

Archaeology Wales

Gurnos Quarry Leat and Tramroad, Cyfarthfa, Merthyr Tydfil

Standing Building Recording, Total Station Survey and
Archaeological Watching Brief



By
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Report No. 1328



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Summary

Archaeological survey and monitoring work was carried out prior to and during extensive consolidation work on the Gurnos Quarry Leat and Tramroad, a Scheduled Ancient Monument (GM478), at Cyfarthfa, Merthyr Tydfil. The leat and tramroad date to the 1790s and were built by Richard Crawshay, ironmaster of Cyfathfa Ironworks, to supply limestone to his furnaces and water to drive his huge waterwheel, Aeolus, and formed part of an extensive network of infrastructure associated with the works. The tramroad was originally built as a railroad, with edge rails along which waggons with flanged wheels would have run. Sometime in the early 1800s the railroad was converted to a tramroad, or plateway, with L-shaped plates set onto the sleeper stones visible on the site today. The tramroad underwent two further track replacements during the 1800s before going out of use in the early twentieth century. The leat appears to have been built at the same time as the original railroad and followed the same route, albeit elevated above the railway, until the southern end of the feature where it would have fed into the Gwynne Water Aqueduct. The aqueduct, built of wood, was an elevated feature that was carried over the river Taff on the Pont y Cafnau, and into the ironworks. The leat remained in use as a water supply for Aeolus until the mid-1800s when it was diverted to feed the lake in front of Cyfarthfa Castle, which functioned as a balance pond for the ironworks.

The consolidation work concentrated largely on the leat, with large scale rebuilding of the leat walls, the lining of the entire length of the leat and the repointing of sections of the embankment retaining wall designed to stem leaks. In addition, the most vulnerable sections of the tramroad revetment wall (on the eastern side of the track) were consolidated. The original plans had included more works to the tramroad revetment wall, consolidation of the tramroad retaining wall (on the western side of the track), re-bedding dislodged sleeper stones, and the re-gravelling of the full length of the tramroad. Due to budgetary constraints most of the proposed work on the tramroad had to be abandoned. The work was carried out under Scheduled Monument Consent, granted by Cadw in March 2011, and under planning consent granted by Merthyr Tydfil County Borough Council in March 2011.

The survey carried out prior to the commencement of consolidation works revealed that there are 731 visible in situ sleeper stones along the length of the tramroad, most of which display wear marks from the different plates and chairs attached to them over the century or so of use. More sleeper stones survive in situ, buried beneath a modern build-up of soil, four of which were revealed in a new drainage channel cut across the northern end of the tramroad. Works to clear vegetation in advance of the proposed consolidation revealed the remains of a building on the eastern side of the tramroad. This is depicted on the 1875 OS map and is likely to be connected to the use of the line. As too is a stone engraved with a 'G' identified adjacent to this building. The watching brief carried out during the works to reconstruct and re-line the leat revealed that at the southern end, where modern pipes had replaced the open channel, the eastern wall had been removed, either deliberately or as a result of erosion. A small excavation into the bank on the eastern side of the leat revealed that the original wall may have been located further east of the current leat edge, indicating that the whole of the southern end of the leat may have been shifted slightly east of its original position, probably during works to rebuild it in the twentieth century. The watching brief also identified multiple episodes of repair to the leat, including both small-scale and substantial rebuilding of the walls, relining of the base and the installation of pipes.

1. Introduction

In July 2011, Archaeology Wales was commissioned by Capita Symonds and Merthyr Tydfil County Borough Council to undertake a programme of mitigation works prior to and during the proposed consolidation and reflooding of the Gurnos Quarry Leat and Tramroad (NGR: SO 03472 07996; fig. 1). The work was primarily undertaken to attempt to stop a series of leaks from the leat which were causing a loss of structure and deterioration to the leat and embankment walls, and which threatened the long-term preservation of the monument. Additional works included access improvements, including the installation of two new bridges, improvements to footpaths within the monument, and the installation of new entrance features. The site is a Scheduled Ancient Monument (SAM: GM478) and Scheduled Monument Consent was granted in March 2011. The work was granted planning consent in March 2011, planning application number P/11/0089. The planning authority is Merthyr Tydfil County Borough Council.

The works to consolidate and reflood the leat and consolidate the tramroad involved draining the leat, rebuilding sections of walling, relining the base of the leat and damming leaks in the embankment walls. Plans were also drawn up to consolidate and rebuild sections of the tramroad revetment wall along the eastern side of the tramroad, and the tramroad retaining wall that runs along the eastern side of the Taf Fechan. In addition, dislodged sleeper stones were to be reinstated and the track bed of the tramroad was to be repaired and new gravel laid down. Once work on the site commenced, however, it became clear that the costs involved in the leat repairs would go beyond what was originally expected and as a consequence most of the proposed works on the tramroad were stopped. The only work that was carried out on the tramroad were repairs to the most unstable sections of the embankment retaining wall and tramroad revetment wall.

The proposed archaeological works involved the following elements:

1. Standing Building Recording (EH Level II) of all structures along the leat and tramroad prior to the commencement of the consolidation works.
2. Detailed Total Station survey of the tramroad sleeper stones.
3. Small-scale evaluation to inform the reinstatement of dislodged sleeper stones.
4. Intensive watching brief during all intrusive works within the SAM.

It became clear that undertaking the Standing Building Recording work to the agreed EH Level II standard prior to the commencement of the consolidation works was impractical as most of the structure of the monument was covered in dense vegetation (fig. 2). An alternative programme of recording was agreed with Rick Turner (Cadw), which involved undertaking a photographic survey of the site prior to consolidation works starting (EH Level I recording). Subsequently, more detailed recording would be carried out of the sections of walling to be rebuilt, involving the photographing of sections of walling after the vegetation had been cleared and prior to any consolidation works being undertaken. The small-scale evaluation of the locations of sleeper stones was not carried out as the works to re-bed the dislodged stones were abandoned.

The leat and tramroad are described in referenced to a Chainage system that was established for the site by Parkman Consulting Engineers in 1992 and which was used by the contractors during this programme of works. Chain 0 is located at the northern end of the site, at the point where the leat exits the covered section and where the tramroad starts, and Chain 860 is located at the southern end of the site, where the leat enters the covered section that then joins the Cyfarthfa Castle lake. The chain system is used to reference locations on both structures and is used in conjunction with a small number of named locations, the 2 overflows, the pipe bridge, the piped section etc. Structural descriptions within the text referring to the main elements of the site are:

- Tramroad retaining wall – located on the western side of the tramroad, along the eastern edge of the Taf Fechan river.
- Tramroad revetment wall – located on the eastern side of the tramroad at the southern end of the site
- Embankment retaining wall – forming the embankment on the raised section of the leat, located on the eastern side of the tramroad at its northern end.
- Eastern and western leat walls – the walls forming the raised sides of the leat structure

The archaeological work was carried out between September 2011 and July 2012. Site works were undertaken by Jerry Bond, Nick Wells and Hywel Keen. Overall management of the project was carried out by Dr Amelia Pannett.

2. Site Description

2.1 Location, Geology and Topography

The Gurnos Quarry Leat and Tramroad are located on the north-western edge of Merthyr Tydfil, north of Cyfarthfa Castle. The scheduled monument extends from the junction of Gurnos Road and Brecon Road to the leat intake structure situated approximately 120m north of the Taf Fechan Viaduct, which carries the A465 Heads of the Valleys Road, an overall length of approximately 1km. At the southern end of the monument the route of the tramroad would originally have continued south towards the site of three lime kilns and beyond, across the Pont y Cafnau, to the site of the Cyfarthfa Ironworks. This section of the monument is now largely destroyed. The leat continues southwards from the scheduled area, and discharges into the lake at Cyfarthfa Castle. On the west side the monument is bounded by the Taff Fechan and on the east by the Lakeside Gardens estate. The area is a national nature reserve and forms part of the Taff Fechan Woodlands SSSI

The leat comprises a largely open channel water course. At the northern end, between the intake and Chain 0 (a distance of 35m), the leat is covered, while at the southern end it is piped between Chain 740 and Chain 800 and then is covered again between Chain 860 and the point at which it enters the lake at Cyfarthfa Castle. The tramroad runs parallel to the river along most of its length, to the west of the leat, and is a public right of way. It comprises a level track bed containing many of the original sleeper stones.

The tramroad and the leat run roughly north/south. The area of the site from north of the Taf Fechan Viaduct, from Chain 0 to Chain 120, runs from the north-east to the south-west. From Chain 120 onwards the tramroad and leat turn to the south-east and continue in that direction to the end of the scheduled area. The monument it is not a straight linear feature but follows

the meandering route of the river. The leat and tramroad are located immediately parallel along much of the length of the monument, with the tramroad located at river level and the leat elevated above. South of the pipe bridge (Chain 500) the two structures diverge, and whilst the tramroad continues in a relatively straight line towards the south-east, the leat curves to the east for around 110m (to Chain 610). It then runs parallel to the tramroad again for a length of around 40m (to Chain 650) before it turns to the south for a length of around 55m (to Chain 705) where, for a length of around 25m near Overflow 2 (Chain 735), it returns to its parallel course before once more turning to the south-east around Chain 760, near Bridge House, from where it continues towards Cyfarthfa Lake.

