheme of investigation (phased if necessary) shall be supplied to Cadw for approval in advance of any works beginning. It is expected that this will include a desktop/background element, along with a watching brief and, if necessary, evaluation works

1.4 An archaeological written scheme of investigation (WSI) was prepared by AW in accordance with the *Standard and Guidance for Archaeological Watching Briefs* (IfA 1994, revised 2011) and was designed to provide an approved scheme of archaeological work to be implemented during the construction works (Appendix I). This WSI was approved by Cadw prior to the works commencing.

1.5 The scope of the construction work to be undertaken at the site included the construction of a ramp down the western side of the valley, partly cut into the side of the valley and partly built-up, to allow access for machinery and materials to the valley floor and culvert. The area around the collapse was scoured to ascertain the extent of the collapse and then an area opened up and secured around the collapse for repair work and re-piping to be undertaken. A new culvert was inserted on the same line and level. Vegetation clearance works had previously been undertaken and the immediate area had been fenced off to prevent public access. This work was undertaken in September and October 2013.

1.6 All work conformed to the IfA's *Standard and Guidance for Archaeological Watching Briefs* (IfA 1994, revised 2011), and were undertaken by suitably qualified staff to the highest professional standards. The AW Project Number for the work is 2171.

2 Site Description

2.1 The Cille Stream flows down a narrow, steep-sided, valley (photo 1) from the Tre-Beddrod Reservoir and into Furnace, on the northern edge of Llanelli (NGR SN 50381 01574). The valley runs alongside the B4309. The main settlement of Furnace lies immediately to the south of the site, with residential development spreading up above the eastern side of the valley and sporadic housing along the western side. The valley itself is largely wooded, with farmland and a former quarry to the north.

2.2 The stream was culverted in the late-18th or early-19th century in connection with an iron smelting furnace built at the southern end of the valley. At the northern end of this section of valley the stream would have emerged from openings within a stone-built retaining wall (photo 3), part of the 18th century industrial complex within the valley. The retaining wall formed a reservoir to the north, controlling water that could then flow down leats along the valley sides to feed the ironworking processes to the south. The main stream flow itself

appears to have pooled at the base of this wall and was then carried in a culvert running centrally down the valley.

- 2.3 In more recent years, the culvert has been rebuilt at the northern end of the valley. This new, concrete, culvert takes the stream to the west of the original retaining wall outlets, linking up with the original culvert along the valley floor. Subsequently, a section of the original culvert at the northern end of the valley collapsed and was partially replaced with a new metal pipe inserted partway into the original culvert.
- 2.4 Recently, the next section of culvert collapsed, at a point where the inserted metal pipe ended. This is the section that required replacement as part of the current scheme of works.
- 2.5 The underlying solid geology comprises sedimentary sandstone of the Hughes Member (BGS 2013).

3 Historical Background

- 3.1 The following historical summary of the site is based largely on research undertaken by R. Protheroe Jones on behalf of Cadw (2004). This was itself based in part on earlier work by Craig, Protheroe Jones & Symons (2002).
- 3.2 Raby's Furnace is a late-18th to early-19th century iron works (PRN 4491, NPRN 40418) located in Furnace, to the north of Llanelli. It is possible there may have been a charcoal-powered blast furnace at the site in the mid-18th century, but the first positive evidence of iron smelting comes from the 1790s. In c.1793 the site was leased to John Gevers and Thomas Ingman, possibly with the financial backing of Alexander Raby. They built a blast furnace along with a water-powered blowing engine to provide the blast. It is likely the main water storage reservoir, which was located a short distance further up the valley, was built at this time.
- 3.3 The site had probably only been in operation a couple of years in 1796 when Alexander Raby bought it and began investing in the local area. Raby was an important figure in the history and development of Llanelli, and played a major role in the development of the local iron and coal industries, as well regionally in the shipping and railway industries. He also built Furnace House adjacent to the ironworks as his main residence. After taking over the ironworks, Raby enlarged the site, adding a 2nd furnace and iron foundry around 1800. It is likely this instigated a complete remodelling of the works. The original layout is unknown, no plans exist prior to 1814, but a possible configuration has been drawn by R. Protheroe Jones (Fig. 2). The remodelling probably included the introduction of a steam-powered blowing engine. In the early years of the 19th century Raby helped finance a 16 mile long tramroad inland from Llanelli docks to help export limestone, iron ore and anthracite coal. The limestone and iron ore were both used in the ironworks. In 1805, two blast furnaces are recorded at the site, with a combined output of 2267 tons of iron per annum. At some point during this period the site was reputedly making cannonballs for use during the Napoleonic Wars. Raby had interests in various industrial concerns throughout south and west Wales; he was also a partner in a Derbyshire ironworks. As a consequence he over-extended himself, which, alongside financial mismanagement, meant that by 1806 he was in financial difficulties. The blast furnaces at Llanelli ceased production in 1807 and in the same year Raby was declared insolvent. In 1811 Raby, along with his son, resumed operational control over many of his industrial concerns in the area. It does not appear that the ironworks were restarted. However, the iron foundry on the site appears to have remained in use.
- 3.4 The earliest plan of the site is dated to 1814 (Fig.3), post-dating the operational use of the blast furnaces. The iron foundry was let to William Yalden & Co. in the previous year and the plan helps reconstruct the possible layout of the works during the second phase of operation

at the start of the 19th century (Fig.4), after Raby's investment and enlargement of the site. It is suggested (Protheroe Jones 2004) that the stream was culverted during this second phase, around the turn of the 19th century.

- 3.5 Close to the site of the collapse, and in the area of the access ramp, lies a building with an enclosure to its south. The function of the building is unclear. It only appears on the 1814 plan, where it is unlabelled. With its attached enclosure it has the appearance of a cottage, slightly detached from the main ironworks complex to the south. However, it is sited within the base of the valley, and largely cut off by a tramway that runs along the upper edge of the western valley slope, giving the impression that it is connected to the ironworks in some fashion.
- 3.6 In 1817 the iron foundry was let to Hugh Thompson Waddle who appears to have continued operating the foundry until the mid to late-1820s when he relocated to Lanmore. It appears that this was the last industrial use of the site.
- 3.7 At some point during the 19th century one of the blast furnaces was demolished. Work also started on the demolition of the 2nd blast furnace but was never complete. It is not clear if this was during the working life of the iron foundry, or was undertaken once industrial activity on the site had ceased by the late 1820s. The remaining furnace still stands and is now a Grade II* listed structure (PRN 60828, NPRN 92882). Part of the retaining wall located at the northern end of the valley also still survives. It is possible that remains of the original water leat, which supplied the works, still survives in the undergrowth along the upper slopes of the steep eastern side of the valley.
- 3.8 By the time the 1st edition Ordnance Survey map was drawn up in 1880 (Fig.5), many of the buildings within the industrial complex had been removed, although some buildings formerly belonging to the ironworks may have been reused at the southern end of the valley. One of the furnaces is still marked on the map. Boundaries and footpaths adjacent to this 'old furnace' may indicate that this area had been landscaped. To the northwest of the valley, a large quarry had opened up and the recorded topography on the map suggests waste quarrying material had spilled into the north-western end of the valley. The collapsed section of culvert appears to be located at a point where the culvert begins to run underground. The valley had become largely wooded by this stage.
- 3.9 The former tramway along the top of the western side of the valley is not shown on the 1880 Ordnance Survey map; it apparently went out of use in 1820. The line of the tramway has been replaced by that of a road, the current B4309, and its adjacent pavement.

4 Methodology

4.1 Aims and Objectives

4.1.1 The aims of the watching brief, as defined by the IfA (2011) are:

- To allow a rapid investigation and recording of any archaeological features that are uncovered during the proposed groundworks within the application area.
- To provide the opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological find has been made for which the resources allocated to the watching brief are not sufficient to support the treatment to a satisfactory or proper standard.
- To establish and make available information about the archaeological resource existing on the site.

4.2 Watching Brief

- 4.2.1 The archaeological watching brief was undertaken during the excavation and construction of the access ramp down the valley-side, and during the scouring and clearance of the valley base, to allow access, and assess the extent of the damage, to the collapsed area, and during any clearance work within and around the edges of the collapse.
- 4.2.2 Excavation and clearance works was undertaken by a mechanical excavator using a toothed bucket (due to the presence of rubble and undergrowth across the site) under archaeological supervision.
- 4.2.3 The base of the collapsed area was c.3m deep. Therefore, shoring was brought in to provide a safe working area for the repair work. This did not, however, allow a close examination of the surviving section of the stone culvert. Along with potentially unstable overhanging deposits around the edge of the collapse it was not possible to undertake accurately measured and levelled drawings of the culvert and surrounding deposits. Records consisted of high resolution digital photographs (using a 14MP camera), sketch drawings and written AW context sheets.
- 4.2.4 The on-site archaeological work was undertaken by Jerry Bond and Philip Poucher. The overall management of the project was by Philip Poucher.
- 4.2.5 All works were undertaken in accordance with the IfA's *Standards and Guidance for an archaeological watching brief* (2011) and current Health and Safety legislation

4.3 Finds

- 4.3.1 No finds were recovered during the course of these works.

4.4 Palaeo-Environmental Evidence

- 4.4.1 No deposits suitable for environmental sampling were encountered during the course of the excavation.

