IW Number 018 Plymouth Ironworks SO05530500

General Description

The Plymouth Ironworks (NPRNs 34,853, 34,114, 34,105), the second ironworks built in the Merthyr Tydfil area, is of national and international historical significance not least for being developed by pioneering ironmasters such as Isaac Wilkinson and John Guest, and later Richard and Anthony Hill, but also for its association with Richard Trevethick and the first steam powered journey by rail on the Merthyr Tramroad (NPRN 91,513).

The Plymouth Iron Works, the northernmost and the earliest of the three Plymouth Iron Works sites, was founded in 1763 by Isaac Wilkinson and John Guest on land leased from the Earl Plymouth, and two years later sold to Anthony Bacon following an initial lack of progress. Control of the works fell to Richard Hill (d. 1806) following Bacon's retirement in 1783. The works remained in the Hill family until the death of Anthony Hill in 1862, when bought by Messers Fothergill, Hankey and Bateman. The Plymouth Works relied on waterpower, long after it had become obsolescent elsewhere and in order to re-use the water supply the works was forced to expand into three separate plants, the Pentrebach Forge (IW017) and Dyffryn Furnaces (IW016) being added to the south. Steam power was finally introduced leading to a dramatic increase in output following the dry summers of 1843 and 1844. During the second half of the 19th century, obsolete technology and economics combined to the disadvantage of the Plymouth Iron Works. The lack of capital to convert to steel production finally leads to closure in 1880; though the company continued to mine its vast reserves of coal.

Little is visible today of the main Plymouth Ironworks site (NPRN 34,114), the site, dismantled in the 1880s, was largely reclaimed and landscaped during two major reclamation schemes carried out in 1974. The major exception being the tramroad tunnel also known as Trevethick's Tunnel (NPRN: 34,853; NGR SO05600482), which carries the former Merthyr Tramroad (NPRN 91,513) under the site of the ironwork's charging bank. This was the first railway tunnel used by a railway locomotive; the original tunnel has been extended to the south. The northern end is buried and both tunnels are currently inaccessible, but the south portal of the later tunnel has been retained as a feature and 'restored', with new stonework, steel grille, mosaic blocking wall and flooring.

Though reclamation has removed much of the standing structures on the site, it is considered that buried remains relating to the furnace bank may also survive, albeit in reduced state, in particular the bases of the furnaces themselves, which were of substantial construction. In addition to the furnace charging bank site (NPRN: 34,853) with its Railway Tunnel for the Merthyr Tramroad (NPRN 91,513), the Ironworks area also contained the site of the earlier Nant Cwm Blacks Furnace (NPRN: 34,105; NGR SO05550505), the original ironworks founded in 1763 by Isaac Wilkinson and John Guest on land leased from the Earl of Plymouth. While the site of Penyard Row (NPRN: 19,262; PRN 02459m; NGR SO 057049); a terrace of early industrial housing dating to before 1803 (originally 8 single storey houses) and associated with Plymouth and Pen y Darren Works, has also been included in the area. The latter two sites, like the main furnace bank (NPRN 34,853) have been demolished, their sites reclaimed and in part redeveloped. The existence/quality of any buried remains associated with these features is unknown.

Historical Background

The Plymouth Ironworks was founded in 1763 by Isaac Wilkinson and John Guest on land leased from the Earl of Plymouth. This was the second ironworks to be constructed at Merthyr Tydfil. The enterprise did not prosper although it was calculated that the furnace could produce 14 torts of pig iron per week. For each ton of iron produced it was calculated that it would take 5 tons of coal and 3.5 tons of ironstone. In 1766 the Plymouth ironworks was sold to Anthony Bacon who used it mainly to supply pig iron to his Cyfarthfa ventures. On the death of Anthony Bacon in 1788 the lease of the works was granted to Richard Hill. When Hill took over the works it consisted of a small furnace blown by bellows and a waterwheel.

By the mid 1790s the furnace at the Plymouth Ironworks could produce about 2,200 tons of iron in a year with most of this being sold to the Cyfarthfa Ironworks. The main works was enlarged as a result and in 1805 there were three furnaces at the Plymouth Ironworks, which produced 5,789 tons of iron during the year and 5,928 tons in the following year.

Despite the furnaces remaining waterwheel blown, output at Plymouth was pushed up to 7,800 tons of iron in 1815. In 1823 the three Plymouth furnaces produced 6,387 tons of iron. An additional furnace was built at the Plymouth Ironworks in 1825 and in 1826 the four furnaces produced 11,440 tons of iron.

The seven furnaces at Plymouth and Dyffryn were able to produce 18,852 tons of iron in 1830. The sale document from an attempted sale of 1834 provides a detailed description of the Hill undertakings at the time. The main Plymouth property comprised four furnaces, capable of producing 500 tons of iron per week, the blast was provided by two waterwheels about 8ft. wide with a 28ft. head of water from the Taff. The combined Plymouth and Dyffryn sites also boasted thirteen running out fineries, a foundry with air furnaces, a cupola, stoves, a crane, a carpenters' shop, a smiths' shop, a lathe and two hundred workmen's houses. The brothers also owned a rolling mill and puddling forges worked by two waterwheels of l0ft. and 6ft. widths with a 24ft. fall of water and capable of producing three hundred tons of finished bars per week.

The reputation and successful marketing of the products from the Hill concerns allowed the partners to undertake a programme of expansion during the 1850s. In the early part of the decade two blowing engines were purchased. These were two out of only four horizontal engines used for furnace blowing in South Wales. Additional furnaces were also built, for the two works were operating nine furnaces by 1854, ten in 1856 and eleven in 1862. At this time the works were producing 40,000 tons of iron yearly.

From 1863 the Plymouth Ironworks and its subsidiaries were linked with Fothergill's Aberdare works through sale. By 1865 Fothergill had modernised some of the plant at the works, although the furnaces continued to be blown by cold blast. Fothergill had reduced the number of furnaces in blast to ten, increased the number of puddling furnaces by eight, added more steam power, increased the speed of the blowing engines and purchased two steam hammers for the works. There were four forges and nine mills at the three sites capable of turning out bar iron of a diameter from 3/16 to óin. Nearly the whole of the mineral ground was drained by an engine, which was built in around 1852. This was an 85in. x l1ft. Cornish beam engine built by the Perran Foundry, which in 1865 was working at 25 psi making 3 to 6 strokes per minute while raising 134 gallons each minute.

There was some reduction in output during the late 1860s for in 1867 only seven out of the ten furnaces were in blast. The extent of the Plymouth undertakings can be gauged from a description of the works written in 1869. Six locomotives conveyed materials at high level from the pits to the works while on the lower level six tank engines on a 4ft. 8½in. gauge line transported materials to the Taff Vale Railway siding. All the Plymouth Company's furnaces were about 40 to 50ft. high with 16ft. being the greatest diameter in the boshes. Weekly pig iron production was 90 to 110 tons per furnace using Welsh mine and haematite. The iron ore was calcined in kilns behind the furnace tops while the coal was coked in open clamps. At the Plymouth Ironworks there were five furnaces with three of them in blast. The furnaces were blown with a cold blast provided by two waterwheels working four 66in. blowing cylinders, a 45in. horizontal engine with a 90in. blowing cylinder and a 52½in. beam engine with a 122in. blowing cylinder. There was no blast regulator as the blast was equalised by the number and size of the blast pipes.

Rail orders continued to be placed at the Plymouth Ironworks with large contracts being completed in 1872 for India, Canada and the Great Western Railway. However, the number of furnaces in blast was reduced to four and by 1874 only two furnaces were being worked. In 1875 the Aberdare and Plymouth Ironworks Company collapsed with the ironworks side of the business never to be reopened. The works were put up for sale in 1882 but no purchaser was found and in the following year the dismantling of the buildings commenced (Ince 1993, pp 53-57).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on estate and other plans, including the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are in the form of Business development and industrial development specifically known as E4 and E4a Reclaimed land site for the Dragonparc development.