The leat and tramroad are contained within the steep sided gorge of the Taf Fechan for much of their length. The underlying geology at the northern end of the site is Carboniferous Oxwich Head Limestone Formation, while at the southern end of the site the geology comprises Carboniferous Twrch Sandstone Formation (BGS 2105). The site lies at 220m aOD at the northern end, and 200m aOD at the southern end.

2.2 Historical Background

The Gurnos Quarry Leat and Tramroad were built to supply the Cyfarthfa ironworks with limestone and water, both essential ingredients in the iron making process (fig. 2).

The Cyfarthfa ironworks had been built in the 1760s by Anthony Bacon and Richard Brownrigg on land leased from Lord Talbot, and was the fourth coke fired ironworks to be built in south Wales (GGAT 2005). The works initially contained a single furnace, a forge and a boring mill for the manufacture of cannon. The ironworks changed hands several times over their first couple of decades before coming under the control of Richard Crawshay, William Stevens and James Cockshutt in 1786 (GGAT 2005). The partnership expanded the business, building a second furnace and enlarging the forge and the mill, before disbanding in 1792. At this point the control of the lease was taken over by Richard Crawshay and Watkin George who finally bought the ironworks in 1794 (GGAT 2005).

In 1771, a lease was granted to allow Cyfarthfa, Ynys Fach, Penydarren and Plymouth ironworks to extract limestone from the quarry at Gurnos (Van Laun 2001), controlled jointly by the ironmasters of the four works. The transportation of limestone from the quarry to the ironworks was probably on horseback in the early days of quarrying, as the following description from James Watt Jnr during his tour of South Wales in the early 1800s attests:

“The Penydarren Company until lately, used to get their lime brought upon horses backs from near the same place where it is now got by the Cyfarthfa Company”
(Gantee 1993)

In 1792, Crawshay applied to the Glamorganshire Canal Company for a license to construct a railroad from Gurnos to his works at Cyfarthfa, which was approved under the four-mile clause¹. Crawshay failed to find a suitable contractor to undertake the construction of the

¹ The four-mile clause was an Act of Parliament designed to allow the construction of railroads less than 4 miles long between a canal and an ironworks or a quarry. The railroads could be built by private individuals but would be considered public roads and therefore subject to tolls and byelaws (Van Laun 2001)

railroad and so built it with his own labour. Following its construction, Crawshay failed to make it public, no doubt due to the fact that he had paid for the work, and started to charge his former quarrying partners to transport limestone to their ironworks:

“The stone was to be quarried in the limestone rocks in Graig y Gwinos, and being ‘good and proper limestone’ was to be delivered by Mr Crawshay on the side of the railroad at the canal warehouse at the price of 1s 9d per long weight.” (Van Laun 2001)

This relates to the Plymouth Ironworks, run by Richard Hill. By all accounts, Plymouth still retained the right to quarry at Gurnos but had no means of transporting the stone except along Crawshay’s railroad, for which they were charged 1s 7d per ton over the going rate for transport on a canal. Not surprisingly, the situation caused considerable discontent amongst Crawshay’s fellow iron masters, and ultimately lead to the construction of the west Morlais railroad by Richard Hill in partnership with the Dowlais ironworks, to carry limestone from the Morlais quarry (Van Laun 2001).

Crawshay’s Gurnos railroad was 1.5km long, connecting the quarry face at Gurnos with the Cyfarthfa ironworks, and crossed the river Taff on the Pont y Cafnau. Built by Watkin George between 1793 and 1796 (GGAT 2005, ICE 2015), this is thought to be oldest cast iron tramroad bridge in the world. The deck of the bridge would have held plates with integrally cast bar rails for the railroad – the current deck plates are replacements but the originals can be found set into the roof of the lime kilns located 400m to the north of the bridge (Van Laun 2001). The width of the spacing between the rails gives a gauge of 3ft 7in for the railroad. These early deck plates demonstrate that the earliest railroad at Gurnos would have comprised cast iron bar edge rails on which wagons fitted with flanged wheels would have run (fig. 3). No evidence for these bar rails can be found on the in situ stone sleepers, however, and Van Laun suggests that the rails would have been set on wooden sleepers (2001).

At a later date, probably in the early 1800s, the railroad was converted to a tramroad. James Watt Jnr describes it as a railroad in 1800 (Gantee 1993), suggesting that the conversion post-dates the turn of the century. With the conversion to a tramroad all the bar rails would have been replaced with plates. These were L-shaped with the flange on the inner edge of rail guiding the wheels along the tramroad (fig. 4). The earliest evidence for the tramroad comes from the wear marks of Outram-type plates on two long stone sleepers that bridge a culvert at the northern end of the tramroad (adjacent to Overflow 1; fig. 5). The gauge during the Outram plateway phase, as indicated by the wear marks, was 3ft (on site measurement; Van Laun 2001).

Benjamin Outram was the driving force in the development of early tramroads across the South Wales valleys (Van Laun 2001). His designs drew from earlier forms of plate rail but were specifically tailored to the needs of surface tramroads and incorporated features to improve stability and to allow heavier loads to be drawn across them (Van Laun 2001). He was also an advocate of the use of stone blocks as sleepers, as he describes in his guidance for tramroad construction:

“On this (road) bed must be laid the sleepers or blocks to fasten the rails upon. These should be made of stone in all places where it can be obtained in sufficient size; they should be not less than 8, not more than 12 inches in thickness; and of such breadths (circular, square or triangular) as shall make them 150lbs or 200lbs weight each. Their shape not material, so as they have a flat bottom to rest upon, and a small portion of their upper surface level, to form a firm bed for the end of the rails. In the centre of each block must be drilled a hole, one inch and a half diameter, and six inches in depth, to receive an octagonal plug of dry oak five inches in length; for it should not reach the bottom of the hole, nor should it be larger than so as to be put in easily and without much driving: for if too tight fitted it might, when wet, burst the stone. These plugs are each to receive an iron spike or large nail, with a flat point and a long head, adapted to fit the counter sunk notches in the end of the two rails, and thereby to fasten them down in the proper position....The blocks and rails being fixed and spiked fast, nothing more remains to be done than to fill the horse path, or space between the blocks, with good gravel, or other proper materials; a little of which must be put on the outsides of the blocks to keep them in their proper places.” (quoted in Van Laun 2001, 20-21).

In 1799, Outram convinced the committee of the Monmouth Canal Company and the Brecon and Abergavenny Canal Company to convert all of their railroads to tramroads, using his plates and stone blocks technique (Van Laun 2001), quite a feat considering the costs involved. At Gurnos, 3ft long Outram style plates were laid, probably onto new stone sleeper blocks. The replacement deck plates on the Pont y Cafnau demonstrate a change in gauge to 3ft, which was probably established with the introduction of the tramroad.

The rolling stock used on the early tramroad is likely to have conformed to the designs seen on many of the South Wales tramroads in the early nineteenth century, with a relatively narrow base (to fit the 3ft gauge) and an open, splayed top (Hughes 1990). The wagons were probably made from wood, although iron plate was also used. George Overton, a prominent railway engineer in the early 1800s describes the design of wagon he favoured:

“I will here observe that I have tried every species and shape of trams, and among such as are made of wood, designed for use both underground and above, I have found none equal to those which are constructed with sides one foot upright and nine inches upon that to bevel a little outwards. The sides consist of four planks, two on each side, the lower planks two inches thick, the upper ones one inch and a half with straps of iron under the bottom extending to the top edge of the sides, which were screwed together, with one inch elm boards at the bottom.” (quoted in Hughes 1990, 177)

A painting by George Childs of the Dowlais Ironworks in 1840 depicts a tram wagon matching Overton’s description (fig. 6). While there are no comparable depictions from Cyfarthfa, it is likely that a similar style of wagon would have been used on the Gurnos tramroad.

The Gurnos tramroad was to go through two further phases of redesign, with evidence for two types of chairs for fastening plates succeeding the Outram type plates. These later developments are probably later nineteenth century in date, one occurring around 1840 and another around 1880, as suggested by Van Laun (2001). The tramroad remained open until 1904, when limestone for the ironworks started to be brought to the site by railway from Penderyn (Van Laun 2001).