5 Results

5.1 Access ramp and scoured area (photos 1 & 4 – 6)

- 5.1.1 To gain access to the collapsed area it was necessary to create a ramp down the side of the steep-sided valley and scour out the area around the top of the collapsed culvert.
- 5.1.2 Although several possible locations for access down the valley side were discussed, in the event the most convenient and accessible place was opposite the existing properties (Rock House & Isfryn) fronting the road that runs to the west of the site. This location was chosen despite concern that the proposed work could expose remains related to a tramway, and a building and enclosure of unknown function, depicted on historic map sources (Fig.3).
- 5.1.3 The access ramp was 2.8m wide and ran in a southeast direction for c.15m. The western edge of the ramp cut into the valley edge to a depth of 0.8m; the eastern edge and south-eastern end of the ramp was created from built-up material. Where the valley-side was exposed it consisted of a loose, dark brown-grey, sandy-silt with abundant medium to large sub-angular stones. No archaeological features were exposed by, or present within, this deposit, which appeared to consist of imported modern material, possibly associated with road widening activity, previous work on the culvert or quarrying waste. The very loose nature of the material suggested a relatively modern date; no finds were recovered.
- 5.1.4 In order to both access and assess the area of collapsed culvert, an area c.32m long by c.7m wide at the base of the valley was cleared of vegetation and landscaped. This work exposed surface deposits across the entire area, all of which could be readily associated with modern disturbances, presumably those associated with previous culvert repair work undertaken immediately to the north. Nowhere were original ground levels or pre-modern disturbance deposits uncovered. No evidence of the previous tramway or early-19th century structures was revealed. At the same time, a section of ground on the western side of the valley was exposed to allow for the passage of machinery onto the site. This revealed material at the base of the slope that corresponded closely to that exposed by the cutting of the access ramp, suggesting the upper deposits on the western side of the valley at this point also consists of imported modern material.

5.2 Culvert (Figs. 6 & 7, photos 7 – 25)

- 5.2.1 A section of culvert c.5m in length had collapsed, roughly from the point at which the modern pipe inserted during the last phase of repair work ended. This pipe had been inserted into the existing stone culvert, but this appears to have concentrated the flow of water, which was clearly very strong, onto specific points of the culvert, weakening and eventually collapsing the stonework. The water then washed away the stonework and scoured out an area several metres in diameter eventually causing the ground to collapse.
- 5.2.2 To expose the collapse and allow shoring and repair work to be undertaken, overhanging material was removed to straighten the edges, eventually exposing an area c.5.5m long by 5m wide, and at most 4.1m deep below current ground levels. This revealed the surviving end of the existing stone culvert, as well as backfilling deposits, original ground levels, and modern overburden. In the following summary of the records made by the watching brief archaeologist, it is important to note that accurate measurement was not always possible, because access was restricted by safety considerations.
- 5.2.3 The culvert (overall context no. 100) is built of stone and has a flat base, straight sides and an arched roof. It encloses a space 1.3m wide and 1.1m high.

- 5.2.4 The walls of the culvert (walls 101) are vertical, straight-sided and built of squared, slate, blocks, keyed in with alternating courses of narrower slate slabs, all set within a firm lime-mortar. The arched roof (arch 102) is built of c.20 flat slate blocks, roughly cut, occasionally wedge-shaped, with a wedge-shaped central key stone. These are all held together in a firm lime-mortar. The base of the culvert, which lay below the waterline, is formed by rectangular slate blocks (structure 103) laid vertically and aligned with the flow of the water. Sat on top of the stone base is a series of wooden beams (structure 104), which extend the width of the culvert and tie into the side walls. Where these wooden beams exist, the internal height of the culvert reduces to 0.95m. The beams appear to have been laid in pairs set approximately 0.5m apart.
- 5.2.5 Two, possibly three, construction cuts associated with the culvert are visible. The original construction cut (cut 106) can be seen along the eastern side. It has a very shallow break of slope at the top, for a depth of c.0.5m, before becoming vertical to encompass the side-walls of the culvert. These walls appear to be built against the material exposed by the cut, namely mid grey, naturally occurring, clays (deposit 105) containing occasional large sub-angular stone inclusions. The shallow top of the cut is roughly level with the arched roof of the culvert. The wider, upper part, contains backfill material consisting of very large angular slate stones set within mid brown-grey silty-clay (deposit 107). This is spread over the top of the naturally occurring clays and is visible throughout the eastern side of the exposed area.
- 5.2.6 Overlying this deposit is a layer of medium to large angular stones set within a silty-clay matrix (deposit 108), possibly consisting of two separate but very similar layers, distinguishable mainly through slight variations in colour. This in turn is overlaid by a thick deposit of moderate, mid brown silty-clay with abundant medium-large sub-angular stones (deposit 109). These layers appear to be both stony backfill and levelling layers, building up the ground levels around and above the culvert. They are capped with a thin, light reddish-brown, mortar-rich layer (deposit 110).
- 5.2.7 Overlying this are intermingled layers of dark grey and orange, stony, ashy-grit, that appear to represent waste material from the ironworking process (deposit 111). These deposits suggest that, at the time of its construction, the top of the culvert ran along ground levels. However, subsequently it appears to have been buried by around 1.5m of material, presumably during the working life of the furnaces.
- 5.2.8 A second cut-line (cut 112) is visible as an insertion through these overlying layers (deposits 107 – 110). It has steep, slightly concave sides, which again are largely visible only on the eastern side, as tumbled material obscures the western side. It extends down to the arched roof of the culvert, presumably for later repair or maintenance works, or possibly for work associated with the construction of a nearby manhole, located c.3m to the south. The cut is backfilled with a series of ashy-gritty deposits (deposits 113 – 138), all of which appear to represent waste material from furnace workings. Tip lines within these deposits indicate that they were tipped in from the western side of the valley base.
- 5.2.9 A distinctive change between the yellowy-orange ashy-gritty material that comprises deposit 116 and the mid brown silty-clays of deposits 129 & 134, suggests a further re-cut is present within these deposits (cut 131). The purpose of the cut is unclear, as it does not appear to have given access any part of the culvert structure; perhaps it resulted from the removal of material from within the infilling deposits themselves. This part of the sequence suggests that the infilling of re-cut 112 occurred gradually.
- 5.2.10 As a close examination of the exposed sequences was not possible, and the in-filling materials described above were similar, it cannot be stated with any certainty whether the later construction cut (112) cuts through layer 111 or is capped by it; deposit 138 may represent a continuation of deposit 111.

- 5.2.11 These deposits were overlaid by c.1m to 1.5m of dark, grey-brown, clayey-silt mixed with stony-ashy deposits. This was a very mixed deposit representing a combination of topsoil and material formed by past landscaping and repair works.
- 5.2.12 No finds were recovered from, or visible within, any of the deposits underlying the modern topsoil.

5.3 Manhole (photos 26 & 27)

- 5.3.1 Located c.3m to the south of the collapsed area was a manhole that gave access to the culvert. It consisted of a square, vertical, shaft, 0.8m by 0.8m in plan, 3.6m deep to the base of the culvert, and 2.2m down to the top of the arch.
- 5.3.2 For 1.7m above the roof of the culvert, the manhole was built of very-large, roughly-squared, roughly coursed slate set in a lime mortar. The sides of the manhole were straight and vertical, and there was no evidence of a built-in access ladder.
- 5.3.3 The upper 0.5m of the manhole shaft was constructed in rough, un-mortared, very large slate slabs, which curved inwards slightly to narrow the opening, presumably for supporting a covering hatch.
- 5.3.4 This stonework was covered in a modern concrete pad that was c.0.2m thick and had a central rectangular metal hatch covering to allow access.

5.4 Repair works

- 5.4.1 The archaeological watching brief ceased when the exposed deposits had been recorded, thus allowing repair work to the culvert to be undertaken. This work comprised attaching a new metal pipe to the existing one exposed at the northern end of the area of collapse. This pipe was then inserted into the stone culvert as far as the manhole. This new section of pipework incorporated a downward curve to take some of the force of the water flow out of the pipe and prevent the scouring effect that had occurred at the end of the previous section of pipework. No *in situ* remains or collapsed remnants of the original stone culvert survived in the area of collapse, so this section of pipe was encased in concrete and in-filled with imported material.

6 Conclusions

- 6.1 The watching brief described in this report was undertaken by Archaeology Wales during essential repair works that took place on a collapsed section of stone culvert associated with Raby's Furnace, a late 18th and early 19th century ironworks in Furnace, on the northern edge of Llanelli. The site is Scheduled Ancient Monument (Cm219), and forms an important part of a modern-day water management system that is maintained Natural Resources Wales.
- 6.2 The culvert runs down the centre of a narrow, steeply sloping, valley and was originally part of the water management system connected to the ironworks. Although the iron furnace works were established in the 1790s, it is believed the stream was culverted as part of a redevelopment of the site around the turn of the 19th century. The blast furnaces ceased produced in 1807, although an iron foundry remained in operation on the site until the mid to late-1820s. The culvert has remained in use to the present day. A section of the culvert had previously collapsed and been replaced immediately to the north of the current area of collapse.
- 6.3 This previous work appears to have contributed to the collapse of the current section. An area, c.5m in length, had fallen in and the strong flow of water exiting from the repair pipe associated with the previous repair had removed the culvert in this area.
- 6.4 At the edges of the section, enough of the culvert was revealed in section to show a well-built structure consisting of slate blocks bonded with lime-mortar, enclosing a space 1.3m wide and 1.1m high. It had an arched roof and a stone and timber base. The culvert had originally been cut into natural clays with the top of the arch level with the original ground level. The area then appears to have been backfilled to a depth of c.1.5m, with material that included large amounts that are assumed to comprise waste from the ironworks.
- 6.5 Subsequently, a cut was made into the overlying material to gain access to the top of the culvert. This was presumably either for repair work to the culvert or connected to the construction of a manhole access shaft c.3m to the south of the collapsed area. This later cut was also in-filled with what appeared to be waste material from the ironworks, so it probably occurred either during the working life of the furnace or subsequently during the demolition works that occurred during the earlier part of the 19th century.
- 6.6 The site was covered in c.1m to 1.5m of modern disturbance. The construction of an access ramp and general scouring that cut into the western side of the valley showed that this area also contained large deposits of modern material. The material is likely to have come from a variety of sources, including nearby 19th century quarries to the north, modern road widening and improvement works on the adjacent B4309, and recent repair works on the culvert to the north.
- 6.7 From the point of the current collapse northwards, it is clear that little remains of the original stone culvert, and that surrounding deposits are of limited archaeological value.