Figure 23a Plymouth Ironworks IW018

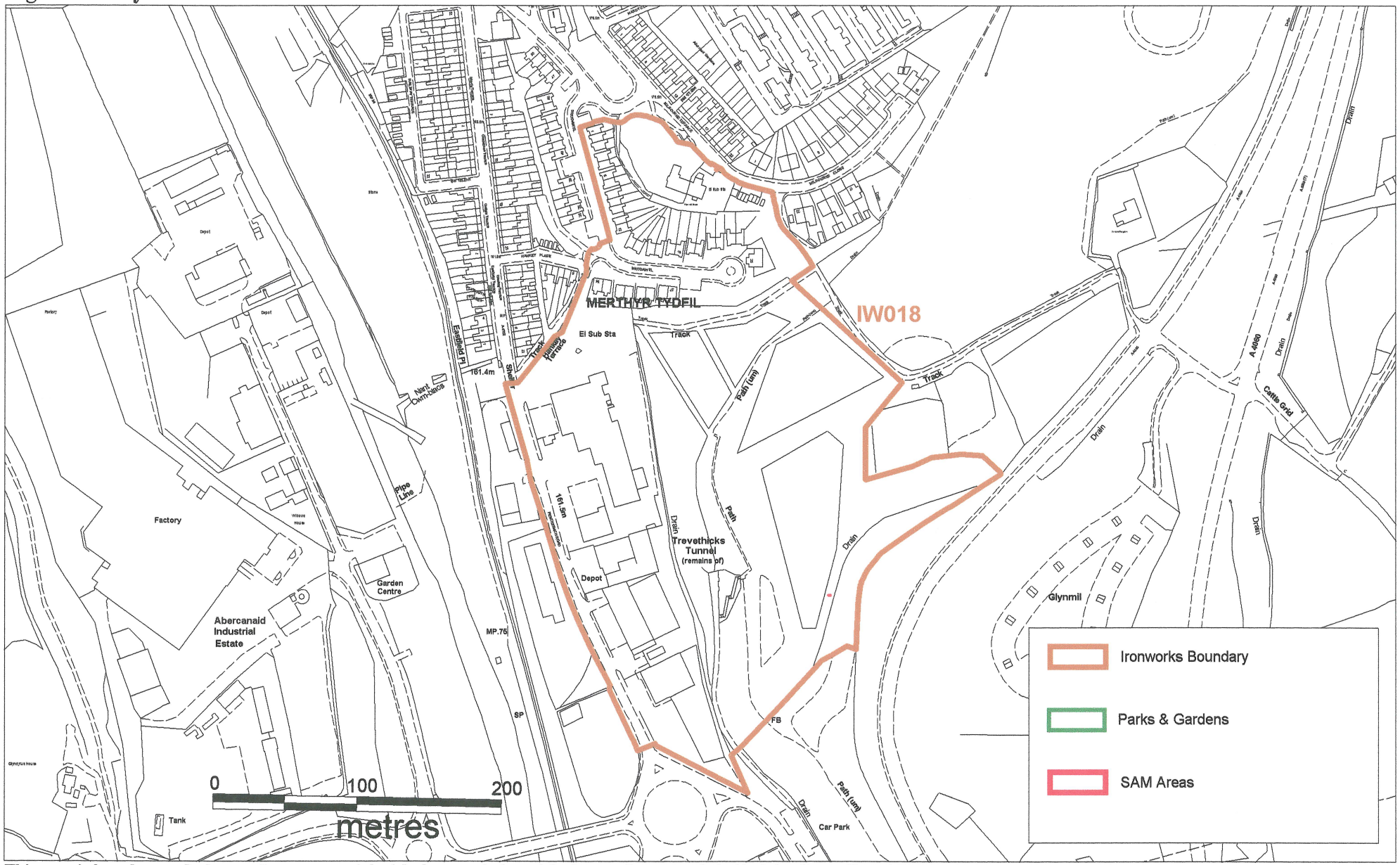

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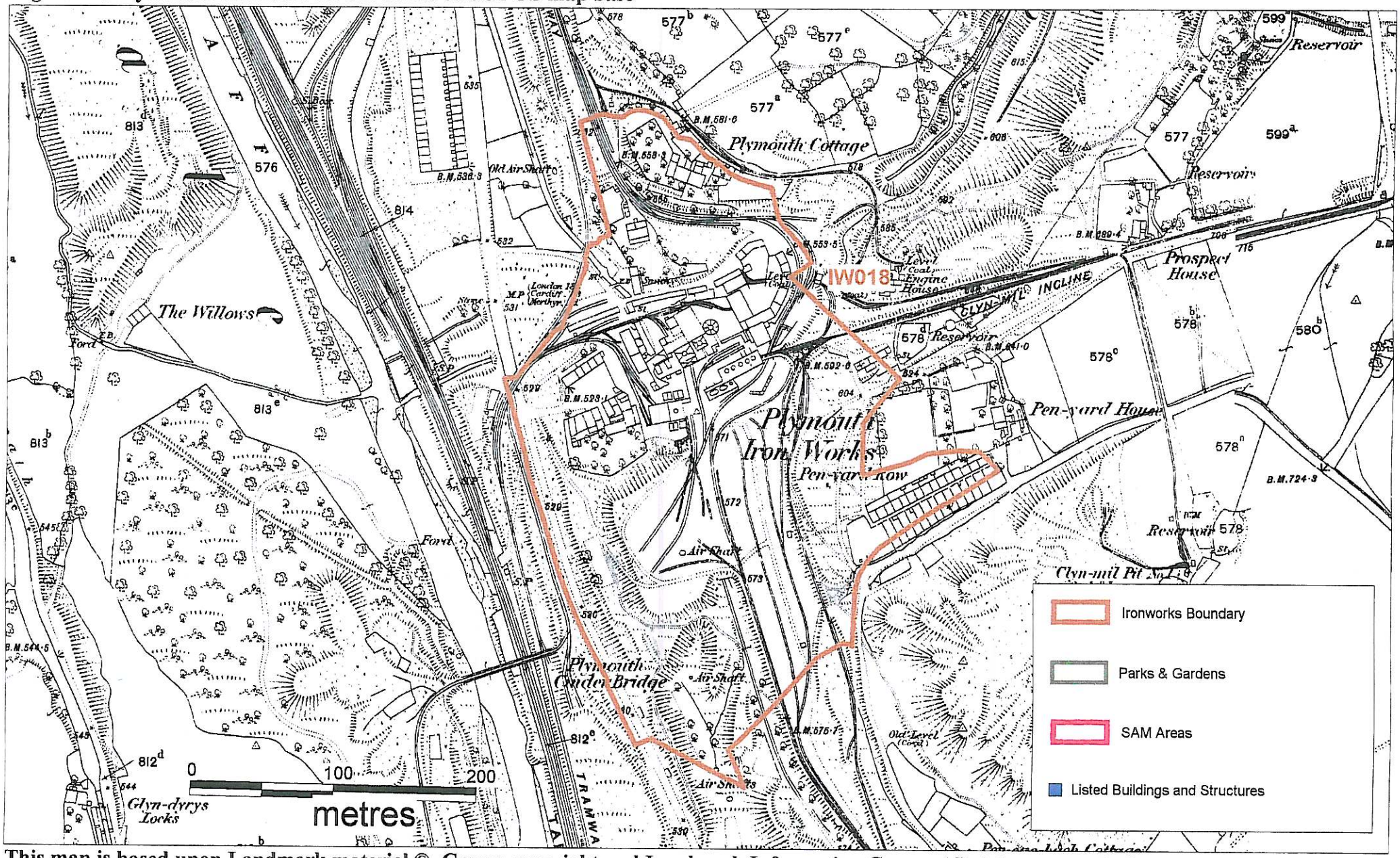
Figure 23b Plymouth Ironworks IW018 on 1st edition OS map base



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IW Number 019 Ynys Fach Ironworks (00964m and 01263m) SO04550605

General Description

The Ynys Fach Ironworks (NPRNs 31; 33,724; and 34,122; PRNs 00964m and 01263m; SAM Gm331), is a nationally important ironworks of early 19th century foundation and is a well presented and interpreted site with good survival of both standing structures and buried remains which extend beyond the area currently protected through legislation (ie beyond the SAM area).

The impressive remains at Ynys Fach represent one of the better-preserved 19th century ironworking complexes still visible within the Merthyr Tydfil area. The site is noted for its association with the early ironworking dynasties of Merthyr Tydfil and experienced expansion under Richard and William Crawshay. It is also noted for being the second in the area to employ steam-blowing engines. However, the site has always played a secondary role to the main works at Cyfarthfa.

For the purpose of the current study the Ironworks site comprises not only the scheduled (SAM Gm331) area, but also the immediate surrounding area. The scheduled area takes in the remains of the blast furnaces (PRN 01263m), a block of 4 furnaces with an engine house freestanding at the N end. The arches have been blocked with brick. Over the third from the engine house is a cast iron plaque inscribed 'WC 1836'. The Furnace block survives in generally good condition, though further remedial work to the masonry of may be necessary to guard against water ingress. The extension of the previously conserved and presented area might be considered for the future. The educational and tourism potential value of the area would benefit from enhanced presentation, perhaps through on site information panels and improved access.

The other main standing structure within the core area is the impressive listed engine house (Grade II* Cadw ref 16073; PRN 01623m; NPRN 33,724), currently in excellent condition, having been restored by the Merthyr Heritage Trust. This engine house was built *c.* 1836 to replace an earlier one depicted in *c.* 1815 by an important local artist, Penry Williams. Merthyr College of Further Education (modern five-storey concrete slab structure of 1950-2, by Yorke, Rosenberg & Mardall) is located over much of the remainder of the area.

Historical Background

The initial development within the historic landscape area of Ynys Fach Iron Works Area emerged as direct result of the American War of Independence (1776-1783), when a foundry was established to cast cannon and cannonballs. Francis Homfray leased the foundry in 1782 to cast cannon from pig iron supplied by the nearby Cyfarthfa Furnace, but was soon after succeeded by Richard Crawshay of Normanton, Yorkshire, who later gained control of the Cyfarthfa Works themselves. The Ynys Fach Iron Works opened as an extension to Crawshay's Cyfarthfa works in 1801 and despite being the second in the area to employ steam-blowing engines, after Dowlais, it generally played a secondary role to Cyfarthfa.

Two furnaces put in blast in 1801, increasing to four in 1805, when it produced 10,460 tons of iron. Expansion continued for in 1807 there were six furnaces at the two sites, two rolling mills and four steam engines (50h.p., 40h.p., 12h.p. and 7h.p.) During the period, Cyfarthfa was the largest of the Merthyr Ironworks and by all accounts the largest ironworks in the world. Crawshay's partner Watkin George supplied much of the necessary engineering expertise for the development of the Cyfarthfa, and its subsidiary Ynys Fach Ironworks. Both Cyfarthfa and Ynys

Fach suffered following the end of the Napoleonic Wars, though conditions gradually improved from around 1817. By 1823 there were eight furnaces in blast at the Crawshay's concerns producing 24,200 tons of iron. A ninth furnace was added in 1824 and in 1830 the nine furnaces produced 29,000 tons of iron. Expansion continued during the 1830s and in 1839 work commenced on the construction of two more furnaces at Ynys Fach and in 1840 a 52 1/2in. beam blowing engine was bought from the Neath Abbey Ironworks to provide the blast.

When steel production started at neighbouring Cyfarthfa in 1884, the four blast furnaces at Ynys Fach were relined and kept in reserve, in case of a renewed demand for iron. However, it is considered unlikely that the furnaces were ever put back in blast (Ince 1993, p 63).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on estate and other plans, including the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are in the form of development proposals for business and leisure use, this relates mainly to the adjacent area to south, the Rhydycar Site, rather than the ironworks core area itself: the Rhydycar area is to be reclaimed and recontoured and developed for business use (PD1).