The leat was built to supply water to power the enormous Aeolus waterwheel designed by Watkin George to drive a blowing engine for blast furnaces and rollers in the mills at Cyfarthfa (GGAT 2005). The waterwheel was 15m in diameter and used 25 tonnes of water per minute (ICE 2015). The water was abstracted from the Taf Fechan at the southern end of the Gurnos Quarry area and flowed through the leat and into the Gwynne Water Aqueduct, which carried it to the waterwheel. The aqueduct was wooden, 185m long and elevated, carried over the river Taff on struts connected to the superstructure of the Pont y Cafnau. James Watt Jnr describes the leat as in existence in 1800, and it is likely that it was built in the 1790s, at the same time as the tramroad, Pont y Cafnau, Gwynne Aqueduct and Aeolus waterwheel.

3. Results of the Archaeological Work

3.1 The Tramroad

The section of tramroad preserved within the scheduled area is around 775m long, extending between Chain 0 and Chain 770 at the Old Cefn Bridge. The width of the tramroad varies along its length, from its narrowest points at Chain 190 to 210 and Chain 394 where it is 2m wide, to its widest point at chain 120 where it is 9m wide. The tramroad slopes gradually downwards from the northern end of the site, following the fall of the Taf Fechan river and decreasing in height aOD by around 20m along its length

The tramroad was in a poor condition along several sizable sections prior to the commencement of the restoration work (fig. 7), with water from the leaking leat causing water pooling on the surface and the erosion of several gullies. The tramroad is a public footpath and is also used by illegal off-road motorcyclists who have also caused damage to the track surface.

The tramroad retaining wall was built along the western side of the track between Chain 400 and Chain 770, preventing the erosion of the riverbank and allowing the surface of the track bed to be maintained at a relatively level gradient. Access to the retaining wall was difficult as it was overgrown and the water level in the river was high. Consequently little recording of this wall was undertaken. From the limited access available it was apparent that the retaining wall was of random coursed rubble construction and was bonded using a lime mortar. No restoration of the tramroad retaining wall was undertaken during the programme of works.

In some sections of the tramroad the sleeper stones were well preserved (fig. 8), being most frequent at the southern end of the site and continuing to approximately Chain 160. Beyond this point the number of sleeper stones visible on the surface diminished and it is thought that they are buried below modern deposits that have raised the level of the tramroad. Further buried sleeper stones were tentatively identified during the survey, including a possible section of double track around Chain 650. Here, the width of the tramroad increases and there are indications of additional sleeper stones to the east of the main line of stones. They are entirely obscured by vegetation and modern soil, however. The proposed works to clear the tramroad

did not occur and consequently no investigation of this possible double track section was possible.

A drainage channel was cut through the width of the tramroad to aid in the draining of the Leat prior to the restoration work starting. This was located at Chain 2 at the northern end of the tramroad, adjacent to the southern end of the covered intake structure. This channel was excavated without consultation with the site archaeologist or Cadw and consequently was not monitored whilst it was excavated but was recorded after it had been dug (Fig. 9). The drainage channel was 2m wide and cut through a 0.1m deep layer of modern build up comprising silt and stones. Below the modern deposits two pairs of in situ sleeper stones were revealed. These had been dug into a 0.3m deep layer of redeposited natural/made ground that constitutes the original tramroad surface. The stones stood just proud of the surface and were set 0.3m apart. The gap between the pairs of stones was filled with gravel.

Evidence for previous remedial drainage works were noted at Chain 70 where missing sleeper stones were noted and a stone-lined open channel ran across the tramroad. Another drainage feature of a recent date was noted at Chain 676 (fig. 10) where a blue plastic flexi pipe was visible on the western side of the tramroad. Another blue flexi pipe was noted running across the tramroad at Chain 225.

3.2 The Sleeper Stones

The sleeper stones were in a variety of shapes and sizes, with most being around 0.4m to 0.6m by 0.60m to 0.80m (fig. 10). Whilst some were sub rectangular in shape, most were not and it seems that the main criteria was that they were of sufficient size to allow the attachment of the rail fixing plates and of sufficient bulk to carry the rails and the trams without excessive movement. The two bridging sleeper stones at Chain 80 measured 0.6m by 1.8m and 0.58m by 2.2m and were roughly rectangular in shape. The GIS plot (included on CD) provides a detailed survey of the size, shape and location of each stone on the tramroad, together with an outline of the associated plate(s).

The sleeper stones were set in a pattern of irregular paired stones, around 0.1m to 0.3m apart (east/west), depending on the size of each individual stone, and a similar spacing north/south (fig. 10). A high proportion of the sleeper stones displayed wear marks caused by the chairs used to fix the rails in place (fig. 11). The chairs were often not set directly opposite each other and were out of line, and it seems that the positioning was unlike that seen on a modern railway. The spacing between the chairs is approximately 1m (3 feet), which gives an approximate gauge for the rails that is comparable to that identified by Van Laun (2001). The chairs and rails were attached to the sleeper stones by metal spikes that were driven into wooden plugs within holes drilled in the sleeper stones. The wooden plugs have long since disappeared and only one complete metal spike was found still in situ in a sleeper stone. The total number of surviving visible in situ sleeper stones recorded along the length of the tramroad was 731, although more are certainly buried below modern deposits.

A number of variations in the design of the chairs were noted during the survey (fig. 12). Some of the sleeper stones had marks from more than one style of chair, identifiable as either several pairs of holes (up to 3) or as marks from chairs of different shapes (fig. 13). This suggests that, in addition to the wholesale replacement of the track and chairs along the tramroad as discussed above, repairs to the trackway were undertaken, with chairs replaced as and when required. Some of the chair impressions on the sleeper stones indicate that the stones had been reset

during their lifetime, with multiple chair impressions at different angles (fig. 14). Some of the sleeper stones had no trace of a chair on them which may be the result of the rails being mounted in such a way that very little downward pressure was exerted on them preventing wear to the underlying stone. Other marks on the sleeper stones are considered to be from where the rails have worn into them and in a few locations marks were noted that are probably from the tram wheels (fig. 15). At Chain 80, adjacent to Overflow 1, two long sleeper stones carried the rails across a culvert that runs beneath the tramroad and takes water from the overflow into the river. These stones bear the marks of cast iron Outram plates that represent the first phase of tramroad construction on the site (Van Laun 2001; fig. 5).

At some point in the history of the use of the tramroad, the Outram plates were replaced with chairs and wrought iron rails, as evidenced by the wear marks. Assessment of the different wear marks indicates that a second phase of chair and rail replacement also occurred, while other forms seen in the wear marks may represent isolated repairs.

A single in situ iron fixture was found during the survey, although the fixing spikes were not present and it was removed from site. It comprised a flat iron plate 0.26m in length, 0.15m wide and 0.06m thick. It had three equidistant holes positioned slightly off-centre along the long axis of the plate (fig. 16). The holes were of 0.022m diameter and slightly oval, probably due to wear. The function of this plate is not fully understood, although it may have been positioned between the sleeper stone and the chair.

A number of chairs were recovered from the silt excavated during the restoration of the leat (fig. 17). The chairs identified during the works have been categorised into two types:

- Type A – narrow rectangular chair with angled cheeks. The single example found measured 0.3m in length, 80mm wide and had a thickness of 20mm. The cheeks were of different heights, one being 20mm and the other 35mm in height. There were two holes in the base plate, at each end outside the cheeks, which were 20mm in diameter. The single example of a type A chair was found with both its mounting spike bolts still in situ.
- Type B - dumb bell shaped chair, were rectangular with an indentation on both of the long sides. The overall length was 0.30m with a width of 0.12m at the widest point and 0.1m in the narrow section. The thickness of the base plate was 20mm and the cheeks were 20mm and 35mm high. There was a hole at each end for the spikes. The two examples of Type B chairs were both recovered from the silt excavated during the restoration of the Leat and one of them retained both its fixing spikes whilst the other retained only a single fixing spike.

A fixing single rail spike (SF#2) was found in situ in one of the sleeper stones. The spikes were manufactured from iron and were sub circular at the top, tapering to a flat chisel form at the tip (fig. 18). The one measured example was 0.1m in length and 25mm in diameter at the top whilst at the tip it was 12mm wide.

The wear marks on the sleeper stones indicate that the type A chairs were earlier than the type B chairs. Where clear sets of multiple chair indentations survived, the wear marks from type A were overlain and/or partially removed by the wear marks from type B. Type A is represented by a single find [SF#5] and type B by two examples [SF#3 & SF#4], all recovered from the silt within the leat. Also recovered from the Leat was a cast iron rail sill [SF#6] (fig. 19). The sill

was 1.4m in length with chairs at each end, with a space between the cheeks of 0.13m. The inner cheek was 20mm high and the outer cheek 0.1m high.

All the rail fittings were retained on site to be used to inform the reconstruction of the section of tramroad being constructed at the entrance to the site. The intention was that they would be deposited with Cyfarthfa Castle Museum by Capita once the reconstruction had been completed. Archaeology Wales has been unable to confirm whether this has been carried out.