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National Monuments Record for Wales, held and maintained by the Royal Commission on the Ancient and Historical Monuments of Wales



Photo 1: View south down the small valley along which the culvert runs. Showing the area of collapse and the extent of the scoured area at the valley bottom.



Photo 2: View north up the valley. The wall on the right is associated with the former ironworks, the machine is sat at the southern edge of the collapsed area.



Photo 3: View northeast of the retaining wall at the northern end of the valley associated with the former ironworks.



Photo 4: West facing shot of the ramp created to gain access to the valley bottom.



Photo 5: West facing shot of the modern deposits revealed by the creation of the access track. 2m scale.



Photo 6: West facing shot of the edge of the scoured area at the base of the valley. Showing the current profile of the western side of the valley is made up of loose modern material. 2m scale.

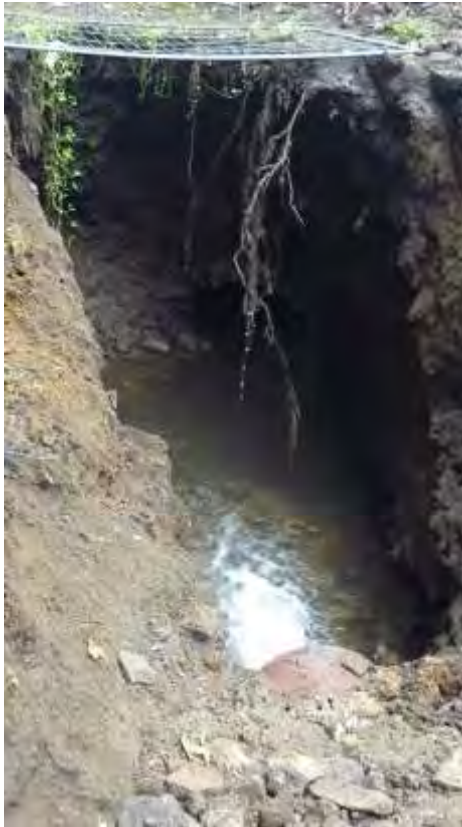


Photo 7: South facing shot of the area of collapse, with the surviving section of culvert visible at the rear.



Photo 8: View of the collapsed area, facing southeast.



Photo 9: West facing shot of the northern end of the collapsed area, showing the pipe inserted through the culvert in the previous stage of repair work.



Photo 10: Close-up of the inserted pipe. The remains of the stone culvert is visible on either side of the pipe.



Photo 11: South facing shot of the surviving section of culvert showing the depth of material above it.



Photo 12: Facing south, showing the surviving section of culvert and the extent of the shoring within the collapsed area, demonstrating the difficulties of getting a detailed recording of the surviving culvert.



Photo 13: Facing south, surviving section of culvert with 2m scale. Taking scale photos was not feasible due to overhanging deposits.



Photo 14: As photo 10, but without scale.



Photo 15: Detail of arched roof of culvert.



Photo 16: South facing view down the surviving section of culvert. The opening for the manhole is visible in the roof of the culvert a short distance in.



Photo 17: Oblique shot showing more detail for the western wall and arched roof of the culvert. Again the manhole opening is visible in the roof of the culvert.

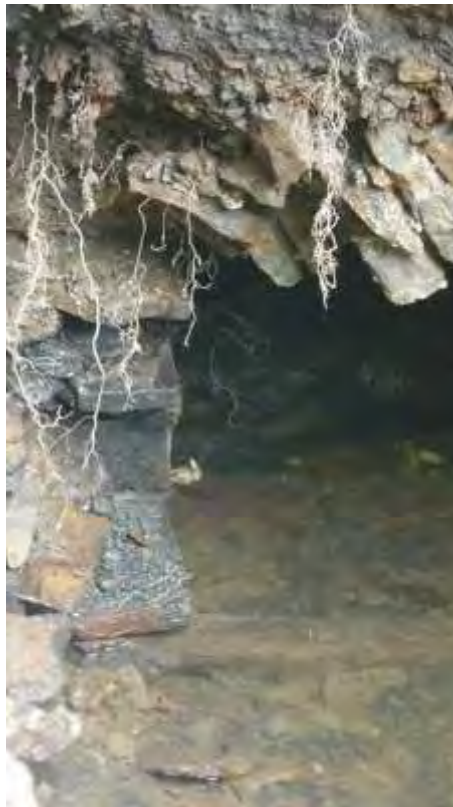


Photo 18: Detail of the eastern wall of the culvert, also showing the tied-in wooden beams along the base of the culvert.



Photo 19: Southwest facing shot showing the wooden beams along the base of the culvert



Photo 20: Southwest facing shot showing original natural stone and clay deposits into which the culvert is cut, with backfill deposits above.



Photo 21: Backfill deposit visible in section above the culvert. Shows tip lines coming in from the west, and iron staining suggesting these deposit derive largely from waste material from the iron working processes.



Photo 22: Backfill deposits above the culvert, also showing the dark layer of modern disturbance and overburden at the top. The partial scale shown is a 2m scale, divided into 0.5m segments.

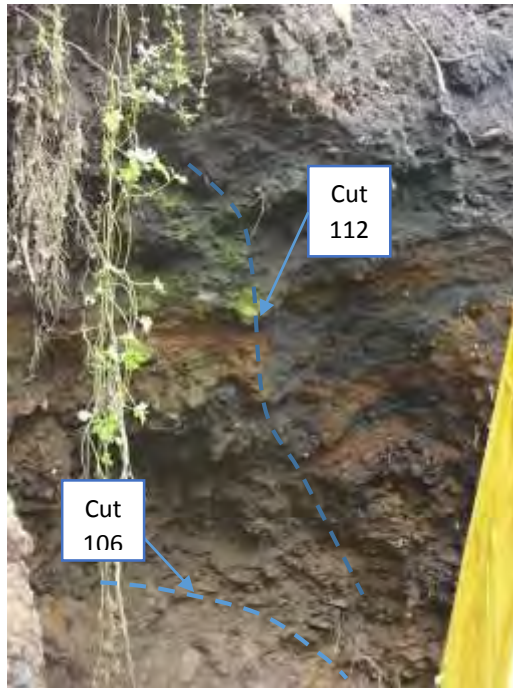


Photo 23: South facing shot of the deposits revealed above the culvert, showing the original construction cut (106) and the later re-cut (112).



Photo 24: East facing, and slightly downward view of the deposits revealed in the side of the collapsed area. Showing natural stone and clays at the base, overlaid by large amounts of presumed 19th century material that appeared to cover the line of the culvert. The dark deposit of modern disturbance and overburden is visible at the top.