Figure 24a Ynysfach Ironworks IW019

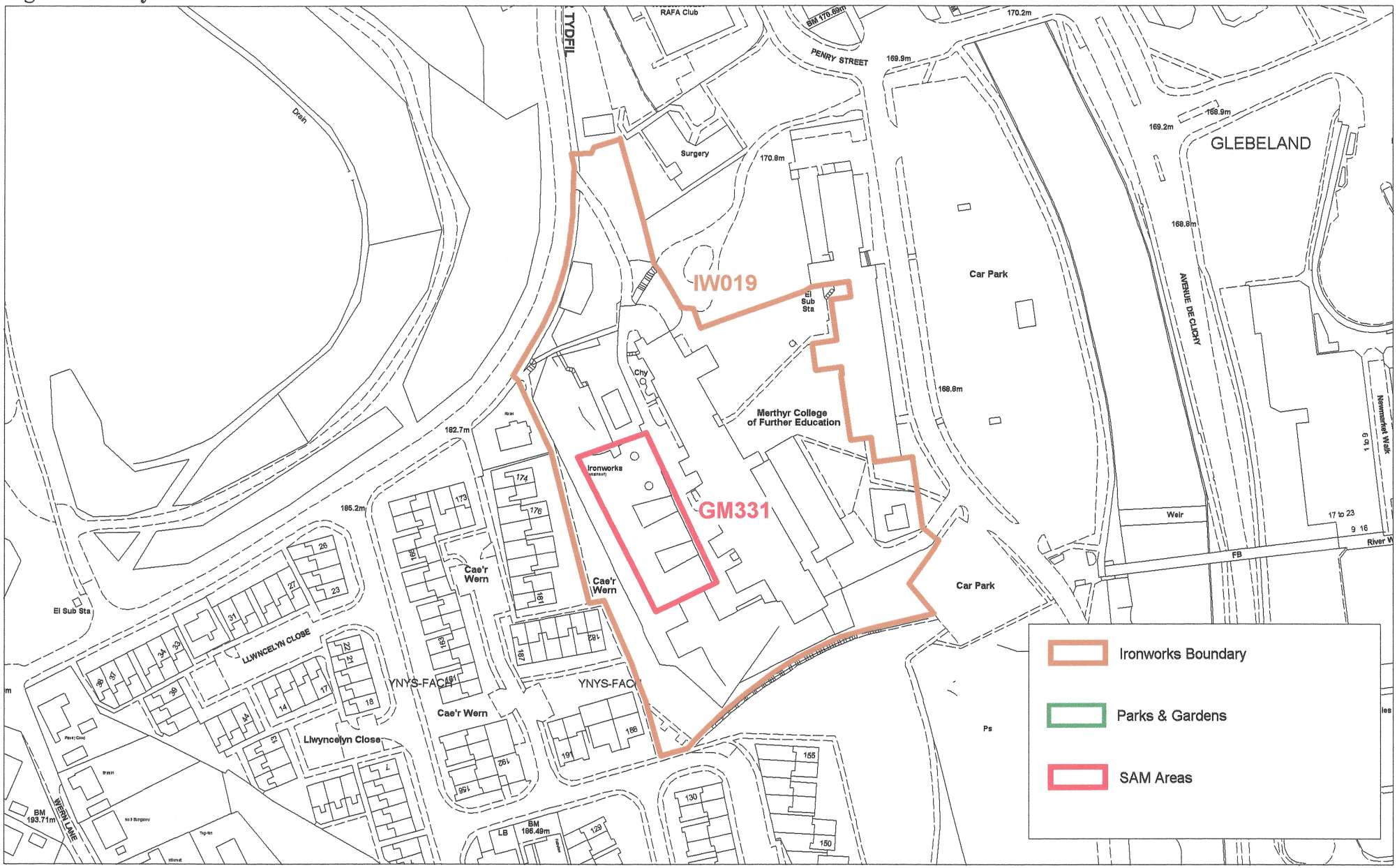

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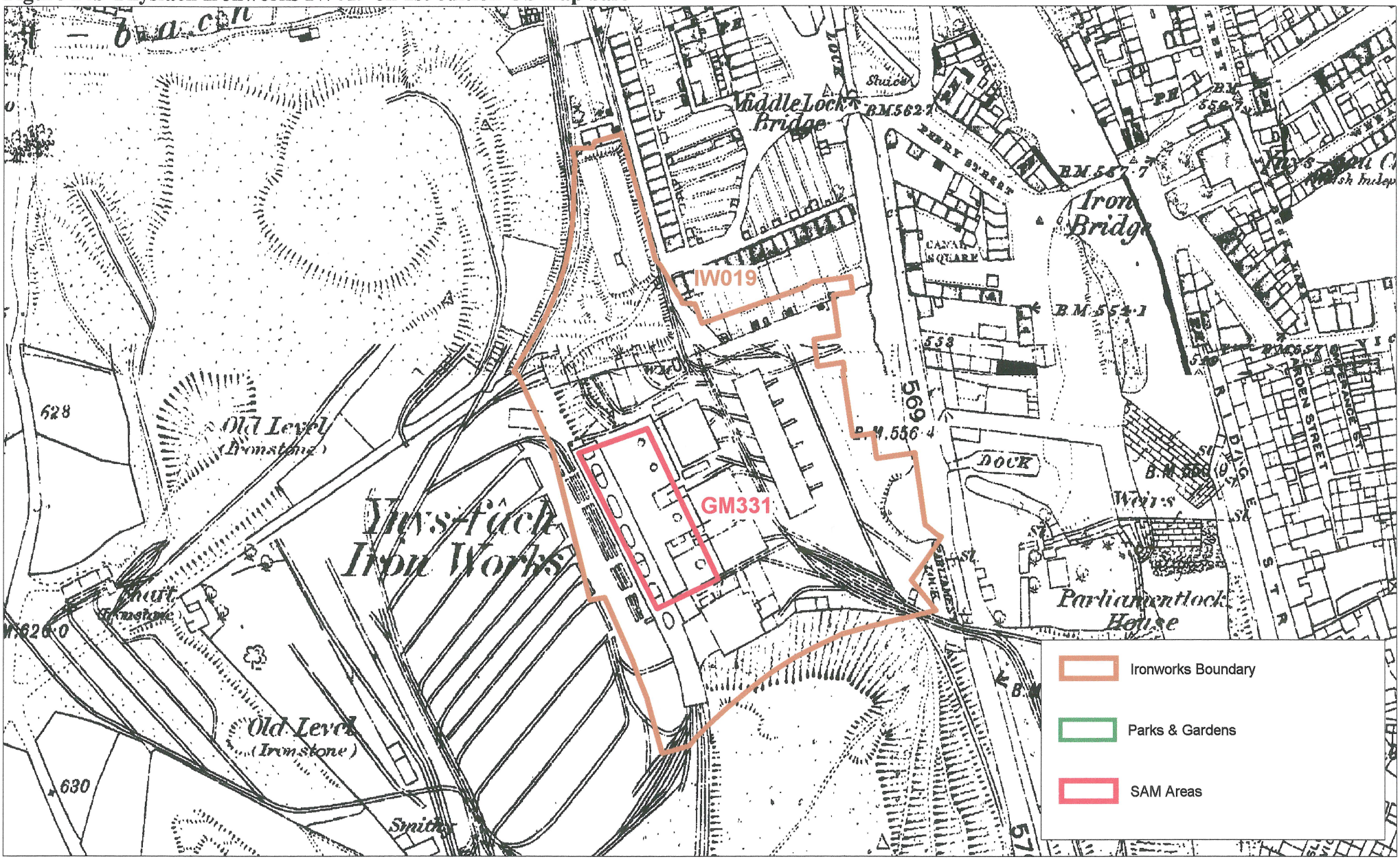
Figure 24b Ynysfach Ironworks IW019 on 1st edition OS map base



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IW Number 020 Cyfarthfa Ironworks (01169m) SO 038069

General Description

The Cyfarthfa Ironworks (NPRNs: 34,078–34,080; PRN: 01169m) is a nationally and internationally important ironworks site, a large section of which is protected by legislation. These include the recently restored furnace bank, water management features and associated transport network. The main ironworks area contains the remains of the furnace bank (PRN: 04960m; NPRN: 275,868), a run of six stone blast furnaces, first blown in 1765 and in use until 1872, notable for their size and extent, brick kilns (PRN: 02370m; NPRN: 34,081), and engine house (PRN: 02372m; NPRN: 34,082), together with the remains of the melting house (PRN: 02373m; NPRN: 34,083) and boiler (all within SAM Gm425). Also included in the area is the Tai-mawr leat (SAM Gm479; PRN: 02435.0m; NPRN: 275,881) to the northwest of the furnaces and Pont-y-Cafnau Iron Bridge (SAM Gm424; PRN: 01090m; NPRN: 34,860; Grade II* Listed Building: Cadw ref: 11,408), a cast iron tramroad bridge, thought to be of c1794, and possibly the world's first iron railway bridge.

The Grade II Listed structures (Cadw refs: 11,404 – 11,407) of the associated Pandy Farm (Farmhouse, clocktower and barn: PRNs 01987m; 01988m and 01989m, respectively; NPRNs: 19,563; 19,564; and 37,630, respectively) have also been included within the area, as have the coke ovens and yard (PRN 04961m), smithy (PRN: 04962m), and a tramroad bridge (NPRN: 300,263) over the river Taff at SO 03930686, all of which are outside the currently scheduled areas.

Adjacent related features include the scheduled Cyfarthfa Feeder Canal and the Gurnos Tramroad (SAM Gm478) located to the north; these have been excluded from the core ironworks area, as part of a wider extensive ironworks landscape comprising transport, water management, and extractive features.

Cyfarthfa, the fourth coke-fired ironworks to be founded in South Wales, is recognized as being a nationally and internationally important for its historic associations and having played a key role in the development innovations in iron production technology, such as Cort’s puddling process. The site is generally well presented and interpreted with good survival of both standing structures and buried remains, which may extend beyond the area currently protected through legislation (ie beyond the SAM area).

The exposed standing remains within the scheduled area are generally in excellent condition, though remedial work to the masonry may be necessary to guard against water ingress. A programme of conservation and presentation, including excavation is currently being devised for the main scheduled area.

Cyfarthfa Iron Works is the site of the ironworks founded in 1765 by Anthony Bacon, a native of Cumberland, and his partner William Brownrigg. The works initially operated a single furnace and concentrated on the production of pig iron. Following Bacon’s retirement in 1783, Richard Crawshay gained control of the Cyfarthfa Works. Thereafter the works remained in the Crawshay family, passing from Richard Crawshay, who died in 1810 to William Crawshay I, who directed operation from his London office, while the day to day management, including the great expansion of the works fell to William Crawshay II, and was responsible for the building of the nearby Cyfarthfa Castle in 1825.

The works at Cyfarthfa was the first in the area to change to the production of bar iron, which ultimately lead to Cyfarthfa becoming the largest Ironworks in the world by 1806. Instrumental in adopting Cort's puddling process soon after it was patented in 1784 were William Crawshay in partnership with George Watkin, foundry manager, perhaps most notable for his involvement in the design of several of the area's early cast-iron bridges, including the surviving Pont-y-Cafnau. Cyfarthfa was forced to buy in supplies of pig iron from both Dowlais and Plymouth for refining to maintain its production of bar iron.

The layout of the works at the time is detailed in a view drawn *c.* 1800 by William Pamplin; this shows four furnaces and associated charging houses and casting sheds used in the production of pig iron, and the 48ft diameter waterwheel which powered the bellow's. Immediately to the north is a large building with numerous chimneys housed the puddling furnaces and rolling mills. The early 19th century layout of the works and its associated features appears on OS maps and surveyors drawings of the period. Also detailed are tramroads leading to the Glamorganshire Canal.

The works benefited from the upsurge in railway construction during the 1830s and 1840s, and in 1833 a new mill was built as a result, however shrinking export markets, among other difficulties were to effect the second half of the 19th century. Robert Thompson Crawshay could see no future in the iron industry by 1864 and only with great reluctance renegotiated the Cyfarthfa lease. Though production reached a peak in 1871, the period was marked by boom-bust and labour relations problems. One strike in particular begun in April 1874 over wage reductions lasted over a year, while the furnaces remained out of blast until 1879 and death of Robert Thompson Crawshay.

The ironworks was shown in detail on the OS maps of 1875 and 1878 located either side of the river Taff connected by two tramroad bridges, in addition to Pont-y-Cafnau. Notable features extant at the time, apart from the blast furnaces, were casting sheds, a smithy, and a coke yard (similar to that illustrated by Pamplin in 1800) with extensive coke ovens to the rear of the charging bank and the Tai-mawr leat to the northwest of the works.

The conversion to steel began shortly afterwards with the construction of four new iron clad furnaces, and steel production started in 1884 under Robert Thompson Crawshay's three sons, trading under the name of Crawshay Brothers (Cyfarthfa) Ltd. Cylindrical iron clad furnaces were erected before the former ironworks blast furnaces. An important feature of the period was the linear slag tip leading northwest along the west bank of the Taff Fawr dating to *c.* 1884. Other changes included a new range of coke ovens with alterations to the configuration of the coke yard. In 1902, an ailing Cyfarthfa works was acquired by GKN. In spite of additional investment, the works proved unprofitable and production ceased in 1910, with a brief reprieve during the First World War.