Noticeable erosion and/or displacement of sleeper stones was noted in a number of locations:

- either side of the Old Cefn Bridge (Chain 770),
- next to overflow 2 (Chain 730),
- Chain 680,
- Chain 670,
- Chain 660,
- Chain 540,
- Chain 510,
- Chain 500 to 490,
- Chain 470,
- Chain 450,
- Chain 425,
- Chain 410,
- Chain 390 to 400,
- Chain 280 to 310,
- Chain 270 to 230,
- next to overflow 1 (Chain 80),
- Chain 30.

A number of displaced sleeper stones were noted within the river at the northern end of the site. A 4m length of concrete kerb stones was set into the surface of the Tramroad at Chain 305 and displaced sleeper stones were also noted in this location, both on the surface of the Tramroad and on the river bank a few metres to the north at chain 297 (fig. 19). Damaged sleeper stones were noted in a number of locations (Chain 140, Chain 290, Chain 525, Chain 535, Chain 730), although many were masked by overlying deposits and it is likely that more damaged sleeper stones would be found if the overlying deposits were removed.

3.3 The Tramroad Revetment Wall

Along the landward side (east) of the tramroad is a revetment wall which runs from near overflow 2 (Chain 730) northwards to its termination at Chain 274. The Tramroad Revetment Wall (TRW) was very overgrown with shrubs, grasses, mosses and lichens and other vegetation and details were hard to see, except in the areas of most obvious collapse and these were recorded by photograph.

The TRW is a vertical wall of both random rubble and coursed rubble construction and for most of its length it butts against, and is mortared to, the rock face (fig. 20). Gaps between the wall and the rock face were packed with rubble and soil. The masonry was bonded with lime mortar. Around Chain 600 to 680 there was a short section of free standing wall. This was not recorded in detail as it lay within an area contaminated by Japanese knotweed.

The TRW is, on average, 2.2m, in height with a maximum height of 2.5m towards the southern end, whilst at the northern end it was decreased to around 2m in height. The northern end of the TRW terminates in a curved terminal at Chain 220, and blends the TRW into the Embankment Retaining Wall (ERW; see below). At Chain 537 there is a step in the TRW, taking the wall eastwards by around 1m and widening the track bed of the tramroad.

The TRW is roughly faced on its outward (west facing) side, and was built predominantly of local limestone. In some places rounded river cobbles were also used in the wall construction. The stones varied in size, ranging from 0.20m by 0.30m to 0.1m by 0.1m. The TRW is built on the same level as the tramroad, bedded onto either the old ground surface, rock cut shelf or made ground, depending on its location.

At chain 660 two walls project out at right angles from the TRW and appear to butt against it (fig. 20). It is thought likely that they are a later feature although their function is unknown. An information plaque is affixed to the south face of the southern wall. The two walls project for a length of 1m (E-W) from the TRW, are 0.48 wide and are set 1.2m apart and survive to a height of 1.8 to 1.9m. The two walls are of coursed rubble construction, rough faced on both sides with dressed masonry on their Western ends, and both have a cap of bricks. The northern wall has four bricks placed lengthwise along its long axis and are possibly an original feature. The southern wall has three similar bricks surviving. The southern wall has been repointed relatively recently, probably part of the restoration work undertaken in the last decade. Around 7m to the south of the projecting walls a 5m long section of the TRW has been repointed, while 10 m to the south is another 2m section of repointing with isolated patches of repointing noted between these two main areas of repair. A 9m length of repointing was noted just to the south of Chain 280 and continued south to Chain 290. At Chain 580 is a 42m long section of repointing. This, again, appears to be relatively modern and has been outlined with a trowel point.

At Chain 579 is a feature inset into the wall, possibly a blocked entranceway, which appear to be part of the original design (fig. 22). The walls of the feature are 2m high and are set 1.4m apart, and two mortared stone steps lead from the tramroad into the space between the walls. The structure is located at the south-western corner of the remains of a building positioned on the eastern side of the TRW, and the two may be associated. The building on the eastern side of the TRW was located in an area of the site that was contaminated with Japanese Knotweed and was overgrown with shrubs and small trees. A limited period of access was possible during the excavations associated with the construction of a link walkway between the Tramroad and the Leat, and a rapid recording of the building was undertaken (see section 3.6 below).

At the north-western corner of the inset structure, at Chain 564, the TRW steps inwards (east) and a section of the wall contains bricks, replacing a masonry block which had been displaced. In this location, tucked into the corner formed by the step was a dressed masonry block with a carved capital letter G on its northern face. The carved stone was not visible until the restoration work on the wall was started as it was buried under overlying deposits of soil and rotten leaves. The block was roughly square in shape and was 0.3m wide (E-W) by 0.25m long (N-S) and had a domed top (from E-W) which gave it a height of 0.33m, whilst the eastern and western sides were 0.3m in height. It was finely dressed and the letter G was well carved. The carving of the G on the block must have had a significance and it is likely to have been associated with the tramroad, perhaps as some form of distance marker.

A pipe bridge which carries a 350mm diameter water main and two high voltage cable ducts across the leat, tramroad and the Taff Fechan River is located at Chain 500. This was built in the 1970s. The water main runs below the leat to the east of the pipe bridge whilst the two high voltage cables are carried in metal pipes over the top of the leat. Directly below the pipe bridge there is a break in the TRW where an old track or access ramp ran from the leat to the south and down to the tramroad, possibly built at the same time as the pipe bridge was installed. The track or access ramp was 1.5m wide and ran from south to north. A separate section of walling was noted in the vicinity of the track. It runs parallel to the TRW for a section before joining it just to the north of the pipe bridge.

The TRW was lowered for a 10m section at Chain 540, to allow machine access to the tramroad. The machines were to be used in the restoration works and this location was also adjacent to the location for the new link walkway. In the area directly below the pipe bridge a 40m long section of the TRW was taken down and rebuilt. The TRW to the north of the pipe bridge had seen considerable collapse due to water erosion caused by the leaking leat (fig. 24).

At chain 260 to Chain 270, where the TRW meets the ERW, a rectangular concrete structure was recorded at the track level, adjacent to the bedrock wall forming the eastern side of the tramroad. It comprised a flat platform of poured concrete with modern pre-formed concrete kerb stones randomly set into its western edge. It measured 6m in length and 1.2m wide and was 0.15-0.2m high. It was probably constructed as the base for a temporary storage shed or a hard standing for the storage of materials during the rebuilding works that were carried out in 2002 and 2008.

3.4 The Embankment Retaining Wall

The Embankment Retaining Wall forms the western side of the elevated section of the leat, extending from the leat level to the level of the tramroad below (fig. 26). It runs from Chain 266 northwards until Chain 50 where the level of the leat becomes the same as that of the tramroad. At the southern end of the wall the masonry was built on to a shelf of the bedrock, between 1m and 3m above the level of the tramroad. The level of the bedrock gradually decreases until by Chain 220 the embankment wall extends from the tramroad surface level to the level of the leat.

The Embankment Retaining Wall is nearly vertical for around 2m to 4m in height and stepped above, with 4 steps joining it to the leat wall. The wall is built from random coursed rubble with an average block size of 0.3m by 0.4m, and was largely covered by mosses and lichens that were not removed during the works. Lengths of the upper, stepped, section were able to be examined from above and it was noted that there were a number of places where two courses of bricks had replaced the original stonework of the upper step. These brick courses are thought to be repairs to the original leat structure.

From Chain 130 northwards the vertical section of the wall disappears, as the levels of the leat and tramroad start to converge, with only the stepped masonry separating the tramroad and the leat wall (fig. 27). The steps are largely brick built, with a masonry capping, which suggests a large scale rebuild of the northern end of the leat at some point. Other sections of brickwork within the embankment wall suggest that multiple phases of rebuilding/repair were necessary over the working life of the structure.

3.5 The Leat

The leat runs southwards from the end of the covered intake structure at Chain 0 for a length of 810m to its entry into the covered section that flows into Cyfarthfa Lake. For the remainder of its length the leat is an open channel feature (fig. 28). The Leat is 1.8m wide and has fall of 1:100.

The southern open channel section of the leat, to the south of the 375mm twin pipe section at Chain 807 was located outside the area of the site and was not examined in detail. It was, however, noted as having a brick built wall on both sides that appeared to be of a relatively modern date. At the northern end of the open channel area was a concrete structure which held the twin pipes that carried the water of the leat between the open channel to the north into this, final, section of open channel. The piped section, that ran from Chain 749 to Chain 807, was constructed sometime prior to 1992. The pipes were laid within the cut for the original leat. They were replaced during the restoration work.