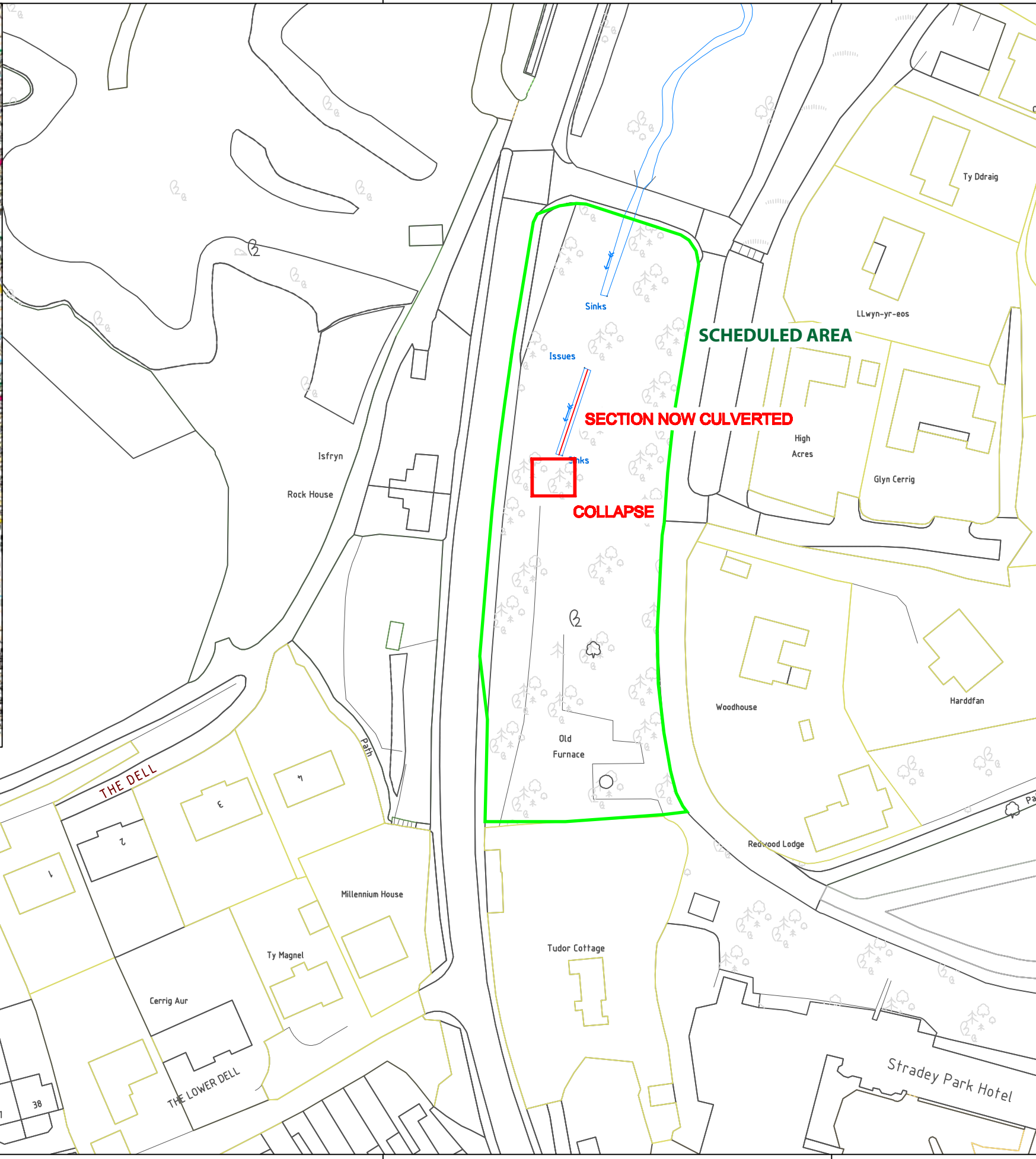
Photo 25: Northeast facing shot of the deposits revealed towards the southern end of the collapsed area. Deposit 110 is clearly visible.




Photo 26: East facing shot of the manhole opening, showing the line of the culvert at the base running left to right and the mortared wall of the shaft topped by unmortared slightly corbelled stonework now carrying the modern concrete and metal manhole cover.



Photo 27: West facing shot showing the opposing side of the manhole shaft.



NOTES		
SITE ADDRESS:		
NEW ROAD (B4309), FURNACE, LLANELLI, CARMARTHENSHIRE, SA15 4HB		
Fig. 1: Site location plan, showing Scheduled Area and area of culvert collapse.		
DATE	AMENDMENTS/ISSUES ↑	No.
 Cyfoeth Naturiol Cymru Natural Resources Wales South West Wales Area Plas Gwendraeth, Heol Parc Mawr, Cross Hands Business Park, Carmarthenshire, SA14 6RE Tel: 01554 713602, Fax: 01269 831704		
SCHEME No.		
TITLE		
CILLE STREAM CULVERT REPAIR		
DWG.		
LOCATION PLAN		
SCALE	1:1000 at A3	
DRAWN	CHECKED	DATE
RH	LTF	10/6/2013
DRAWING No.	REV.	
150/CILLE/13/001		

Dwg. No.

Project

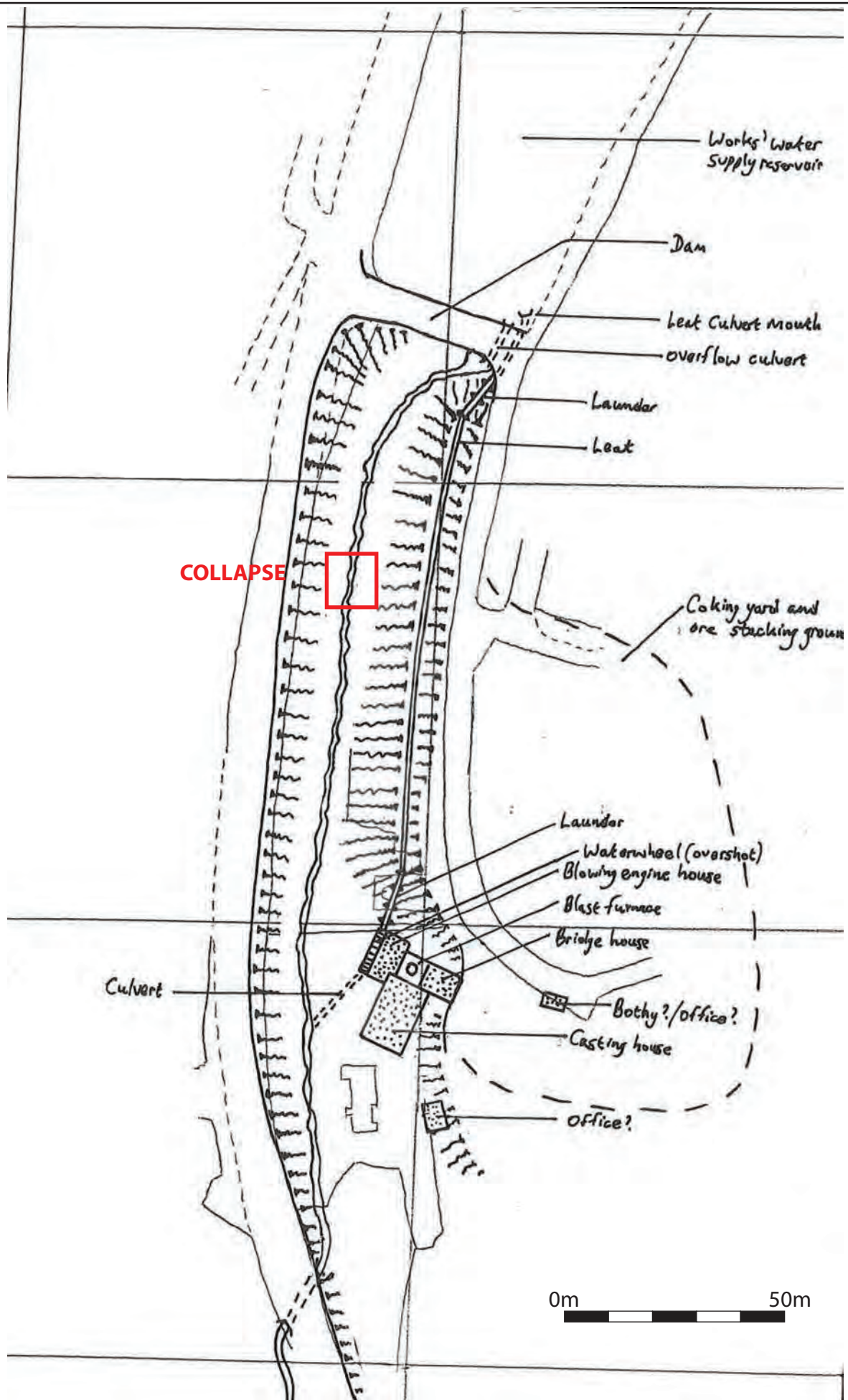


Fig. 2: Projected layout of the main industrial features at Raby's Furnace at the end of the first phase of development in c.1794. Superimposed onto modern OS detail. Image provided by Robert Protheroe Jones for Cadw, 2004.