The need for both water and limestone at the Cyfarthfa Ironworks necessitated the construction of a combined packhorse or plateway bridge and aqueduct, Pont-y-Cafnau, during the 1770s this would have been of wood; sketches by JMW Turner in 1797 depict the elevated wooden aqueduct, which formerly fed a great water wheel known to have been in use from 1796. A lease of 1771 secured the right to quarry limestone from the Gurnos Quarry and the Gurnos Tramroad had been built by 1792-3. The present Pont-y-Cafnau Iron Bridge, depicted in a painting of *c.*

1819/20 by Penry Williams, is thought to date from this period, or shortly after, *c.* 1793. The layout of the features of the area is detailed by 1875 OS map which also depicted the Cyfarthfa Feeder Canal and the leat approaching from a weir (possibly that built in 1766-77) on the Taff Fechan, outside the ironworks area to the north.

Historical Background

The foundation of the Cyfarthfa Ironworks dates from a lease granted in 1765 to Anthony Bacon and William Brownrigg. A furnace was completed in 1767: some 50ft. high and 38ft. square. A forge was also erected at Cyfarthfa to make wrought iron using the stamping and potting process. There was also a boring mill at Cyfarthfa, which was used for making cannon.

An important development occurred in 1782 when Bacon leased part of the Cyfarthfa Ironworks to Francis Homfray of Stourton, Staffordshire. Homfray was granted the mill for boring cannon and a foundry. It is probable that the land leased by Homfray included the forge. Homfray did not occupy the property for long and in 1784 the forge and mill were taken over by David Tanner. Also associated with this Venture were James Cockshutt, Thomas Treharne and Francis William Bowzer. Thomas Treharne acted as manager along with Cockshutt until 1786 when the property was sold to Richard Crawshay and Company. In the same year Bacon died and a lease of the furnace at Cyfarthfa was granted by the Court of Chancery for nine years to Richard Crawshay, William Stevens and James Cockshutt. The new owners of the furnace now enlarged their forge and mill and an additional furnace was built. These improvements cost the partnership no less than £50,000. Cockshutt, Stevens and Crawshay operated the Cyfarthfa Ironworks for five years before the partnership was dissolved with Richard Crawshay and Watkins George taking over the works from 1792 onwards. In 1794 Crawshay and George were able to gain a full lease of the Cyfarthfa property and purchase the ironworks.

Under Craw shay's direction the Cyfarthfa Ironworks expanded to become the largest of the Martyr works during the early years of the nineteenth century. The production of cannon proved to be so successful that the boring mill had to be supplied with iron not only from the Cyfarthfa furnaces but also from the Dowlas and Plymouth furnaces.

The Cyfarthfa Ironworks was one of the first concerns to make wrought iron using Court's puddling process, which was adopted by Crawshay in 1787. Cort visited the Cyfarthfa Ironworks and supervised the installation of eight of his puddling furnaces. The advances in the use of puddling came following the development of a preliminary refining.

Despite initial problems, the early adoption of puddling gave Cyfarthfa an advantage in the wrought iron trade and this financed further expansion within the works. In 1794 the Cyfarthfa Ironworks consisted of two coke furnaces, eight puddling furnaces, three refineries, three balling furnaces and a rolling mill driven by a 20ft. diameter waterwheel. The three furnaces were able to produce 7,204 tons of iron in 1796 and a fourth furnace was added in 1797. Parallel development of the forges and mills, also took place. The expansion of the works during the l790s can be gauged from the following description of the Cyfarthfa plant made in 1798:

Upper Works.

Great waterwheel, 56 ft. diameter, 6ft. wide working four blowing cylinders 52in. diameter, 5ft. stroke blows two furnaces with 1 3/4lb with 4in. pipes and four double refineries with 2in. pipes. Waterwheel 25ft. diameter, 3 ft. wide works four pairs of rolls, a pair for roughing down blooms,

a pair for bars, a pair for rolling balls into blooms and a pair for planishing. Rolls working at 40 revs, per minute. A waterwheel 20ft. diameter and 6ft. wide works a shingling hammer, a waterwheel 38ft. diameter and 4ft. wide for turning rolls, a steam engine 50in. cylinder, 9ft. stroke for blowing in case of scarcity of water.

Lower Works.
A 20ft diameter, 7ft. 5in, wide waterwheel working two pairs of rolls, 35 to 40 turns per minute, a 20ft. diameter, 6ft. wide waterwheel works a shingling hammer and a second 20ft. waterwheel works a planishing hammer.

It is obvious from this description that the two old furnaces at Cyfarthfa had been decommissioned and demolished. Svedenstierna only saw two furnaces at the main Cyfarthfa site in 1803 and these were blown by the great waterwheel coupled to a 70-80h.p. steam engine. The Swedish tourist noted that the wheel was 52ft. in diameter and 7ft. wide.

The success of Crawshay's undertakings allowed further expansion during the early 1800s. The works was to remain in Crawshay family hands from this date until the early years of the twentieth century.

In 1805 the four furnaces were in blast and produced 10,460 tons of iron for the year. Expansion continued for in 1807 there were six furnaces at the two sites, two rolling mills and four steam engines (50h.p., 40h.p., 12h.p. and 7h.p.) Cyfarthfa was now the largest of the Merthyr Ironworks and by all accounts the largest ironworks in the world.

Watkin George was responsible for the design of the great waterwheel and the steam blowing engine, and supplied engineering expertise for the development of the Cyfarthfa Ironworks. The depression in the iron trade at the end of the Napoleonic Wars affected Cyfarthfa like all the other British ironworks. Yearly production for 1814 was only 9,600 tons and at times during the year only three furnaces were in blast. Conditions gradually improved and in 1817 Cyfarthfa produced 14,191 tons of iron. Expansion continued during the 1820s commencing with the purchase of a 52 1/2in. beam blowing engine from the Neath Abbey Iron Company in 1820. By 1823 there were eight furnaces in blast ant in that year they produced 24,200 tons of iron. A ninth furnace was added in 1824 and in 1830 the nine furnaces produced 29,000 tons of iron.

A pair of high-pressure beam engines was purchased from the Neath Abbey Ironworks in 1833 but instead of being used directly to drive rolling mills they were used to return water for the mills' waterwheels. This adherence to waterpower was to continue at Cyfarthfa up to the 1870s by which time the works was clearly lagging behind the modern practices of ironworks such as Dowlais. However, further steam power was added when the works purchased in 1835 an 18in. high-pressure beam engine from the Neath Abbey Iron Company.

In the mid 1840s a large steam powered rail mill was constructed powered by a condensing beam. In the period 1856-61 all eleven of the furnaces were in blast and in 1857 a new mill was constructed. Output reached a yearly total of 50,000 tons in 1864 and in the following year a detailed description of the works was published. At that time a fifty year old beam blowing engine made at Cyfarthfa was being replaced by a new engine of greater power. The hot blast was being applied to five out of the eleven furnaces with waste gas being used for the generation

of steam. The forges and mills, which were powered by five waterwheels and several steam engines, were able to produce 1,200 tons of puddled bars per week.

Production at Cyfarthfa appears to have been divided between rails and merchant bar iron. Much of this was exported for the Crawshays had built up important trade links with Eastern Europe, particularly Greece, Turkey and Russia. In 1872 the works was operating seventy-two puddling furnaces and seven mills but still the Crawshays relied heavily on waterpower. The members of the Institution of Mechanical Engineers visited Merthyr in 1874 and at Cyfarthfa they saw seven furnaces available for iron production although only four were in blast during the year. The furnaces were 52 1/2ft. high with 14 1/2ft. diameters across the boshes. Cold blast and two with hot blast could blow five of the furnaces. All except one had closed tops with bell and hoppers. Two waterwheels and two non-condensing engines drove the puddling mills. The bar mills were driven by two condensing beam engines and an oscillating non-condensing engine. The power produced by the waterwheels could be aided by a 30in. x 8ft. non-condensing beam engine, which pumped water from the river back to the mills.

Problems with the unions, the decline of the wrought iron trade and the old fashioned nature of the works prompted Robert Thompson Crawshay to close down Cyfarthfa. The works was slowly run down during 1874 and one furnace was in blast during the first three months of 1875 before complete closure took place. This closure sparked off much controversy within the Crawshay family. The death of Robert Crawshay in 1879 allowed his sons to reopen the Cyfarthfa Ironworks and in the following year 900 tons of iron was being produced weekly. However, owners and managers realised that the works had to be modernised. The Cyfarthfa Ironworks was again closed in 1881 but this time the closure took place to carry out a complete rebuild of the furnaces and for the installation of a steel works. The work was completed during 1884 with the first batch of steel being produced in February 1885.

The steel works was designed by Edward Williams of Middlesbrough. During 1884 three plate-encased furnaces were erected and the foundations of a fourth laid. Three vertical engines built by J.C. Stevenson of Preston with 33in. steam cylinders and 72in. blowing cylinders both with 4ft. 5in, strokes, provided the blast. These engines worked at 25 to 30 strokes per minute producing a blast at 5-6 psi. Later the blowing capacity was increased by the addition of three 44in. x 5ft. Davy vertical blowing engines with 96in. blowing cylinders. The blast was heated up to 1,400^{0}F by seven Cowper stoves. Steel was manufactured in two 5 ton Bessemer converters which could be worked up to 10 tons. The converters received their blast from vertical compound blowing engines with 42in. high-pressure cylinders, 78in. low-pressure cylinders and 55in. blowing cylinders, all working to a 5ft. stroke. Also at this time two new reversing cogging mill engines with 40in. cylinders were installed together with a pair of Davy reversing mill engines with 50in. cylinders. The Bessemer machinery was constructed by Tannett, Walker and Company.

The Cyfarthfa Iron and Steel Works under the title of Crawshay Brothers, Cyfarthfa, Limited continued in operation until 1902 when it was bought out by Guest, Keen and Nettlefold of the Dowlais works. The Cyfarthfa works continued in production until closure in 1910. The works was reopened in 1915 but final closure came in 1919 (Ince 1993, pp 60-64).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on estate and other plans, including the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are as follows: a potential development to enhance built heritage, derelict land within Cyfarthfa Heritage area: PD3 Swansea Rd site provision of business land.