In the area now occupied by the twin pipes the western side of the leat comprised a brick built wall of relatively modern date, while the original eastern wall of the leat was not visible. At Chain 785 a 2m long section of masonry was identified on the eastern side of the leat during works to repair a leaking water main (fig. 29). The masonry survived as a single course of roughly coursed rubble with blocks of 0.2 to 0.25m in height and 0.3 to 0.5m in length. It was not possible to determine whether the blocks were bonded, although this is likely. The masonry section was located 2.3m to the east of the western leat wall making the channel here wider than the rest of the leat. The 1875 map (fig. 2) shows that the leat channel does widen at the southern end, in the area where the line of the leat curves eastwards away from the route of the tramroad (between Chain 550 and Chain 770). It is unclear what function this would have served, but does account for the missing eastern wall which is likely to be buried below the eastern bank.

North of the piped section, Between Chain 740, near Overflow 2, and Chain 716 a poorly constructed section of walling was identified on the eastern side of the leat. This was 24m in length and comprised uncoursed rubble, bricks and concrete kerbstones and had been partly constructed on top of a row of loose, unmortared, concrete kerbstones of relatively modern date. This section of rough walling was 0.5m to 0.6m high. At the northern end of this section of rough masonry, and continuing northwards for 25m, a modern sandbag wall formed the eastern side of the leat. From the northern end of the sandbag wall to Chain 520, close to the pipe bridge, no evidence was found for the existence of an eastern leat wall. Instead, the modern leat channel was cut through accumulated soil and rock. Adjacent to the southern side of the pipe bridge, from Chain 500 to Chain 518 an 18m long stretch of poor quality walling was identified on the eastern side of the leat. This was similar to the walling noted around Overflow 2, and comprised roughly coursed stone and concrete blocks facing a patchy rubble infill that had been mortared using cement. The rough walling was 0.8m high and is of relatively recent date. During the demolition of this section of walling it was revealed to have been built on top of an earlier wall constructed from stone blocks mortared to the rock face. This masonry is thought to be the remains of the original eastern leat wall, which survived for around 10m.

The southern section of the western leat wall, within the piped section, comprised an 18m long stretch of relatively modern brickwork. The brickwork survived to between 5 and 8 courses high and was mortared in places. To the north of the brick wall, between Chains 790 and 780, a 10m long stretch of coursed masonry made up the western side of the leat. This had been

built using dressed and faced blocks of limestone which appeared to have been partly covered, on the internal side, by a lime render. Only the upper two courses were examined in any detail and these were constructed from dressed blocks ranging from 0.3m to 1.85m in length. Around Chain 778, the western leat wall turned north-east and returned to a brick construction. The bricks within this section of wall butted against the masonry of the section immediately to the south and appear to be a later rebuild. The brick wall was 6 courses high and was in a poor condition, with lifting of the brickwork in some areas and also misalignment of the bricks and missing mortar from many of the joints. The poor condition of the wall explains the decision to pipe the water past Bridge House. The brickwork in the southern section of the western leat wall was laid as stretchers, topped by two courses laid as vertical headers.

The pipe bridge marks a clear divide in the structures of the leat, with the walls to the north of it, Chain 500 to Chain 0, being stone built. The western leat wall comprised four courses of dressed limestone blocks, which were laid on top of the upper stepped course of the embankment retaining wall. The stones in the lowest course were of variable sizes and did not appear to have all been faced, and it is thought that this course provided the foundations for the upper three courses. The middle two courses comprised square faced blocks, ranging in size from 0.25m to 0.5m in length and roughly 0.35m high, mortared in lime. The stones making up the upper course were larger, between 0.75m and 1.25m long and 0.35m high. A 26m long section of the western leat wall, extending 16m south of the pipe bridge and 10m north of it, had a skim of modern concrete applied to the internal face that may relate to the insertion of the pipe bridge or to works to fix leaks. The eastern leat wall to the north of the pipe bridge was of the same coursed masonry construction as that detailed for the western leat wall and generally survived in a better condition with fewer traces of earlier repairs having been undertaken.

A series of recent repairs had been undertaken to the leat (fig. 30) and these, along with earlier repairs/modifications, were visible in the masonry. The recent repairs included the laying of a waterproof liner in some areas of the leat, undertaken in 2008 by Merthyr Tydfil County Borough Council. The butyl liner was attached to the inside face of the leat walls by wooden batons, and were clearly visible from Chain 490 to Chain 330. Other repairs were undertaken by the Council in the summer of 2001 when at chain 400 a 24m long section was rebuilt following a collapse in March 2000. A number of other sections of repair were noted on the western leat wall, sections where brickwork had been added to the upper course of the leat walls and also sections where brick appeared to have been used to replace the masonry:

- A 16m long section of brickwork was noted 11m to the north of Overflow 1,
- A 3m long section of brickwork on top of the masonry was noted at Chain 160,
- A 14m long section of brickwork made up the western leat wall at Chain 150,
- A small brickwork patch was noted at chain 228,
- A 3.3m long stretch of brickwork was noted at Chain 130,
- A small brickwork patch was noted at Chain 110,
- An 8m long stretch of brickwork was noted at Chain 8,
- A short section of aero bricks were noted at Chain 394. These were cemented to the inner face of the western leat wall next to a section of the Butyl liner,
- Bricks were set into the top of the leat to replace a missing masonry block at Chain 340,

- A 1.5m long stretch of bricks was noted at Chain 294,
- A 1.2m long stretch of bricks was noted at Chain 276,
- A small patch of bricks was noted at Chain 91,

There was also considerable damage to the western leat wall at Chain 100 with a 12.5m section of displaced masonry with very wide joints.

There were also some sections of damage/repair noted in the eastern leat wall:

- A single concrete block, 1m in length, had been inserted to replace one of the upper masonry blocks at Chain 475
- A missing block from the upper course of masonry was noted at Chain 470 and Chain 465
- A section of partly displaced blocks was noted in the upper course at Chain 457, with two blocks missing at the northern end of the displaced blocks at Chain 451,
- A 3m long section of missing upper course blocks was noted at Chain 448,
- A partly damaged block was noted in the upper course at Chain 360,
- Two damaged upper course blocks were noted at Chain 359,
- Missing and displaced upper course blocks were noted at Chain 346, Chain 322, Chain 304, Chain 280 to 290, Chain 274, Chain 123 to 130 and Chain 98
- Minor damage to the upper course masonry blocks was noted at Chain 212 to 218, and Chain 204,
- Partly displaced upper course blocks were noted at Chain 156 to 160,
- Between Chains 100 and 107 a course of masonry blocks was noted overlying 8 courses of brickwork. This is one of the few sections that show signs of earlier repairs or restoration having taken place on the eastern leat wall. At both ends of this section the brickwork clearly butts against and was built over the lower courses of the original masonry,
- A section where the upper course is increasingly displaced and falling in between Chain 90 and Chain 60 where another section of brickwork has been inserted into the fabric of the eastern leat wall,
- From Chain 50 to Chain 0 the masonry was in a poor condition with sections of the upper courses displaced and falling in.

All of the damaged sections on both eastern and western leat walls were repaired during the restoration works.

The Leat was filled with a dark brown silt up to 0.45m deep, which contained frequent stones, pieces of metalwork (including tramroad chairs), glass bottles and modern debris. Puddle clay was revealed below the silt along short stretches just to the north of Overflow 2 and to the north of the pipe bridge, but in the main the base comprised a pale red brown gritty silt. In one location, between Chains 394 and 416, the base of the leat had been covered by tarmac.

Two overflow structures are located on the western side of the Leat (fig. 31), one at Chain 66 to Chain 82 (Overflow 1) and a second located at Chain 730 to Chain 742 (Overflow 2).

Overflow 1 regulates the level of water within the leat by means of a weir which discharges excess water into the river through a culvert. The overflow is 15m in length and 0.8m wide and consisted of vertical walls enclosing a roughly rectangular trough. The walls are constructed

from coursed rubble and abut the outer side of the western leat wall. The walls are render covered and overlies a channel cut into the ground which feeds a culvert beneath the tramroad. A 1.7m long section of the upper course of masonry of the western leat wall had been removed to form the overflow and signs of a butyl liner were visible under the masonry just to the north and south of the removed masonry. The culvert below the tramroad is certainly contemporary with its use, as the presence of bridging sleeper stones (discussed above) attests, however it is not clear whether or not the weir structure represents later alterations to the overflow.

Overflow 2 is a modern feature designed to divert excess water from the highway drainage in Lakeside Gardens. The spillway consists of a brick structure inserted into and on top of the earlier brickwork of the western leat wall, which contains two shallow open runoffs and a sluice with a mechanical sluice plate. The overflow is 10m in length and has a concrete sloped ramp on its western side, placed centrally to allow the excess water from the Leat to cascade over the rock face and fall into a pool at base of the rock face. The water from the pool flows through a channel cut/eroded through the tramroad and into the river.