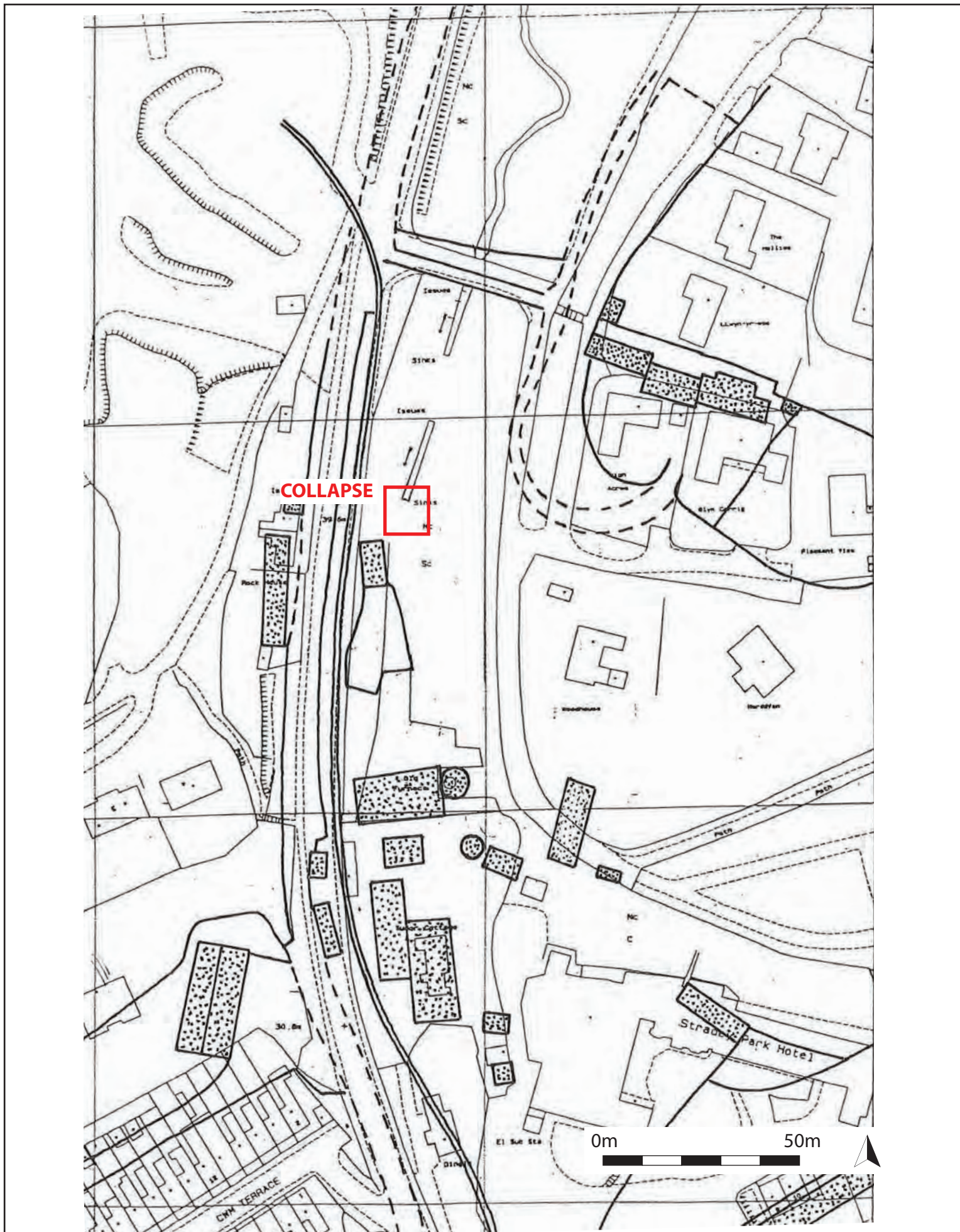


Fig. 3: Detail from Llanelli Public Library Plan 9, dated 1814, showing the layout of the industrial complex and surrounding buildings. Overlaid on modern OS detail. Image provided by Robert Protheroe Jones for Cadw, 2004.

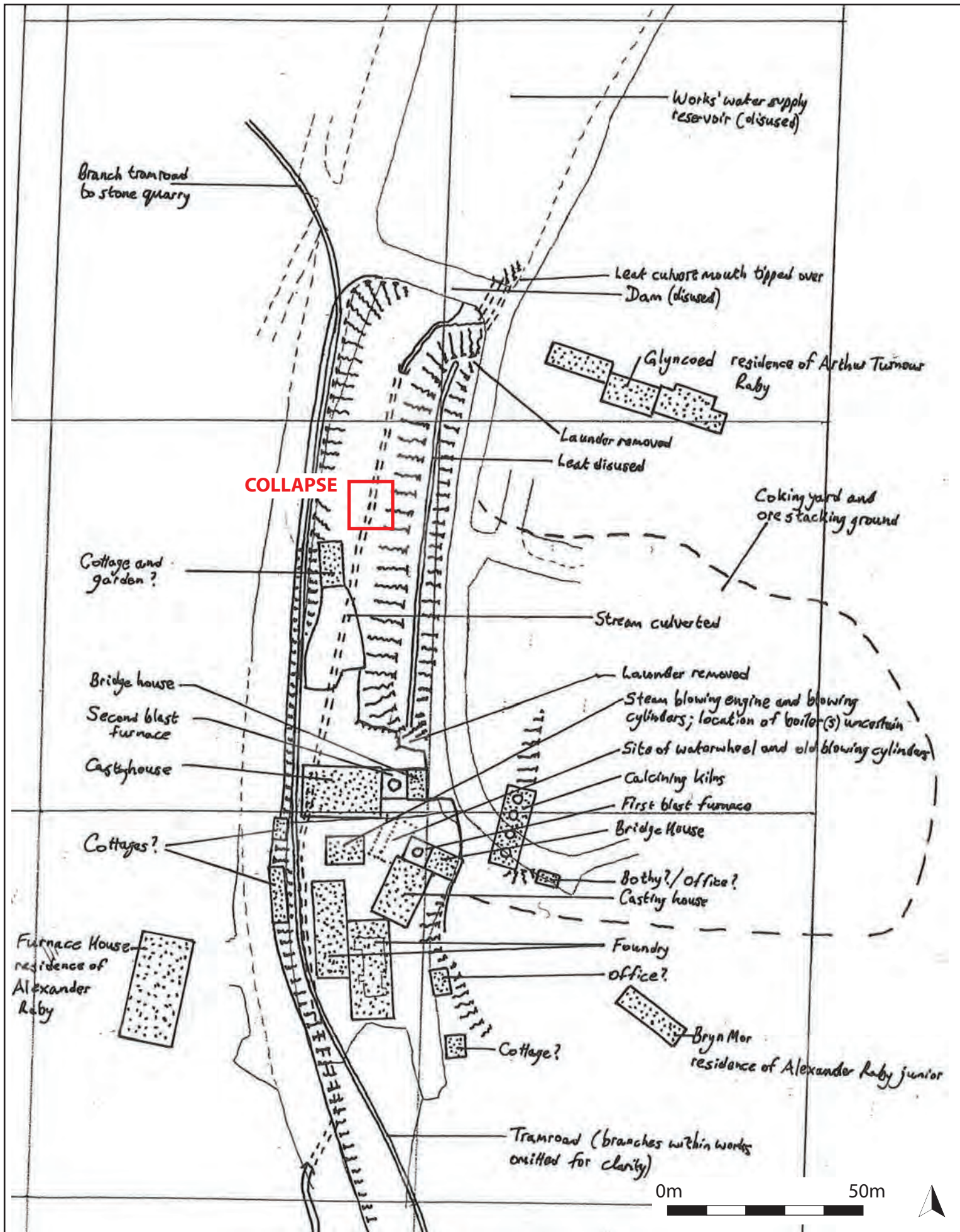


Fig. 4: Projected layout of the main industrial features at Raby's Furnace at the end of the 2nd phase of development in c.1807. Superimposed onto modern OS detail. Image provided by Robert Protheroe Jones for Cadw, 2004.