Figure 25a Cyfarthfa Ironworks IW020

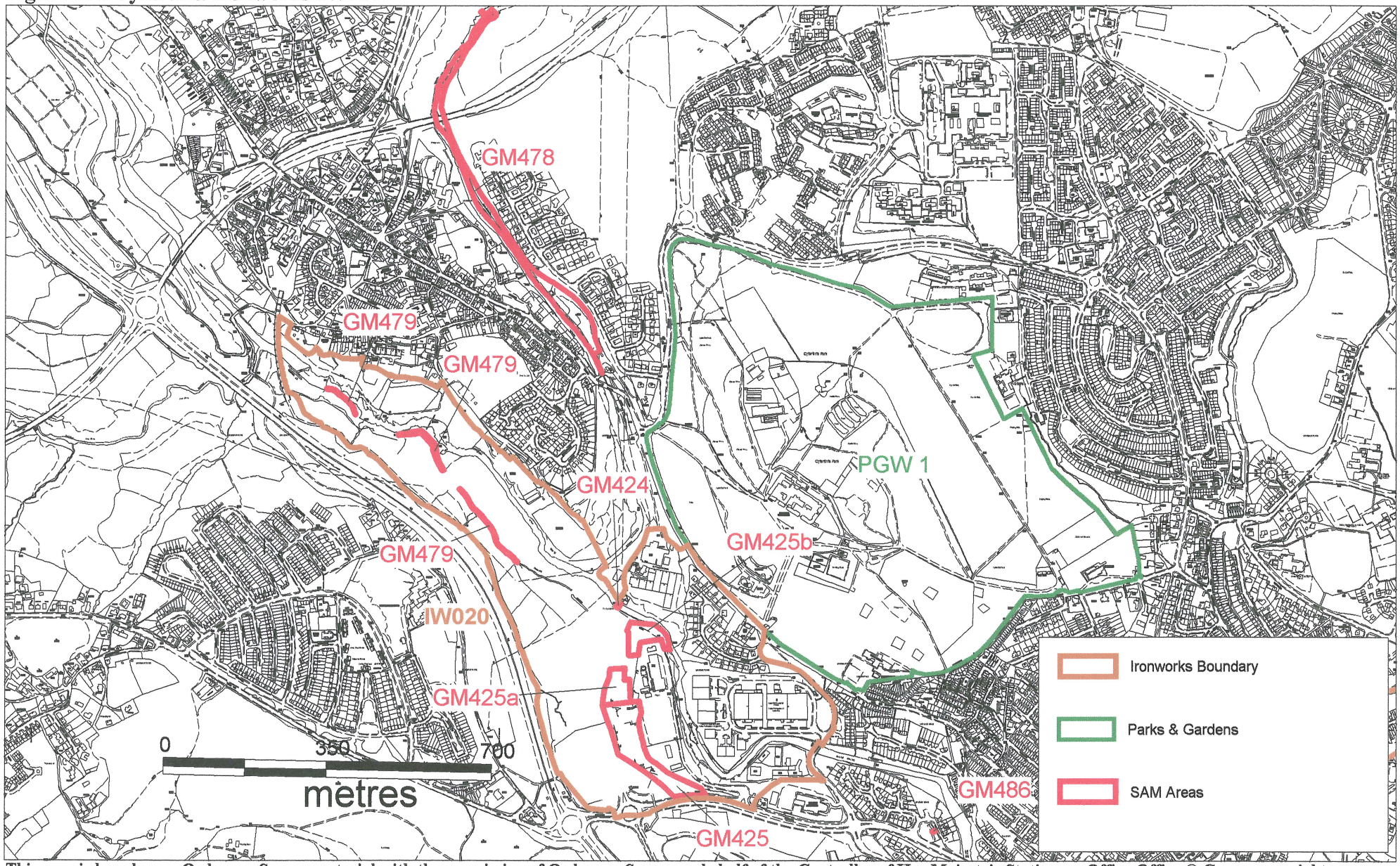

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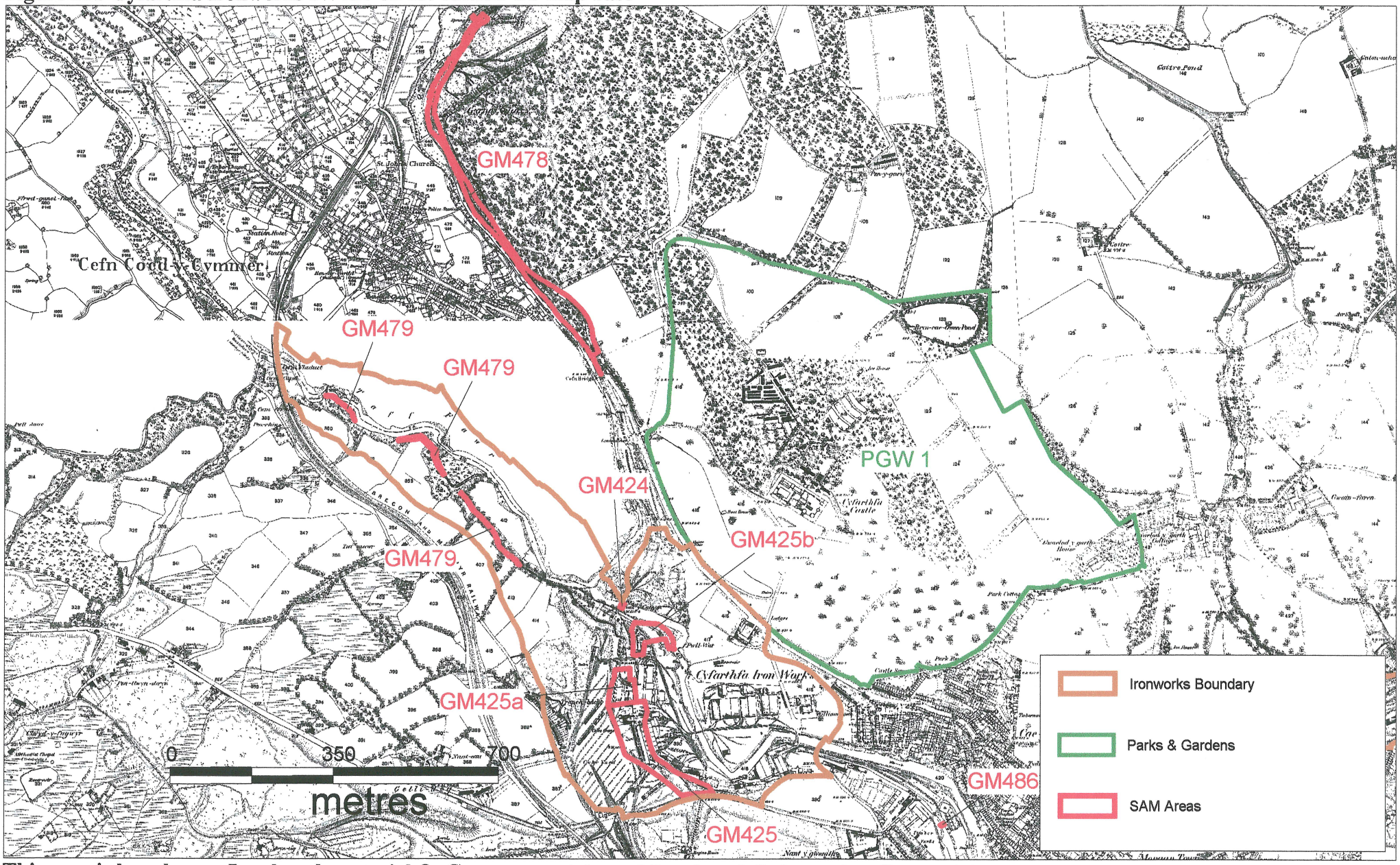
Figure 25b Cyfarthfa Ironworks IW020 on 1st edition OS map base



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IW Number 021 Penydarren Ironworks (01170m) SO 0690 0320

General Description

The Penydarren Ironworks (NPRNs 34,113; 40,460; PRN 01170m) is an important ironworks of 18th century foundation with nationally and internationally significant historic associations, in particular associated with Trevithick and the Penydarren Tramroad and technological advances, such as the use of and development at an early date of puddling processes, together with the use of an intermediate refinery stage. Penydarren was the second Merthyr ironworks to begin production of bar iron from 1788, and was also one of the earliest concerns to enter the wrought iron rail trade.

The core ironworks area identified for this study encompasses the main area of the ironworks founded in 1784 by Francis Homfray as based on available cartographic evidence, including the 1st edition OS maps. Although the site is of great historical significance little now remains visible on the site that is intelligible. The only features to survive to any extent above ground are the fragmentary remains of the charging bank adjacent to the site of the blast furnace rank. The latter, depicted in an Albumen print by Robert Thompson Crawshay c. 1870 was extensive (Lord 1998). These remains are located within a small industrial area on the south-eastern corner of the area at SO 05573 06880. The western end of the ironworks area as it appears today is taken by a development of 19th century/early 20th century terraced housing. Although the extent of the condition/survival of buried remains over the site is as yet unknown, it is likely that the massively constructed blast furnace bases survive in a buried state.

The development of the ironworks is traceable through cartographic material: in the late 18th century two blocks of Ironwork buildings and a “waggon way” approaching Penydarren Ironworks from coalmines to the south are in evidence (1799 Yates). The works developed numerous trackways and tramways over the following period and by 1814 the mineral area to the south and east was already heavily quarried. The Homfray family’s association with the works ended with the death of Samuel Homfray in 1822. Thereafter the works continued under the partnership of Thompson and Foreman. The Penydarren iron works engaged in rail production at an early stage, supplying the Liverpool and Manchester Railway. However severely competitive markets of the 1850s caused increasing difficulties and production ceased in 1859, under Messers Fothergill and Hankey. The works and its associated vast mineral deposits were later sold to Dowlais for almost £60,000. Cartographic sources indicate the Ironworks, including its blast furnaces, casting houses, rail network and ancillary plants still survived in 1875-78, while contemporary photographs show the works in ruins and partly dismantled. The area of ironworks was subsequently cleared and by 1919, the tramway depot and the electric power station of the Merthyr Electric Traction and Lighting Co. occupied the furnace area. The western part of the ironworks was later redeveloped for housing; by 1905 the southern side and part of the northern side of Trevithick Street and a short row at Gwynnes Close were in place, and completed by 1919. The cartographic evidence also showed a short row dating from before 1850, opposite the entrance to Penydarren Park.

Historical Background

The Penydarren Ironworks was founded in 1784 by Samuel and Jeremiah Homfray. By 1786 the partners of the company consisted of Jeremiah Homfray of Penydarren, Thomas Homfray, Samuel Homfray and Richard Forman, and was later expanded to include other members of the Foreman family.

By 1794 the site comprised one furnace blown by cylinders and pistons, two chaferies, three melting fineries and four balling furnaces. Two years later the company was operating two furnaces, which produced 4,100 tons of iron that year. The Penydarren Ironworks experimented with puddling at an early date and the management were pioneers in the use of an intermediate refinery stage. By 1802 that there were three blast furnaces operating at Penydarren coupled with three refineries and twenty-five puddling furnaces producing about 8,000 tons of iron yearly. Samuel Homfray also developed an interest in steam power and in 1798 two Boulton & Watt engines were constructed at Penydarren. One was a 40in. x 8ft beam blowing engine with an 84in. blowing cylinder and this engine was notable as being one of the first Boulton & Watt engines to be built with an iron beam, no doubt Homfray had a part to play in the adoption of this innovation. The second engine was a double acting 33 1/3in. x 7ft. beam engine to power rolling and slitting mills. Samuel Homfray already had a wealth of experience with steam power as he had already operated several Newcomen engines on the Penydarren property. Homfray's interest in steam power led him in 1803 to become a partner with Richard Trevithick in the development of his compact high-pressure steam engine. Several Trevithick engines were built at Penydarren including the world's first steam locomotive, which made successful journeys along the Penydarren Tramroad in 1804. Another Trevithick engine was used at Penydarren to provide a blast, probably for the refineries.