3.6 Watching Brief during the construction of the link walkway.

The excavations for the construction of the ramp for the new link walkway involved the removal of the topsoil deposits in a section that ran diagonally north-westwards from the western side of the leat at Chain 600 to join the Tramroad adjacent to the pipe bridge at Chain 500. This area contained large quantities of dumped material, including bricks thought to have been brought to site during one of the phases of repair to the leat walls, and household rubbish. On the slope to the west of the ramp a section was excavated to allow for the placement of a number of Gabion baskets. This involved minor terracing of the bank and exposed a deposit of stone aggregate probably associated with the construction of the pipe bridge in 1970.

On the southern side of the location of the Gabion baskets the remains of a structure located behind the TRW were partially revealed and recorded (fig. 32). The structure was only visible along its western and northern sides, and was largely covered with vegetation and rubble. The western wall consisted of large dressed masonry blocks, 0.8m long and 0.35m high, with chamfered edges, mortared with lime, and was at least 5m in length. Overlying the masonry was a section of walling that it was not possible to examine in detail but is likely to have been of mortared stone construction. A number of bricks were noted amongst the rubble in this area and it is possible that the structure was partly brick built. The northern wall of the structure was visible for a length of 5m and survived to a height of less than 0.5m. The wall did, however, protrude from a bank of rubble of a similar height, which may have been covering the bottom of the wall. The northern wall was constructed from finely dressed masonry blocks, one of which was noted as being chamfered on its end. This structure is likely to have measured around 10m by 10m externally, with an internal area of 6m by 6m. It is probable that more of the remains of the building were buried beneath the overlying vegetation and overburden/rubble or had been removed at some time in the past. A structure is depicted in this location on the OS 1:2000 map from 1875, however there is no indication of its function. It is, however, undoubtedly associated with the operation of the leat and tramroad.

4. Summary and Conclusions

The Gurnos tramroad was conceived and built by Richard Crawshay in the early 1790s, following the approval of plans by the Glamorganshire Canal Company under the four-mile clause in 1792. The tramroad, probably followed the route of an established horse pack trail

between the limestone quarry at Gurnos and the Cyfarthfa ironworks, as the quarry had been operational for 20 years prior to the granting of a railroad license. The earliest infrastructure on the site is thought to have comprised a railroad with cast iron bar edge rails mounted on wooden sleepers along which wagons fitted with flanged wheels, to fit on the rails, would have been pulled by horses. No trace of this railroad exists on the site. In the early 1800s the railroad was converted to a tramroad, with the iron bar rails replaced by L-shaped plates set onto stone sleepers. The flange on the inner edge of the plate would have held the straight wheels of the wagons in place as they were pulled along the track. The earliest plates identifiable from the wear marks on stone sleepers are of Outram style, a heavy rail, 3ft long, with lugs on the inner edge to increase stability (Van Laun 2001). The rails would have been attached directly to the sleeper stones by means of a single iron pin fixed through the connection between two rails into a pre-drilled hole in the stone. Traces of this single pin fixing can be seen on a number of the visible sleeper stones along the length of the tramroad. Later developments on the tramroad involved the replacement of the original Outram-style plates with plates that sat in chairs, the chairs being attached to the sleeper stones. At least two types of chair have been identified at Gurnos, by Van Laun and the present study, identifiable through the wear marks left on the visible sleeper stones. This indicates that the track was completely re-laid twice in the life of the tramroad, in, suggests Van Laun (2001), the 1840s and again in the 1880s, and was also subject to repairs as and when necessary.

The survey carried out prior to and during the consolidation works on the tramroad revealed that there are 731 visible in situ sleeper stones within the scheduled area, predominantly located in the central and southern section of the tramroad, south of Chain 170. A further four sleeper stones were identified in a drainage channel cut across the tramroad at its northern end. These were buried under a deposit of soil and it is likely that many more stones at the northern end of the tramroad are also preserved below a modern soil build-up. A number of sleeper stones were also identified in the river, having been displaced from the tramroad.

The tramroad is predominantly a single track line along its length. Around Chain 650 there were indications of a possible second line of sleeper stones, putatively identified as a sidings or a double section of track, designed to allow trams to pass each other. This possible second section of track was, however, obscured by vegetation and modern soil build up at the time of the Total Station survey. Plans to reveal the track bed of the tramroad during consolidation works were abandoned and consequently it was not possible to investigate the areas of possible double track in any detail. It would not, however, be unexpected to have sections of double track on a tramroad of this length.

The tramroad was built on a platform between 2m and 9m wide that was constructed by cutting into the rock face on the western side of the Taf Fechan gorge. On the western side of the tramroad, at the southern end, a retaining wall was constructed to prevent damage to the tramroad from the river. Despite initial plans to undertake consolidation work on this wall it was not carried out as part of the current works. The wall is in a poor state of repair and will require consolidation works in the near future to prevent collapse.

The eastern side of the tramroad was defined by the tramroad revetment wall at the southern end, between Chain 274 and Chain 730. The wall abuts the rock face along much of its length,

having been mortared directly to the rock, and may have been constructed to prevent collapse. In two places, the remains of possible structures were identified. One of these had steps leading into a possible entrance feature, and may be related to the remains of a building identified on the western side of the revetment wall. The function of both of these paired wall features remains unknown, but they are thought to be related to the use of the tramroad. The discovery of a stone carved with an elaborate 'G' adjacent to the northernmost of these putative structures is interesting, and although its function is unknown it is possible that it was some kind of distance marker.

The history of the leat is recorded in less detail than that of the tramroad, but it is likely to have been built at the same time as Crawshay's 1792 railroad. The leat supplied water to the Aeolus waterwheel in the Cyfathfa ironworks which was existence by the mid-1790s giving a *terminus ante quem* for the construction of the leat. In practical terms, it would have been extremely difficult to build the leat once the railroad was in use, so it seems probable that the two would have been contemporary. The structure of the leat revealed that it has undergone a number of phases of repair since its construction, with bricks replacing stone in many places, and a modern butyl liner and a tarmac coating of the leat base representing the most recent repairs. A 50m stretch of the southern end of the leat had been replaced, in the later twentieth century, by pipes. This had occurred in an area of the leat containing significant evidence for repairs and rebuilding, and may have been a particularly problematic section. It is also adjacent to Bridge House, and it is possible that damp problems caused by the leaking leat prompted the laying of the pipes. At the southern end of the leat much of the original eastern wall was not identified. One small section of the original line of the wall suggests that it was further east than the modern leat edge. This concurs with the 1875 map (fig. 2), which shows two sections of the channel that are notably wider than the rest of the leat. The original design of the leat appears to have used puddle clay to seal the base, with the side walls constructed from limestone blocks mortared with lime. Significant repairs were undertaken along the length of the leat during the current works to reduce leaks and strengthen the structure to ensure its long-term survival.

The Gurnos Leat and Tramroad date from the early 1790s and were built by Richard Crawshay to supply limestone and water to his ironworks at Cyfarthfa. The two structures would have been part of a network of infrastructure in the landscape, including aqueducts, bridges, weirs and a canal, that all serviced the needs of the Cyfarthfa works. The leat was built to supply water to the Aeolus waterwheel and would have remained in use until the water powered bellows were replaced by steam power in the mid-nineteenth century. The leat was then diverted to feed the lake in front of Cyfarthfa Castle, which functioned as a balance pond for the ironworks (GGAT 2005). The tramroad was initially constructed as a rail road, with edge rails, but was converted to a tramroad, with flanged plates, in the early 1800s. The tramroad underwent two further episodes of redesign, with the original plates replaced by different styles of plates set within chairs, before finally going out of use, probably in the early twentieth century. The structures are highly significant features within the former industrial landscape of northern Merthyr Tydfil, and survive in a relatively good state of repair.