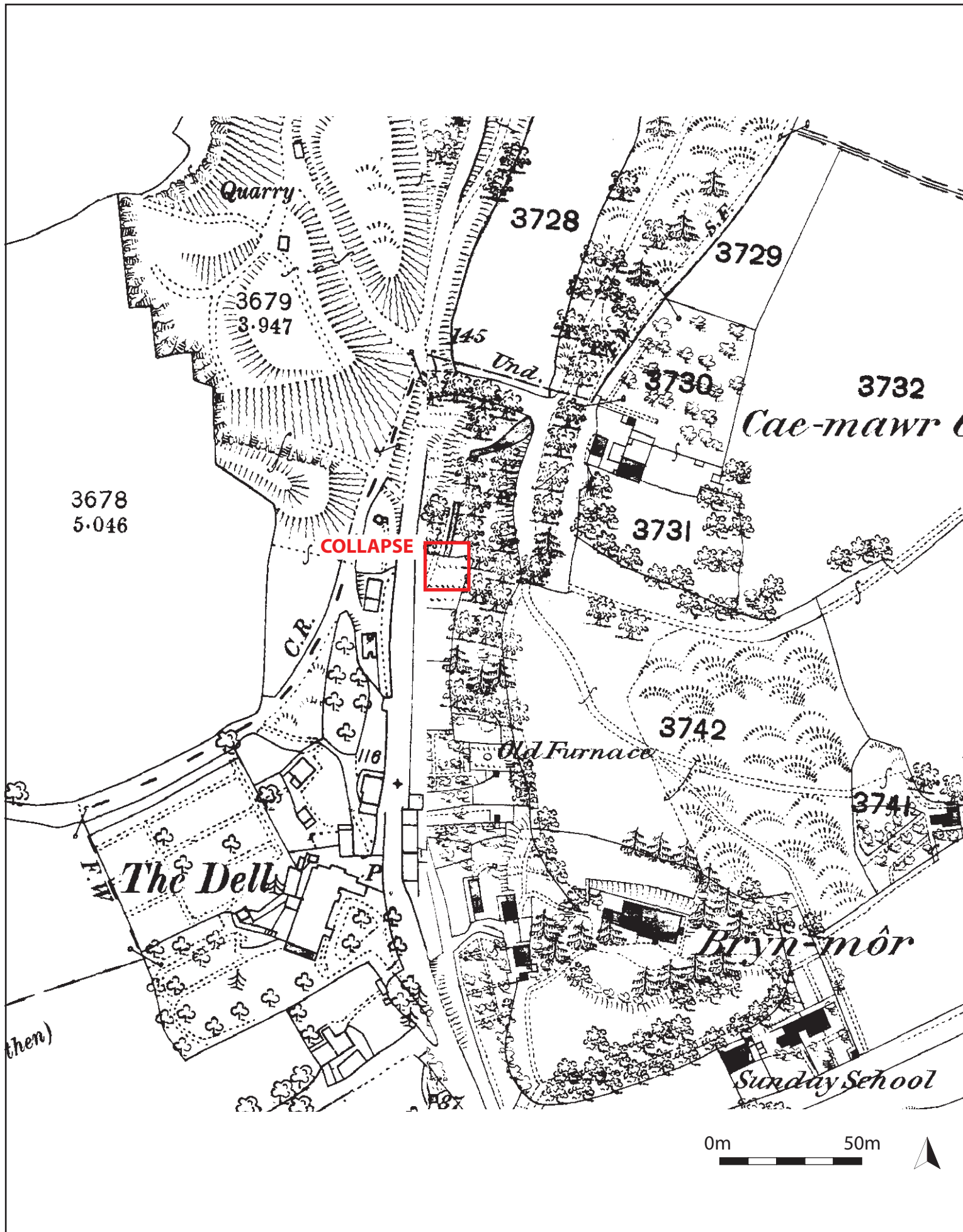
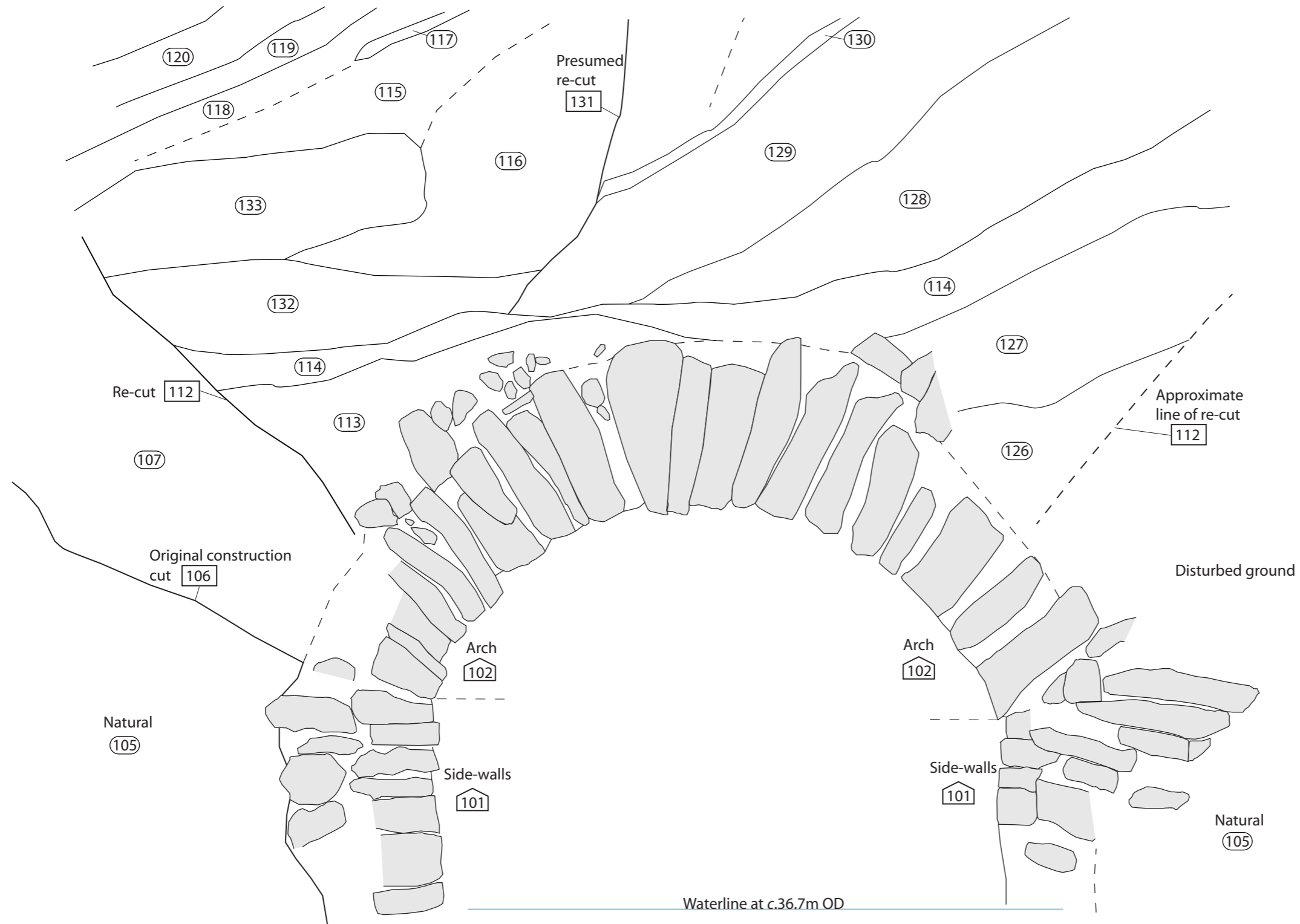


Fig. 5: Extract from the Ordnance Survey 1;2500 map of 1880 showing the site after it had fallen out of use.



0m 0.5m

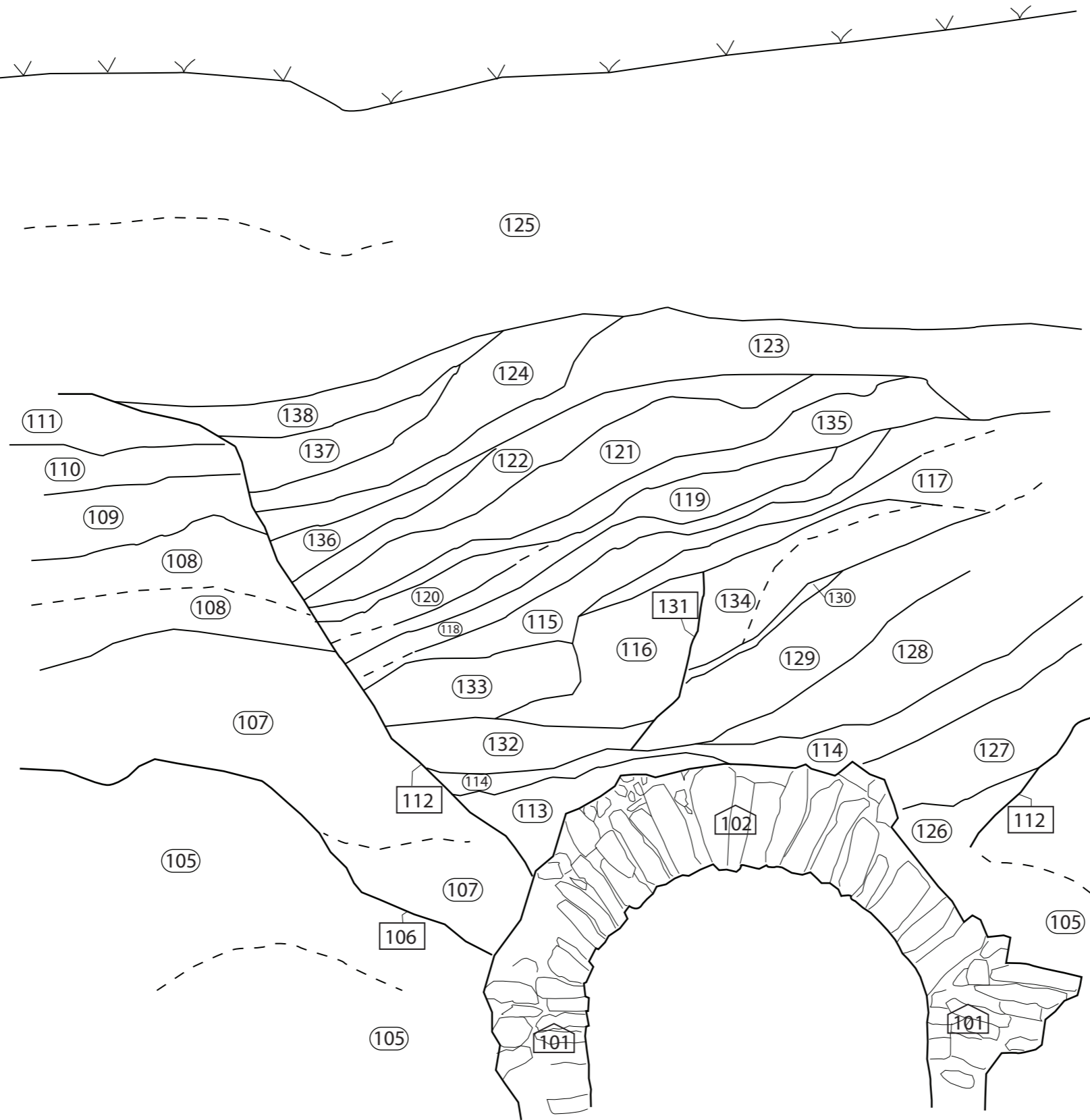
Fig. 6: Profile of the exposed north-facing section of culvert and overlying deposits at Raby's Furnace, Llanelli. Dimensions should be taken as approximate as close measurement of features and deposits were not possible on Health & Safety grounds.

Date: 27/1/14

Drawn By: PP



Valley floor at c.40m OD



Waterline at c.36.7m OD



Fig. 7: North facing section of deposits revealed overlying the culvert in the area of collapse at Raby's Furnace, Llanelli.
 Dimensions should be taken as approximate as close measurement of features and deposits were not possible on Health & Safety grounds.