William Forman and William Thompson were the partners operating the works from 1819, expansion occurred during the early 1820s. A 52½in. beam blowing engine was purchased from the Neath Abbey Iron Company in 1819 and after this date additional furnaces were constructed. By 1823 there were five furnaces in blast and during that year they produced 15,547 tons of iron. One important customer for Penydarren iron was Robert Stephenson and Company who purchased £1,252 of iron during the period 1826-30. Some of the engineering products of Stephenson's works were purchased by the Penydarren Iron Company possibly in part payment for the iron.

The Penydarren Ironworks was one of the earliest concerns to enter the wrought iron rail trade for in 1830 they produced rails for the Liverpool and Manchester Railway. In that year the works produced 17,025 tons of iron. Further expansion of the Penydarren Ironworks took place in the late 1830s. A 38 ½in. Neath Abbey beam blowing engine was installed in 1837 and by 1839 the company had six furnaces in blast. In 1845 the number of furnaces in blast had risen to seven and production had increased to 25,600 tons of iron.

In 1859 William Forman attempted to sell the concern, and whilst the Dowlais Iron Company showed a serious interest the final purchase was limited to the mineral ground. A detailed inventory of the Penydarren ironworks was made at the time:

> Cinders Incline - a pair of l4in. x 2ft. high-pressure engines with two boilers.
> Rail Shed - four presses, two punches plus one small punch, a new 2lin. engine nearly ready with a boiler.
> Brick Yard
> New Mill - a 33in. x 6ft. 6in. high pressure beam engine with three boilers, twenty-four heating furnaces for this and old mill.
> Old Mill - a 30in. x 6ft. 6in. high-pressure beam engine with three boilers.
> New Puddling - a 36in. x 6ft. 9in. high-pressure beam engine with three boilers and

thirty-one puddling furnaces.
Roll Lathes - a 24in. x 4ft.6 in. engine, one boiler, five roll lathes, new machine for cutting rail ends (cost £70) and stock of rolls.
Fitting-Up-Shop - a l0in. x lft. 7in. engine with one small boiler, five lathes, two screwing machines, one drilling machine, one old boring mill and one old chuck lathe.
Blast Engines - an old low pressure beam engine with 50in. steam cylinder and 96in. blowing cylinder, working 14 stokes per minute (in bad repair), a high pressure beam engine, 38½in. x 8ft. with 122in. blowing cylinder working at 17 strokes per minute.
Blast Furnaces - six in blast, 45ft. high, l6ft. in boshes, one out of blast for repairs, six hot blast stoves and six refineries.
Smiths' Shop - eleven fires, two fires for chain makers, one fire for boiler makers and one furnace for heating plates.
Foundry - two old wood cranes, one small cupola, one small foundry with an air furnace, one small furnace for brass and one old wood crane.
Also a new engine not yet erected, 36in. x 6ft. 9in., a stable engine, l0in. x lft. 7in., two donkey engines, l0in. x l0in, and one donkey engine, 7½in. x 7½in,
Estimated value of plant - £18,140

The Penydarren Ironworks remained unoccupied until 1863 when the enterprise was taken over by Davies, Williams and Phillips. In the following year this partnership was working a blast furnace, a rolling mill and a puddling furnace. However, the production of iron turned out to be a most expensive venture because the partners did not own any mineral ground. This led to the sale of the ironworks to the Aberdare Iron Company in 1865. This sale was to result in a long court case for Richard Fothergill brought an action against the previous partners. Fothergill claimed that between the time he had initially inspected the works and when his company occupied it some demolition had taken place, which damaged buildings and machinery.

When the case was resolved Fothergill began to rehabilitate the works. Puddling commenced in 1869 and in 1870 repairs were undertaken and refineries put to work. Fothergill fully intended to put some of the Penydarren furnaces into blast for the Neath Abbey Iron Company was called in during 1871 to repair the 122in. blowing cylinder of No.1 engine. At this time the company was operating thirteen puddling furnaces but no rolling mills were listed as being on the site. Presumably the rolling mills had been removed at an earlier date. However, conditions in the iron trade worsened and the furnaces were never relit.

In 1873 a steam hammer was erected in the forges but the little activity that took place on the site ended with the collapse of the Fothergill undertakings in 1875. The Penydarren Ironworks remained in a derelict state until 1883 when the remaining plant was sold off (Ince 1993, pp 77-80).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on estate and other plans at the Glamorgan Record Office, including a plan of 1832, the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 held at the Glamorgan Record Office and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are in the form of industrial improvements, no further details are given.

Below ground remains may survive in the area of the charging ramp/blast furnaces and the possibility of excavation could be explored. A programme of conservation should be devised to ensure the preservation of the above ground remains associated with the charging bank and blast furnaces. This could include an awareness campaign through designation as an area of industrial archaeological importance and the provision of information, eg display panels, to help ensure the long term survival of any surviving remains.

Figure 26a Penydarren Ironworks IW021

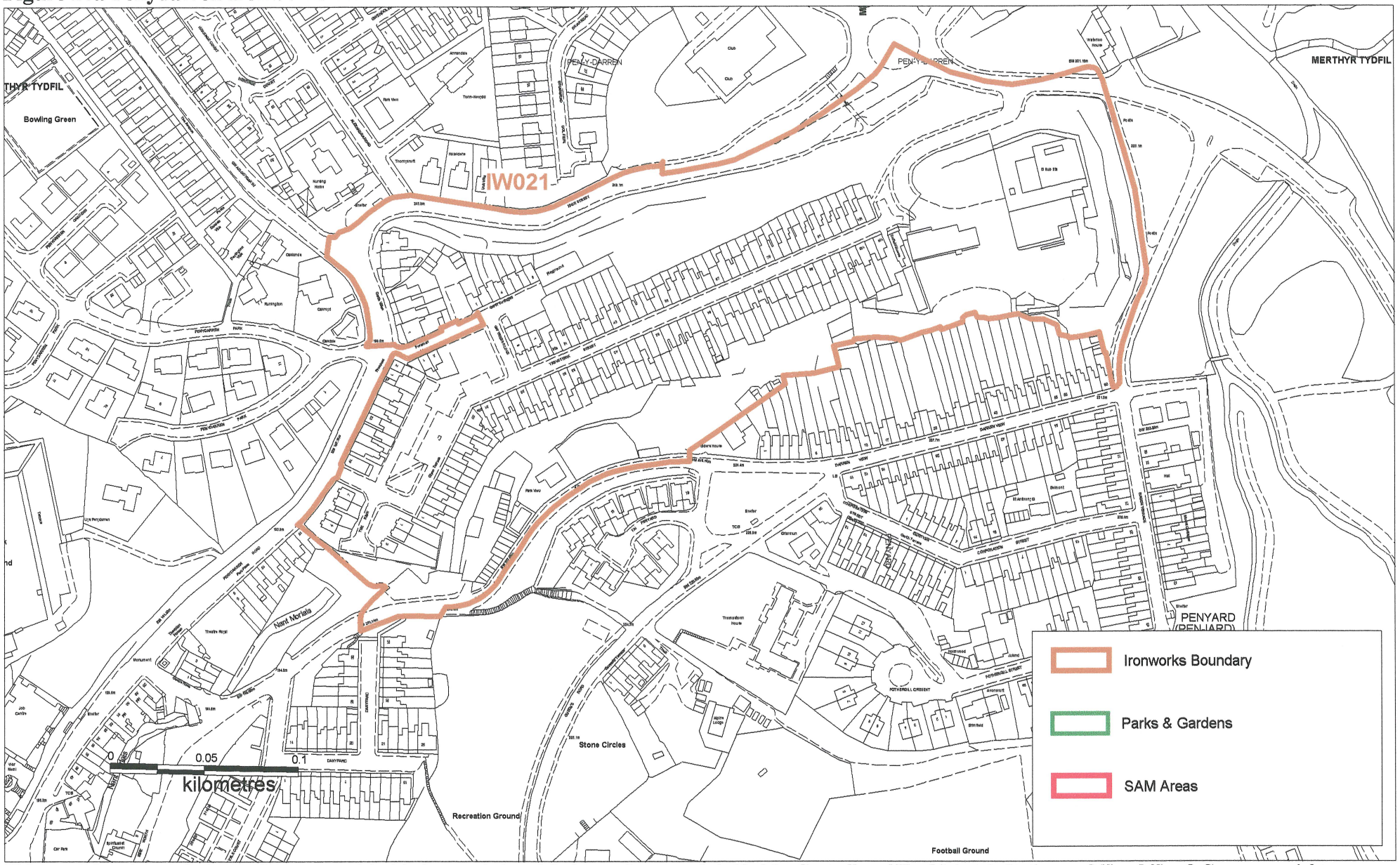

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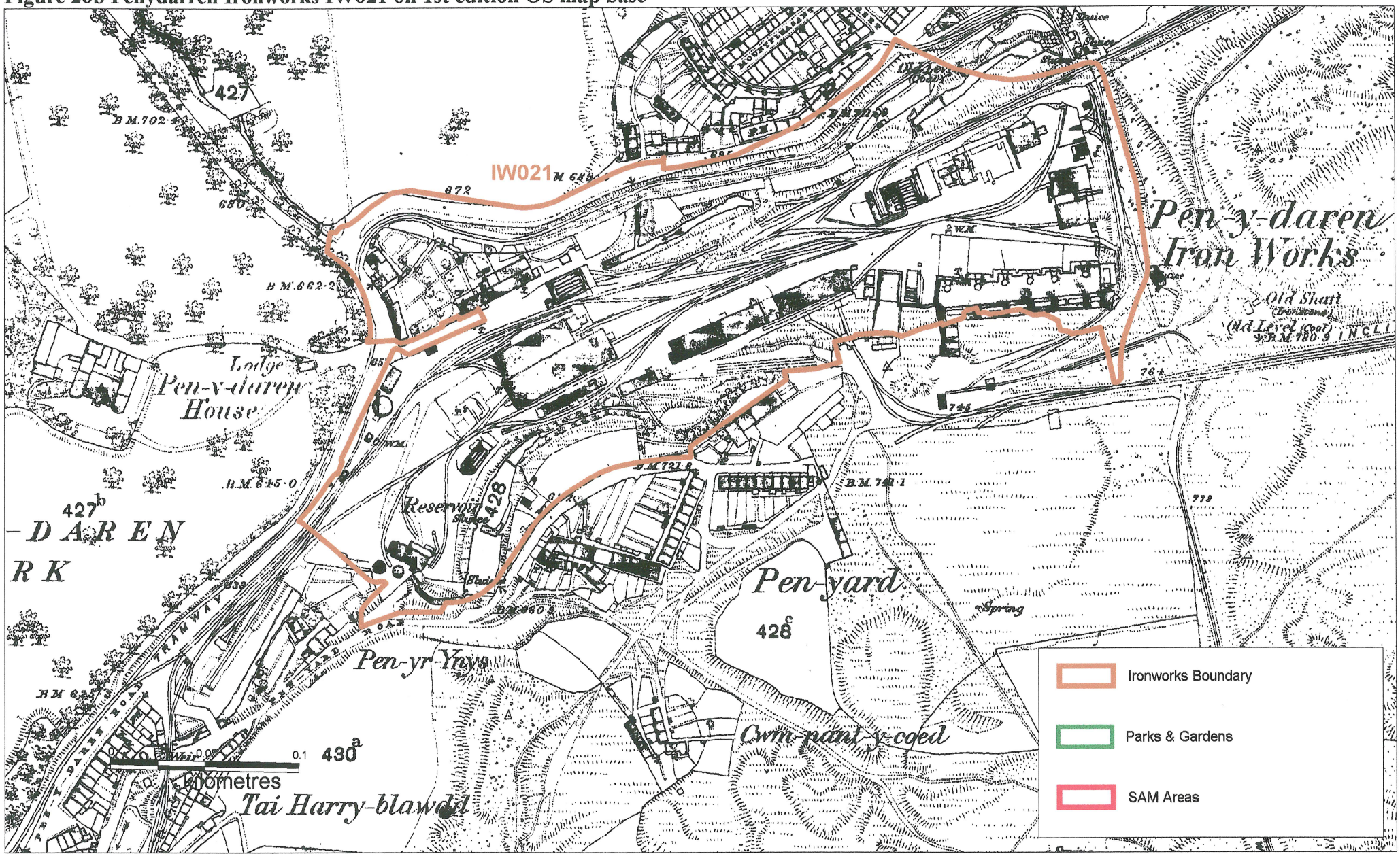
Figure 26b Penydarren Ironworks IW021 on 1st edition OS map base