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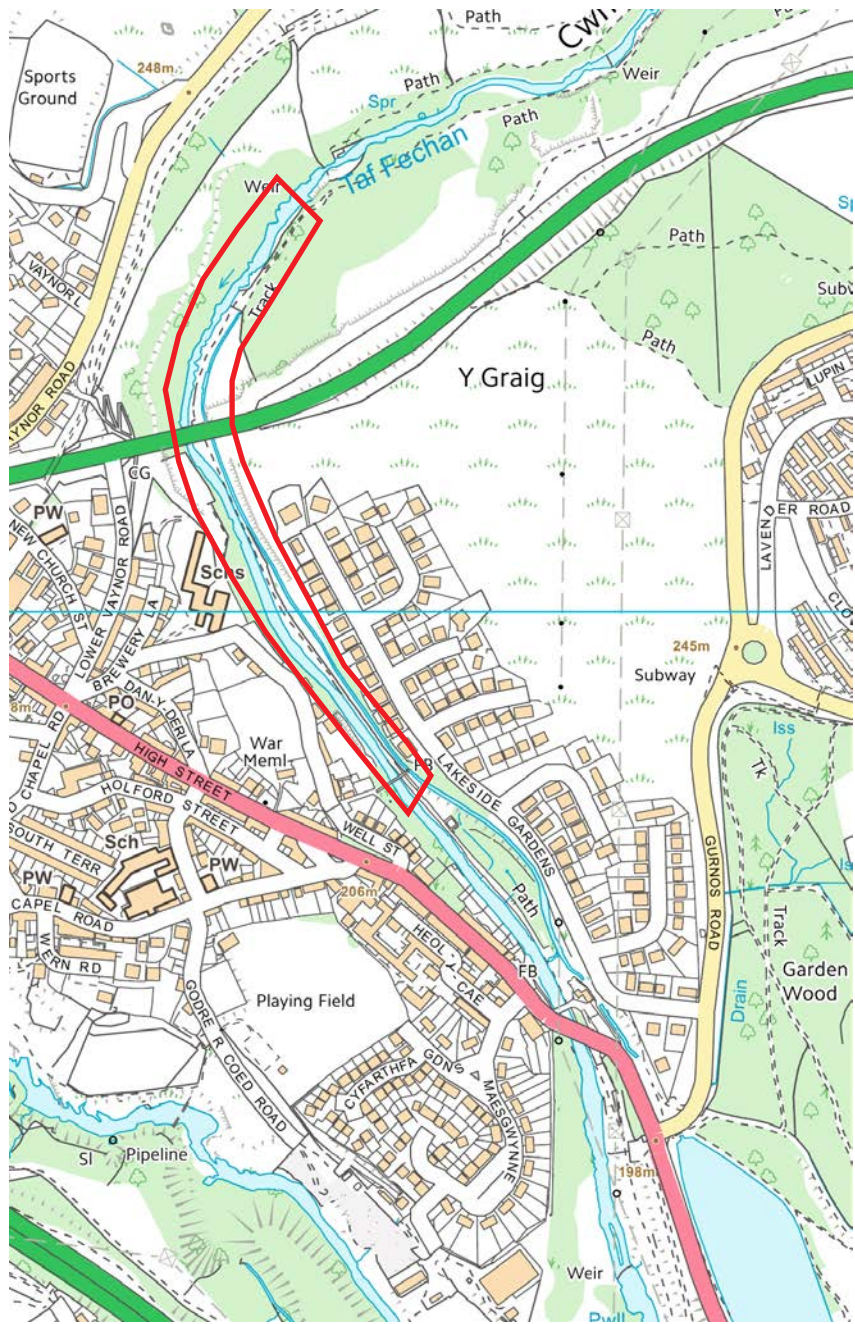


Fig. 1
Location of
site



County: GLAMORGANSHIRE, Date(s): 1875 Survey scale: 1:2,500 (c) Crown copyright and Landmark Information Group Limited 2015. All rights reserved.

Fig. 2
1875 OS map of the
Gurnos Quarry area
showing the leat and
tramroad

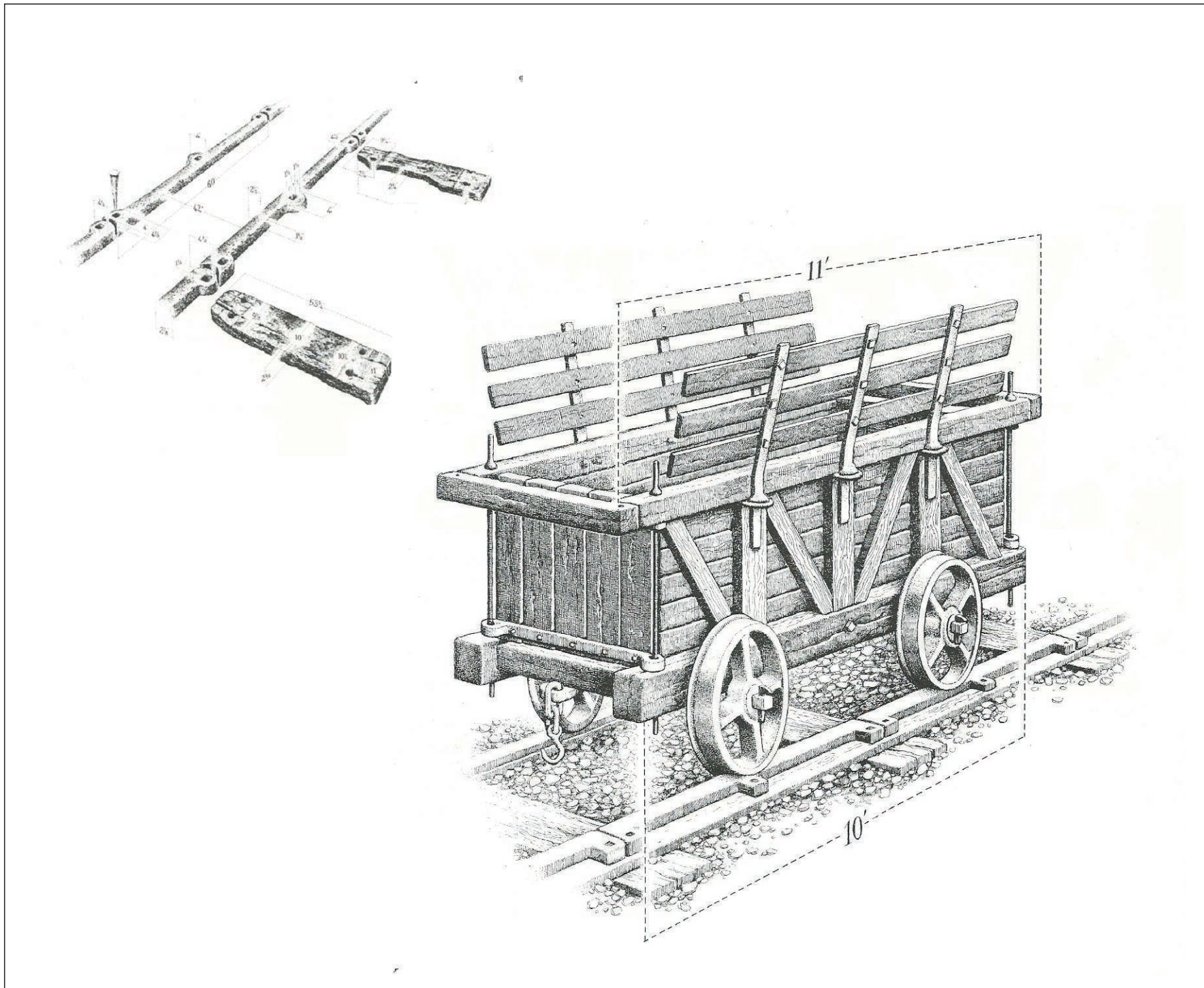
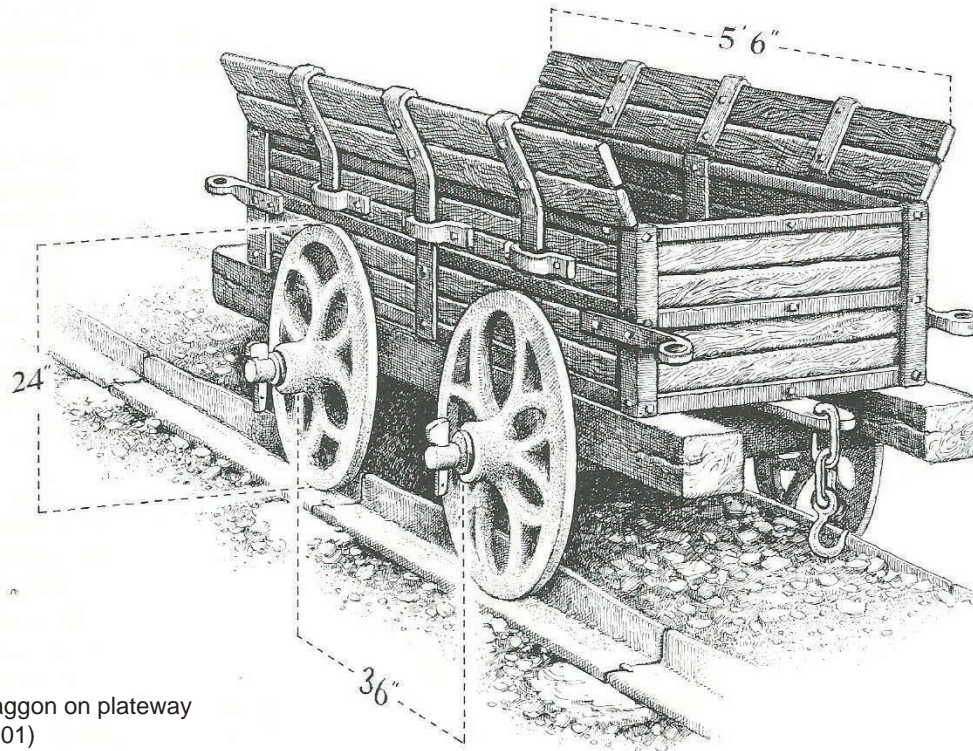


Fig. 3
Early style of railroad
bar edge rails and
tram waggon
fitted with flanged
wheels (from Van
Vaun 2001)



a. In situ plateway at Cribarth Quarry (from Hughes 1990)



b. Illustration of wagon on plateway (from Van Laun 2001)

Fig. 4
Tramroad/plateway
rails and wagon



Fig. 5
Wear marks from
Outram style plates
on sleeper stones at
Chain 80

Scale = 2m and 0.3m



Fig. 2
View N along the tramroad from chain 265 showing the leaf retaining wall overgrown with vegetation

Scale = 2m



Fig. 6
Painting by Childs
showing the Dowlais
ironworks with a
tramroad wagon
in the foreground
(c) Gathering the
Jewels



Fig. 7
View N along the tramroad showing the overgrown vegetation on the revetment wall and the water on the track. Taken prior to consolidation works starting.