Date: 27/1/14

Drawn By: PP



Archaeology *Wales*

APPENDIX I: List of Contexts

Context Descriptions

Context Number	Context Type	Description	Dimensions
100	Structure	<ul style="list-style-type: none"> Overall context for Culvert Orientated north-south, built of slate with compact lime mortar. Occurs at a depth of 2.2m/2.4m below current ground levels 	c.1.9m wide, c.1.4m high. Internally 1.3m by 1.1m
101	Structure	<ul style="list-style-type: none"> Side walls of Culvert Built of very-large, roughly-squared, slate blocks. Coursed (c.7 courses visible above water), with alternating thin and thick courses. Vertical internal face, rough unfaced external edge. Bonded in a compact, light grey lime mortar, largely flush with the wall face 	c.0.3m wide, at least 0.5m high (base not revealed)
102	Structure	<ul style="list-style-type: none"> Arched roof of culvert Built of c.20 very-large flat slate blocks The blocks are roughly cut, occasionally wedge-shaped, with a wedge-shaped central key stone. Smooth internal face Bonded in a compact light grey lime-mortar, partially covering the face 	c.0.35m thick, spanning a gap c.1.2m wide. c.0.7m vertical distance from base of arch to top of arch
103	Structure	<ul style="list-style-type: none"> Floor of culvert Built of very large, roughly cut, slate stone Laid vertically and aligned with the flow of the water Bonding material unknown 	At least 1.2m wide Other dimensions unrecorded (underwater)
104	Structure	<ul style="list-style-type: none"> Beams in base of culvert Built of flat wooden beams, each tied into the side walls (101) and set approximately 0.5m apart, overlying floor 103 Reduces internal height of culvert to c.0.95m 	Each beam at least 1.2m long, c.0.2m – 0.3m wide
105	Layer	<ul style="list-style-type: none"> Natural subsoil Compact, mid grey, clay with common, large, sub-angular stone inclusions 	1.2m thick At least 3m long exposed in section
106	Cut	<ul style="list-style-type: none"> Construction cut for culvert Very shallow break of slope at the top, slightly concave, for a depth of c.0.5m, before becoming vertical to encompass the side-walls of the culvert Base not reached 	Base 1.8m wide, top at least 2.6m wide. At least 1.1m deep, base not reached
107	Deposit	<ul style="list-style-type: none"> Original culvert backfill and levelling layer Friable, mid brown-grey, silty-clay with common, very large, angular slate stone 	0.5m thick At least 3.5m exposed in section, also visible in opposing sections (5m apart)
108	Layer	<ul style="list-style-type: none"> Backfill/Levelling, Iron processing waste 	0.4m thick

		<ul style="list-style-type: none"> Friable, light brown, silty-clay with abundant medium to large angular stones 	At least 3m long exposed in section
109	Layer	<ul style="list-style-type: none"> Backfill/Levelling, Iron processing waste Friable, mid brown, silty-clay with abundant medium-large sub-angular stones 	0.25m thick At least 3m long exposed in section
110	Layer	<ul style="list-style-type: none"> Backfill/Levelling, Iron processing waste Loose, light reddish-brown, sandy-silt with abundant mortar inclusions 	0.15m thick At least 3m long exposed in section
111	Layer	<ul style="list-style-type: none"> Backfill/Levelling, Iron processing waste intermingled layers of loose, dark grey and orange, ashy-grit with abundant small stone angular stone inclusions 	0.25m thick At least 3m long exposed in section
112	Cut	<ul style="list-style-type: none"> Re-cut onto culvert Shallow break of slope at top, steep, slightly concave sides extends down to the arched roof of the culvert 	At least 3.3m wide, western edge not fully exposed 1.5m deep
113	Deposit	<ul style="list-style-type: none"> Backfill within 112 Friable, mid grey-brown, silty-clay with abundant medium to large, sub-angular stone inclusions 	0.3m thick 1m wide
114	Deposit	<ul style="list-style-type: none"> Backfill within 112 Friable, dark grey-black, sooty-ashy grit with rare, medium, angular stone inclusions 	0.15m thick At least 2.2m wide
115	Deposit	<ul style="list-style-type: none"> Backfill within 112 Friable, dark brown-black, silty-clay with abundant ashy-grit inclusions 	0.2m thick 2.1m wide
116	Deposit	<ul style="list-style-type: none"> Backfill, within 131 Loose, dark orange, ashy-gritty material 	0.5m thick 0.6m wide
117	Deposit	<ul style="list-style-type: none"> Backfill within 112 Friable, dark grey-black, sooty-ashy grit 	0.3m thick At least 1.5m wide
118	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Loose, mid reddish-brown, fine ashy-grit with rare medium angular stone inclusions 	0.1m thick 1.8m wide
119	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Friable, dark brown, silty-clay with common small to medium sub angular stone inclusions 	0.15m thick 1.7m wide
120	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Loose, mid reddish-brown, fine ashy-grit with rare medium angular stone inclusions 	0.15m thick 0.8m wide
121	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Loose, dark orange, ashy-gritty material 	0.2m thick 2.1m wide
122	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Friable, dark brown-black, ashy-grit 	0.15m thick 1.8m wide
123	Deposit	<ul style="list-style-type: none"> Backfill, within 112 Loose, dark orange, ashy-gritty material 	0.25m thick At least 2.8m wide

124	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, dark grey-black, sooty-ashy grit with common, medium, angular stone inclusions 	0.3m thick 1.2m wide
125	Layer	<ul style="list-style-type: none"> • Upper modern deposits, a mix of topsoil and disturbed ground • Friable, dark grey-brown, clayey-silt mixed with stony-ashy deposits 	1.5m thick Extends throughout exposed area
126	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, dark grey-black, sooty-ashy grit with common, medium, angular stone inclusions 	0.2m thick 0.4m wide
127	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, mid grey-brown, silty-clays with common small to medium sub-angular stone inclusions 	0.3m thick At least 0.8m wide
128	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Loose, mixed light yellow-brown and dark brown-black, silty-clay, abundant medium-large sub-angular stone inclusions 	0.35m thick At least 1.2m wide
129	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, mid grey-brown, silty-clays with common small to medium sub-angular stone inclusions 	0.3m thick At least 1.2m wide
130	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, dark grey-black, sooty-ashy grit 	0.1m thick 0.55m wide
131	Cut	<ul style="list-style-type: none"> • Later re-cut • Sharp break of slope at top, steep, slightly concave, sides, moderate break of slope at base onto a slight concave base 	1.3m wide 0.6m deep
132	Deposit	<ul style="list-style-type: none"> • Backfill, within 131 • Friable, dark grey-brown, silty-clay with common medium-large sub angular stone inclusions 	0.2m thick 0.8 wide
133	Deposit	<ul style="list-style-type: none"> • Backfill within 131 • Friable, dark grey-black, sooty-ashy grit with rare, medium, angular stone inclusions 	0.2m thick 0.7m wide
134	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, mid grey-brown, silty-clays with common small to medium sub-angular stone inclusions 	0.3m thick 1m wide
135	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Loose, mid reddish-brown, fine ashy-grit with rare medium angular stone inclusions 	0.2m thick 2.2m wide
136	Deposit	<ul style="list-style-type: none"> • Backfill within 112 • Friable, dark grey-black, sooty-ashy grit with rare, small, angular stone inclusions 	0.15m thick 0.7m wide
137	Deposit	<ul style="list-style-type: none"> • Backfill within 112 	0.2m thick 0.8m wide

		<ul style="list-style-type: none">• Friable, dark grey-black, sooty-ashy grit with rare, medium, angular stone inclusions	
138	Deposit	<ul style="list-style-type: none">• Backfill within 112?• Loose, dark orange, ashy-grit with abundant small stone angular stone inclusions	0.15m thick 1.2m wide

Archaeology

Wales

APPENDIX II:

Written Scheme of Investigation

Archaeology Wales

**WRITTEN SCHEME OF INVESTIGATION
FOR AN ARCHAEOLOGICAL WATCHING BRIEF**

AT

Raby's Furnace, Llanelli,

Prepared for:

Natural Resources Wales & Cadw

13th September 2013

Archaeology Wales Limited
Rhos Helyg, Cwm Belan, Llanidloes,
Powys, SY18 6QF
Tel: +44 (0) 1686 440371
Email: phil@arch-wales.co.uk

NON TECHNICAL SUMMARY

This Written Scheme of Investigation (WSI) details the proposal for an archaeological Watching Brief during groundworks associated with essential repair work to be undertaken on a collapsed culvert at the site of Raby's Furnace (Scheduled Ancient Monument CM219), to the north of Llanelli. It has been prepared by Archaeology Wales Limited for Natural Resources Wales and Cadw.

1. Introduction and archaeological background

Raby's Furnace is the site of 18th and 19th century industrial remains within a steep-sided narrow valley in Furnace, to the north of Llanelli (NGR SN 50381 01574). The site is fed from the north by the Cille Stream which flows through a series of stone culverts. The site is designated as a Scheduled Ancient Monument (SAM Cm219).

Natural Resources Wales have the responsibility for the maintenance and upkeep of this water management system. Previously a section of this culvert had collapsed and was repaired, a recent CCTV survey has revealed that a further section of the stone culvert to the south of this repair within the Scheduled area has also collapsed. This culvert still forms an important part of the modern-day water management and therefore repairs are required to maintain this water management system, as a consequence Scheduled Ancient Monument Consent has been granted by Cadw for essential repair works at the site.

The scope of the construction work to be undertaken at the site includes the construction of a ramp down the western side of the valley, a short distance to the north (upstream) of the collapsed section of culvert. This ramp will be partly cut into the side of the valley and partly built-up, to allow access for machinery to the valley floor and culvert. The area around the collapse will be scoured to ascertain the extent of the collapse and then excavated down to the collapse for repair work and re-piping to be undertaken. The collapsed section of the stone culvert will be demolished and a new culvert constructed on the same line and level. Vegetation clearance works have already been undertaken and the immediate area has been fenced off to prevent public access. A site compound will be placed outside the SAM area.