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IW Number 022 Dowlais Ironworks (01666m) SO 06948 07645

General Description

The Dowlais Ironworks (NPRN: 34,084; PRN 01666m) is an important ironwork site of nationally and internationally significant historic, technological, and artistic associations with surviving standing structures and buried remains. The ironworks, now in use as an industrial park, was founded during the 18th century, however the surviving standing remains are later. The main surviving industrial structure in the area is the red brick Blast Engine House of 1909 (Listed Grade II: Cadw ref no. 11,491; NPRN: 33,697), currently used by the OP Chocolate Factory. The furnace bases and other potential features are thought to survive under massive banks of reclaimed soil, however their current condition is unknown. The area includes the site of Dowlais House re-built 1818 for JJ Guest (1785-1852), demolished c. 1960. Other sites include the Dowlais Ironworks Offices (NPRN: 88,063), the site of industrial workers terraced housing at 28-33 Cae Harris, Pond Street (PRN: 0893m; NPRN: 18,195), and the extensive lines of the Dowlais Iron Company Railway (NPRNs: 85,626; 85,638; and 85,653) and the Dowlais Iron Company Tramroad (NPRNs: 85,627 and 85,655).

The core ironworks area encompasses site of the ironworks founded in 1759 by a partnership headed by Isaac Wilkinson, an ironmaster from Bersham, Clwyd. The change over to the production of bar as opposed to pig iron was comparatively late at Dowlais. The lack of success in applying Peter Onions' puddling process dissuaded all but John Guest from investing in the technology during the 1780s and Dowlais continued to supply pig iron to Penydarren and Cyfarthfa. The Dowlais works was the first in Merthyr Tydfil to install Steam blowing engines, replacing waterwheel-powered bellows in 1798.

The Dowlais Ironworks has strong historic associations with the Guest family; first John Guest, then his son, Thomas Guest (1787) and in turn by his son Josiah John Guest (1807), a liberal who advocated free trade and was Merthyr's first MP, following the 1832 Reform Act. It was a result of the latter's vision and business acumen that Dowlais became the largest ironworks in the world. The rails for the Stockton and Darlington Railway were produced at the Dowlais works in 1821 heralding the rewards to come of the railway boom years of the 1830s and 1840s. Technological advances such as the adoption of the 'hot blast technique', patented in 1828, which substantially reduced the amount of coke required for smelting, enabled Dowlais to maintain its competitive edge. Further mills were constructed to produce rails: the Big Mill in 1830, supplemented by the Little Mill in 1840. The extent of the Dowlais Ironworks during the period was strikingly illustrated in a series of watercolours painted in 1840 by George Childs (Lord 1988).

William Menelaus was appointed general manager in 1856 and soon after the Dowlais works began experimenting with a new process developed by Henry Bessemer. Menelaus was to oversee the conversion to steel production, which began in a limited fashion in 1865. The local ironstone was unsuitable for the production of steel, due to its high phosphorous content and by the 1870s ironstone mining had ceased altogether in the Merthyr area. Based on imports, chiefly from Spain, steel production would ultimately transfer to coastal sites, such as the new steelworks built by the Dowlais Company at East Moors in Cardiff in 1891. In 1905, under GKN a new blast Furnace complex, which included two American designed 'Yankee' furnaces and a new mill was added. However, after a period of prolonged decline, in 1930 the production of steel at Dowlais finally came to an end.

The early development of the works can be charted from cartographic sources, including estate maps and early OS maps and surveyor's drawings, the Tithe map of 1850 and unpublished map of 1851, among others. The extent of the ironworks development is well demonstrated by the 1878 6-inch OS map, which in part reflects the conversion of the works to steel production in the years after 1865. Numerous features were recorded within the area including charging bank, furnaces and brick kilns among other industrial features southeast of Dowlais House. Other features shown are engine houses, levels, a brickworks, the reservoir to the south of Dowlais House, Cae-Harris Pond, adjacent cottages on Pond Street (now demolished), the Dowlais Railway and numerous railway sidings and tramroads. Goat Mill, Coed Cae pond, and an adjacent row of cottages (demolished by 1905) were located to the south the area.

Significant changes occurred in 1905 when the plant was remodelled under GKN: additional reservoirs and extensive coke ovens were built in the area to the north of the brickworks, which itself had been extended. The Goat Mill was enlarged and Cae-Harris station had been constructed; this included a goods shed, an engine shed and cattle pens. Further alterations indicated by 1919 were primarily in the area to the southeast of Dowlais House and the blast engine house (now listed grade II), and included additions to the furnaces.

Historical Background

The Dowlais Ironworks was the first and longest lived ironworks constructed at Merthyr Tydfil. The partnership, which built the Dowlais Furnace in 1759, consisted of Thomas Lewis of Newhouse, Llanishan, Monrnouthshire, Thomas Price of Watford, Glamorgan, Richard Jenkins of Cardiff, a Mercer, Thomas Harris of Bristol, John Curtis of Bristol, Nathaniel Webb of Bristol, John Jones of Bristol, Ironmaster, Isaac Wilkinson of Plas Gronow, Denbigh and Edward Blakeway of Shrewsbury.

The coke-fired furnace at Dowlais is known to have produced 18 tons of iron weekly during 1760. At this time the furnace was blown by cylinders and pistons worked by a waterwheel. In 1767 John Guest of Broseley was appointed manager, and later in 1782 joined the partnership. During 1782 there were two furnaces in blast at Dowlais, this had increased to three by early 1790s. Unlike some ironworks in the locality Dowlais was not producing wrought iron. Pig iron produced by Dowlais was often sold to other ironworks for manufacturing into wrought iron as in 1796 when an agreement was signed with the Cyfarthfa partners for Dowlais to supply them yearly with 2,000 tons of iron.

In 1801 the important decision was made at Dowlais to manufacture wrought iron using Cort's puddling process. In order to increase production the company had invested in a Boulton and Watt beam blowing engine. This engine was built at Dowlais in 1798 and had a 40in. x 8ft. steam cylinder with a 90in. x 7ft. blowing cylinder. The engine certainly seems to have had the desired effect for in 1805 the three furnaces at Dowlais produced 6,800 tons of iron with 8,148 tons produced in the following year. To aid the manufacture of wrought iron the company was also operating rolling mills powered by Boulton and Watt engines; the first of these a 36½in. x 8ft. beam engine was built in 1803, the second, a 31½in. x 7ft. beam engine, was installed in 1808.

In 1808 a fourth blast furnace, capable of producing 50 tons of iron per week, was built and put into blast in 1810. At the same date a 50in. x 8ft. beam blowing engine with an 84in. x 8ft. blowing cylinder was purchased from Boulton and Watt. At that time the works also comprised

four refineries, twenty puddling furnaces and ten balling furnaces. A fifth furnace was added in 1815 with the Dowlais Ironworks being able to produce 15,600 tons of iron per year.

The works suffered in the general trade depression, which accompanied the end of European hostilities in 1815. However, this set back was to be of a fairly short duration and in 1817 three additional blast furnaces were built at Dowlais. A beam blowing engine was also constructed in that year. By 1823 the Dowlais Ironworks possessed ten furnaces, which made in that year 22,287 tons of iron. In the following year another beam blowing engine was constructed at the works. This engine was still working in the 1840s. A further blast furnace was added in 1828 together with a fifth blowing engine. This was a non-condensing, high pressure beam blowing engine with a 54in. x 9ft. 3in. steam cylinder which was working in the 1840s with a 144in. blowing cylinder making 13 strokes per minute and blowing 27,476cu. ft. of air per minute. This was the first of Dowlais' beam blowing engines to be supplied with a flywheel, which was l5ft. in diameter. During 1830 the Dowlais Ironworks had twelve furnaces in blast, which produced 32,611 tons of iron. Certainly, by this date, Dowlais had become the largest of the South Wales ironworks.

The expansion of the works was partly due to Dowlais' successful entry in the late 1820s into the wrought iron rail trade. To cater for the production of rails the rolling capacity of the works was improved with the opening of the Big Mill in 1830. After this event output of rails steadily rose reaching 20,000 tons by 1835. The Dowlais ironworks continued to expand during the 1830s when two further blast furnaces were constructed and an additional beam blowing engine was installed in 1838. This engine was a high pressure example with a 40m. x 8ft. steam cylinder and a 122in. blowing cylinder. This engine was built for the Dowlais Ironworks by the Neath Abbey Iron Company at a cost of £3,894. In the 1840s this beam blowing engine was making 16 strokes per minute and discharging 20,687 cu ft. of air per minute. Like beam blowing engine No.5 this engine was provided with a flywheel, which was 10ft, in diameter. Further expansion was undertaken by the company but at a subsidiary concern called the Ivor Ironworks built slightly to the north (see IW023).

Dowlais was now the largest ironworks in the world and in 1845 its eighteen furnaces produced 74,880 tons of iron with 7,300 people being employed. The Big Mill alone turned out 400 tons of rails per week and in total the mills produced monthly 2,000 tons of rails and 2,000 tons of bars. The Dowlais Ironworks was now pre-eminent in the wrought iron rail trade and had also built up an extensive export trade in this product. Large foreign orders were common as in 1844 when the works won a contract for 50,000 tons of rails for Russia.

The works experienced some difficulties during the late 1840s when the problem of the renewal of the Dowlais lease faced the Guest family. The eventual renewal of the lease prompted a new period of expansion with the modernisation of the blowing engines undertaken. Two of the old beam blowing engines were sold off in 1849 in preparation for the building of a new large blowing engine, the 'mighty Merthyr Guest' engine, in the following year to designs of Samuel Truran, the works' engineer.