Scale = 2m and 1m



Fig. 8
View S along
tramroad showing
in situ sleeper
stones

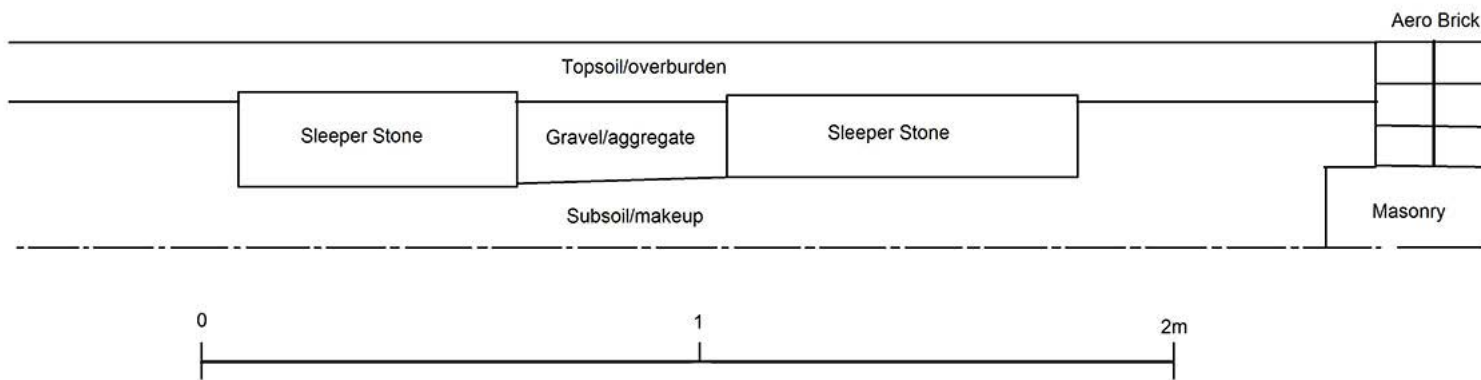
Scale = 2m



a. Viewed from the S



b. Viewed from the E



c. Measured section through drainage channel

Fig. 9
Drainage channel
cut through the
tramroad at Chain 2

Scale = 2m



Fig. 10
In situ sleeper stones
with broken plastic
drainage pipe
buried below at
Chain 676



Fig. 11
Sleeper stones
with wear marks
from successive
chairs

Scale = 2m and 0.5m



Fig. 12
Examples of wear
marks and spike
holes on sleeper
stones

Scale = 0.5m



Fig. 13
Examples of wear marks from multiple chairs on sleeper stones

Scale = 0.5m



Fig. 14
Wear marks from
chairs showing them
set at different angles

Scale = 0.5m

Wear from tramwheel

Wear from rail



Fig. 15
Sleeper stone with
wear marks from
rail and tram wheel

Scale = 0.5m



Fig. 16
Iron plate found
in situ on the
tramroad



a. Two type B chairs



b. A type A chair



c. A type B chair

Fig. 17
Chairs found
during the watching
brief

Scale = 0.5m, 0.3m
and 0.1m



0

100mm



Fig. 18
A rail spike found
in situ on the
tramroad



Fig. 19
Displaced sleeper
stone found slumped
into the river at
Chain 297

Scale = 0.3m



Fig. 20
The TRW at Chain
630

Scale = 2m

Projecting walls at Chain 660



Fig. 21
View north along
TRW

Scale = 2m and 1m



Fig. 22
Possible entrance
feature inset into
the TRW



Fig. 23
The 'G' Stone found
at Chain 564

Scale = 0.5m



Fig. 24
A section of TRW
at Chain 500
during consolidation

Scale = 2m



Fig. 25
Concrete platform
at Chain 260

Scale = 2m and 0.5m

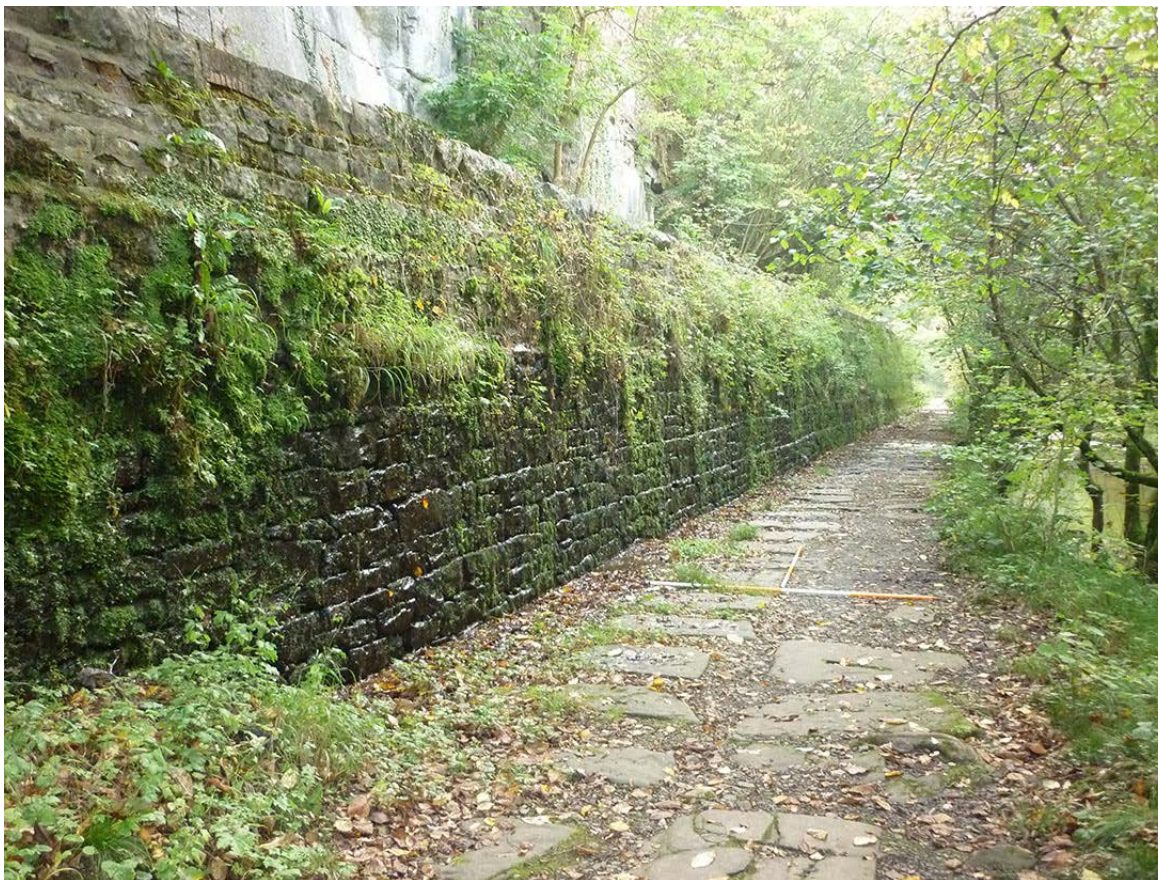


Fig. 26
View S along the
Embankment
Retaining Wall

Scale 2m



Fig. 27
Stepped wall where
the ERW meets the
leat wall

Scale = 2m



Fig. 28
View S along the
leat and tramroad
from the A465 viaduct



Fig. 29
Section of the
eastern leat wall at
Chain 785

Scale = 2m and 0.5m



Fig. 30
Evidence of repairs
to the leat

Scale = 2m, 1m and
0.5m



b. Overflow No. 2



a. Overflow No. 1

Fig. 31
The overflows on
the leat

Scale = 2m



Fig. 32
The structure
identified in the
area of the new
link walkway

Scale = 2m and 0.5m

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