This WSI has been prepared by Philip Poucher, Project Manager, Archaeology Wales Ltd (henceforth - AW) at the request of Lester Fulcher, Natural Resources Wales. It provides information on the methodology that will be employed by AW during an archaeological watching brief at the site.

The methodology set out in this WSI will be agreed with Cadw prior to the commencement of groundworks due to be carried out on the site.

All work will be undertaken in accordance with the standards and guidelines of the Institute for Archaeologists (2011).

2 Site description and historic background

Raby's Furnace is a late 18th to early 19th century iron works (PRN 4491, NPRN 40418) in Furnace, to the north of Llanelli. An original ironworking blast furnace was built on the site in the early 1790s, bought out by Alexander Raby in 1796. Raby was an important figure in the history and development of Llanelli, playing an important role in the iron and coal industries, as well as shipping and railways in the region. After taking over Raby enlarged the site, adding a 2nd furnace around 1800. The site was reputedly making cannonballs during the Napoleonic Wars. The ironworks were only in operation until c.1815. One blast furnace was subsequently demolished, the other however remains and is now a Grade II* listed structure (PRN 60828, NPRN 92882). Remains of the water management of the Cille Stream to the site (NPRN 34045) also survive to the north of the ironworks.

Due to its relatively early date it is difficult to establish an accurate layout of the whole ironworking site. The main iron working complex was clustered to the south of the affected area. However, a plan of 1814 shows a building with an attached enclosure at the northern end of the site, a short distance to the south of the collapsed section of culvert. This building appears to have been built into the side of the valley slope, its function is unclear however. Although no above ground remains of this building are obvious, this area will be avoided by the planned works in order to prevent the disturbance of potential buried archaeology. Remains of the original water leat that supplied the ironworks runs along the upper slopes of the steep eastern side of the valley. A former tramway ran along the upper slopes on the western side of the valley, possibly under the current footpath alongside the B4309. The 2nd edition Ordnance Survey map of 1907 shows possible platforms or landscaping work along the western side of the valley, in the area of the planned ramp.

Alongside remains of the culvert itself the former tramway and possible platforms are the only features currently identified that may be disturbed by the planned works.

3 Site specific objectives

The aims of the watching brief, as defined by the IfA (2011) are:

- To allow a rapid investigation and recording of any archaeological features that are uncovered during the proposed groundworks within the application area.
- To provide the opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological find has been made for which the resources allocated to the watching brief are not sufficient to support the treatment to a satisfactory or proper standard

4 Watching Brief Methodology

General

The archaeological watching brief will be undertaken by AW staff using current best practice.

All work will be carried out by a suitably qualified archaeologist with relevant level membership of the Institute for Archaeologists (IfA) and will follow the IfA Standard and Guidance for an archaeological watching brief (2011).

Detailed

The Watching Brief will be carried out by a suitably qualified archaeologist during all phases of groundworks on the site, including the removal of topsoil and all other associated work (cutting of the ramp, levelling, scouring and excavation to expose the collapse) where the sub-soil or culvert remains are likely to be exposed or cut into.

If archaeological features, finds or deposits are uncovered, work will be stopped in the area of the exposed feature in order that the supervising archaeologist can clean and identify the extent and nature of the feature and for excavation and recording to take place.

All archaeological deposits that are identified will be mapped, cleaned, recorded and fully excavated. The developer will provide a safe working area and sufficient time to record and excavate all features to the satisfaction of AW and Cadw. Full excavation of identified features will not be compromised by the construction programme.

Contingency Arrangements

In the event of significant archaeological features being discovered all activities in this area of the site can be temporarily suspended. This will allow a period of consultation with Cadw and if required the opinion of specialists.

Following such consultation, recommendations will be presented to the Natural Resources Wales, the site contractor and Cadw.

The methodology and timescale of additional archaeological work to investigate such features will be presented and included in the Contractors Programme; the feature will be fenced off and secured thus allowing the site programme to continue.

Recording

Recording will be carried out using AW recording systems (pro-forma context sheets etc), using a continuous number sequence for all contexts.

Plans and sections will be drawn to a scale of 1:50, 1:20 and 1:10 as required and related to Ordnance Survey datum and published boundaries where appropriate.

All features identified will be tied in to the OS survey grid and fixed to local topographical boundaries. The location of all features will also be recorded using a Topcon GTS725 total station.

Photographs will be taken in digital format, using a 14MP camera with photographs stored in Tiff format. Should significant remains be identified that require excavation, photographs will also be taken in black and white and colour slide (35mm film).

The archaeologist undertaking the watching brief will have access to the AW metal detector and be trained in its use.

Artefacts

Archaeological artefacts recovered during the course of the excavation will be cleaned and labelled using an accession number, which will be obtained from the local

museum. A single number sequence will be allocated to all finds. The artefacts will be stored appropriately until they are deposited with a suitable local museum.

All finds of gold and silver will be removed to a safe place and Natural Resources Wales, Cadw and the local coroner informed, within the guidelines of the Treasure Act 1996.

Any finds which are considered to be in need of immediate conservation will be referred to a UKIC qualified conservator (Phil Parkes at Cardiff University).

Human remains

In the event of burials or cremations being found all work will be halted in the area of the burials and their extent and nature established. The client, Cadw and the Ministry of Justice will be informed and a methodology of excavation agreed which will adhere to Ministry of Justice Guidelines.

Environmental and technological samples

Environmental samples will be taken where necessary when significant deposits are located. Technological samples will be taken where necessary when significant deposits are located.

Specialists

In the event of certain finds/features etc. being discovered, the site archaeologist may have to seek specialist opinion for assistance. Such specialists will be accessed either internally within AW itself or from an external source. A list of external specialists is given in the table below.

Type	Name	Tel No.
Flint	Dr Amelia Pannett	02920 899509
Animal bone	Jen Kitch	07739 093712
CBM, heat affected clay, Daub etc.	Rachael Hall	01305 259751
Clay pipe	Hilary Major	01376 329316
Glass	Andy Richmond	01234 888800
Cremated and non-cremated human bone	Malin Holst	01759 368483
Metalwork	Kevin Leahy	01652 658261
Neo/BA pottery	Dr Alex Gibson	Bradford University
IA/Roman pottery	Jane Timby	01453 882851
Post Roman pottery	Mr Stephen Clarke	
Charcoal (wood ID)	John Carrot	01388 772167
Waterlogged wood	Nigel Nayling	University of Wales (Lampeter)
Molluscs and pollen	Dr James Rackham	01992 552256
Charred and waterlogged plant remains	Wendy Carruthers	01443 233466

5 Post-Fieldwork Programme

Conservation

After agreement with Natural Resources Wales, Cadw and any identified landowner arrangements will be made for the long term conservation and storage of all artefacts in an appropriate local or county museum.

Archive

The site archive will be prepared in accordance with MAP 2, Appendix 3 (English Heritage 1991). It will comprise all the data recovered during the fieldwork and shall be quantified, ordered and indexed and will be internally consistent. The archive will be deposited with the finds in a suitable local museum.

Reporting

The results of the watching brief will be submitted in an illustrated and bound report, which will include the following material:

- Non-technical summary
- Location plan showing the area/s covered by the watching brief, all artefacts, structures and features found
- Plan and section drawings with ground level, ordnance datum and vertical and horizontal scales.
- Written description and interpretation of all deposits identified, including their character, function, potential dating and relationship to adjacent features. Specialist descriptions and illustrations of all artefacts and soil samples will be included as appropriate.
- An indication of the potential of archaeological deposits which have not been disturbed by the development
- Statement of local, regional and national context of the remains
- A detailed archive list at the rear listing all contexts recorded, all samples finds and find types, drawings and photographs taken. This will include a statement of the intent to deposit, and location of deposition, of the archive.

Monitoring

Any changes to the specification that the contractor may wish to make after approval will be communicated to Cadw for approval on behalf of the Planning Authority.

Representatives of Cadw will be given access to the site so that they may monitor the progress of the watching brief. Cadw will be kept regularly informed about developments, both during the site works and subsequently during any potential post-excavation.

Archive Format & Deposition

The full site archive will be deposited within one month of the completion of the client report.

The paper/drawing/digital archive will be deposited at the appropriate regional archival store with the finds will be deposited with the appropriate local museum. AW will agree the location and timing of the deposition of the archive before the contract commences.

The archive will include all site notes, finds, documents, drawings, photographs, digital

data and a copy of the final report and any prior draft versions. All of these items will be clearly quantified in tabular **from in an 'archive deposition statement' located at the rear of the clients report**, and their ultimate location and proposed date of deposition stated.

6 Resources and timetable

Standards

The watching brief will be undertaken by AW staff using current best practice.

All work will be undertaken to the standards and guidelines of the IFA.

Staff

The project will be undertaken by suitably qualified AW staff.

Equipment

The project will use existing AW equipment.

Timetable of archaeological works

The watching brief will be undertaken at the convenience of the client.

Insurance

AW is an affiliated member of the CBA, and holds Insurance through the CBA insurance service.

Health and safety

All members of staff will adhere to the requirements of the *Health & Safety at Work Act, 1974*, and the Health and Safety Policy Statement of AW.

Archaeology Wales



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