This 55in. x l3ft. beam engine had a blowing cylinder of 144in. diameter working with a l2ft. stroke. Each minute the engine made twenty strokes producing 44,000 cu. ft. of air at a pressure of 3¼ psi. The air blast was discharged into a 5ft. diameter pipe, which was 140 yards long and acted as a regulator. This non-condensing engine was worked up to 650 h.p. with a steam

pressure of 60 psi at one third cut off. The beam was 40ft. 1in. long and cast in two parts, each part weighing 16½ tons. The 22ft diameter flywheel weighed 35 tons and there was a further 75 tons of cast iron framing under the steam cylinder. For a period this powerful blowing engine supplied the blast to eight furnaces but later it was used with three other blowing engines to provide the blast for twelve furnaces. At that time some of the Dowlais furnaces were making 235 tons of forge iron per week.

Josiah John Guest gained complete control of the Dowlais in 1851 and a year later the management of the works fell to his widow Lady Charlotte Guest with trustees being appointed when Lady Charlotte remarried in 1855. The trustees employed William Menelaus to act as works' manager. At that time the enormous size of the Dowlais Ironworks can be gauged by the number of steam engines on the site for they included four pumping engines draining collieries, iron ore workings and supplying the works with surface water, sixteen engines winding at coal and iron ore pits, fourteen engines working inclined planes, eleven locomotives, two engines driving clay and pug mills, five blowing engines, ten forge and mill engines and two engines driving lathes and shearing cold iron. These engines gave a total of 7,308 h.p. Details of the puddling mill engines in the early 1850s are known and these engines consisted of:

No.1 - 45in. x 7ft. low pressure condensing beam engine working at 22 strokes per minute.
No.2 - 36in. x 7ft. low pressure condensing beam engine working at 22 strokes per minute.
No.3 - 42in. x 6ft. high pressure beam engine working at 20 strokes per minute.
No.4 - 37in. x 7ft. high pressure horizontal engine working at 23 strokes per minute.
No.5 - 26in. x 4ft. high pressure vertical engine working at 30 strokes per minute.

In 1856 sixteen furnaces out of Dowlais' eighteen were in blast with the works continuing to dominate Britain's wrought iron rail trade. To enable Dowlais to continue in its pre-eminent position in the rail trade the building of a new mill was started in 1857. This was the legendary Goat Mill. The mills inside this building were powered by a pair of 45in. x l0ft. coupled high pressure beam engines. They worked at 24 strokes per minute with a one third cut off with six Cornish boilers l4ft. long and 7ft. diameter supplying the steam. The two beams were supported upon eight columns and each beam was constructed in two parts and weighed 37 tons. The flywheel was 21ft. in diameter and weighed 30 tons. These engines were capable of driving one rail mill turning out 1,000 per week, another mill capable of turning out 700 tons of rails or roughed down iron per week and one bar or roughing down mill capable of making 200 tons per week. Two blooming mills and two hammers were also worked by the same engines. The roof of the Goat Mill was 240ft. by 210ft. and was supported by lattice girders of an average length of 45ft. The covering of the roof was made up of corrugated iron plates and the floor of the mill was constructed of one inch cast iron plates.

Within two years the Goat Mill was in full production and it was probably in this building that special bars were rolled for the 1862 exhibition. In 1865 the weekly production at Dowlais was 1,400 tons of rails and 600 tons of bars, plates, angles and girders. At this time two 5 ton Bessemer converters were being put into commission with four others approaching completion. This development allowed Dowlais to manufacture steel rails and steel headed rails. The blowing machinery for the steel plant was manufactured by Hick and Son of Bolton. Ores being used at Dowlais in the mid 1860s were from Wales, Whitehaven, Barrow, Cornwall, Forest of Dean,

Northampton and Spain. When the Dowlais Ironworks was inspected in 1865 it was operating seventy balling furnaces and one hundred and fifty puddling furnaces with all the steam in the works being generated by waste gases.

A detailed description of the Dowlais Ironworks was made in 1869 when sixteen out of the seventeen furnaces were in blast. All the furnaces were fed with raw coal and were blown at a pressure of 3-3¼ psi. The works employed 9,000 people and produced yearly 150,000 tons of iron. Each furnace had evolved into the characteristic shape of being square at the base and taking a cylindrical shape at half its height. Output from each furnace was 180 tons weekly with tapping taking place three times in twenty-four hours. The furnaces were blown by six beam engines namely (a) the Merthyr Guest engine, (b) the Ivor works' engine with a 144in. blowing cylinder, (c) an engine with a 50in. x 6 ft. blowing cylinder, and (d) three engines with 120in. x 8ft. blowing cylinders. There were six forges at the old works and three at the Ivor works with the puddling furnaces receiving their draught from eighteen Lloyd's fans driven in groups of two or three by independent engines. The Dowlais works had seven mills consisting of a 24in. steel mill, a four roll 21in. girder mill, two 20in. rail mills and three 18in. bar mills. In the steel department there were six 5 ton converters blown by vertical 36in. Hick engines with 54in. x 5ft. blowing cylinders although more blowing capacity was to be added with installation of a pair of beam blowing engines. For hammering steel ingots the works had recently installed a duplex steam hammer. In 1869 there were just under one hundred steam engines working at Dowlais and Ivor including six blowing engines, twenty seven mill engines, four large pumping engines and thirty winding and underground engines.

Dowlais built its first Siemens steel furnace in 1871 and also during that year a new cogging mill was opened: This mill was designed for rolling down steel ingots and was driven by a pair of 30in. horizontal engines without flywheels. The mill engines and additional small engines for working the rollers were built by Kitson and Company of Leeds with the rolling machinery being designed and built by the ironworks itself. During this period the works had sixteen furnaces in blast and possessed one hundred and fifty puddling furnaces serving fourteen rolling mills. To improve the steel making capacity at the works a new furnace was put into blast in 1874, which was 55ft. high with an 18ft. diameter across the boshes. This furnace was capable of turning out three hundred tons of Bessemer pig iron per week. It had a closed top and was blown with hot blast at l,200^{0}F. The materials were raised to the furnace top by means of a water balance. By this date the Dowlais Iron Company was operating four regenerative gas furnaces on the Siemens-Martin steel process and six Bessemer converters.

The works increased its steel making capacity by enlarging their Bessemer converters in 1881 so that they possessed four 8 ton converters and two 6 ton converters. The mills also received new investment during the mid 1880s for in 1884 a new set of reversing mill plant was installed. This mill was powered by a pair of 60in. x 5ft. horizontal engines made by Kitson and Company. These were piston valve engines driving on one shaft and they produced 120 revolutions per minute. In the following year two new foundries were constructed, one in the upper works for moulding steel and one in the lower works for ingot moulds. A new cogging mill was also built at this time on the site of the old centre Goat Mill.

In 1888 construction started on a new works situated at Cardiff. Production of iron at the new site commenced in 1891 and the two works continued to work in tandem until iron making ceased at Dowlais in 1930 (Ince 1993, pp 47-53).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity extensively shown on estate and other plans at the Glamorgan Record Office, including the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are in the form of economic and business development.

Below ground remains may survive in the area of the blast furnaces; a conservation/management programme should be devised to ensure the preservation of the buried blast furnace remains, to include the possibility of excavation of the furnace site. An awareness campaign, including designation of the site as an area of industrial archaeological importance and the provision of information, eg display panels, to help ensure the long-term survival of any surviving remains should form part of the management strategy.

Figure 27a Dowlais Ironworks IW022

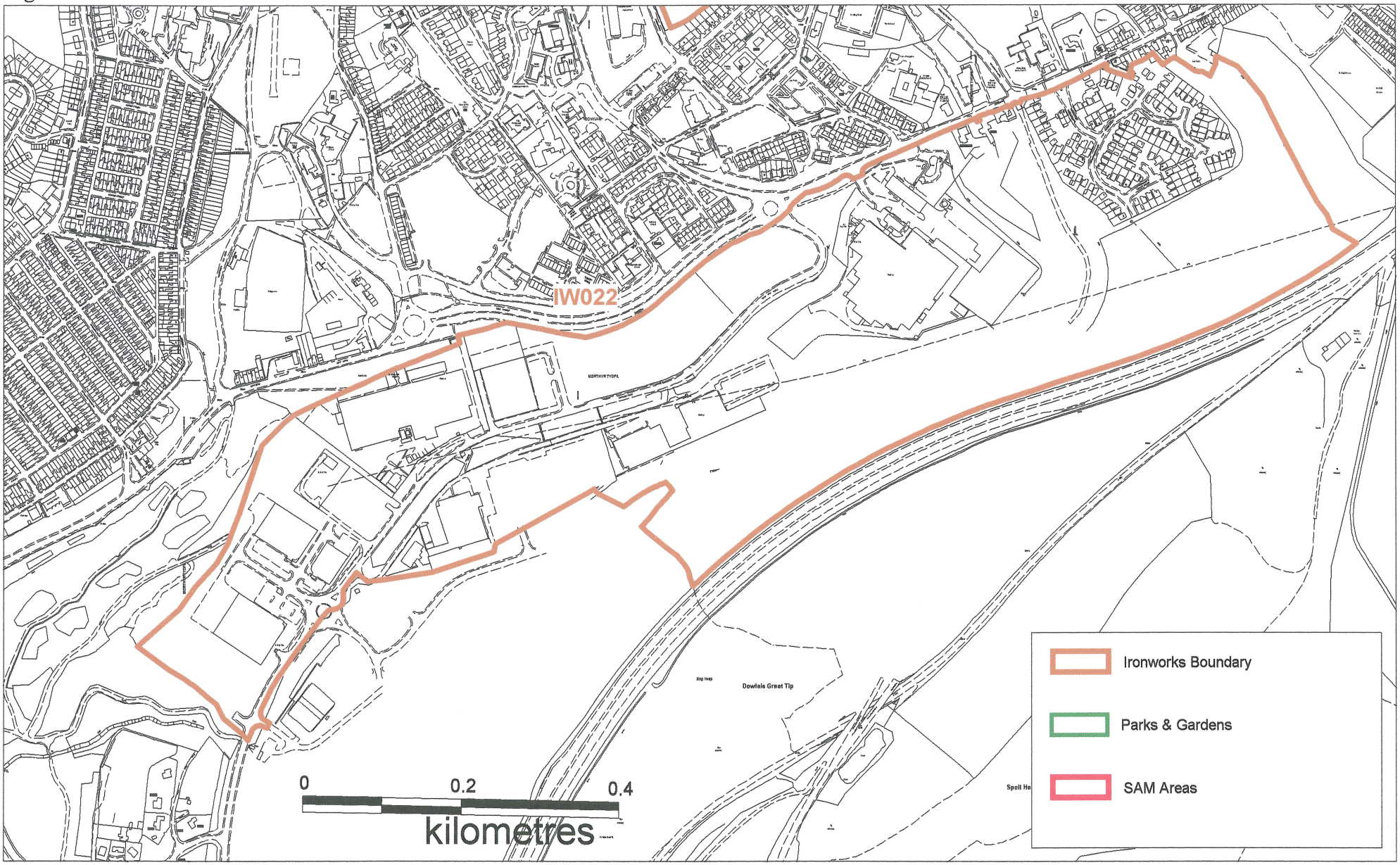

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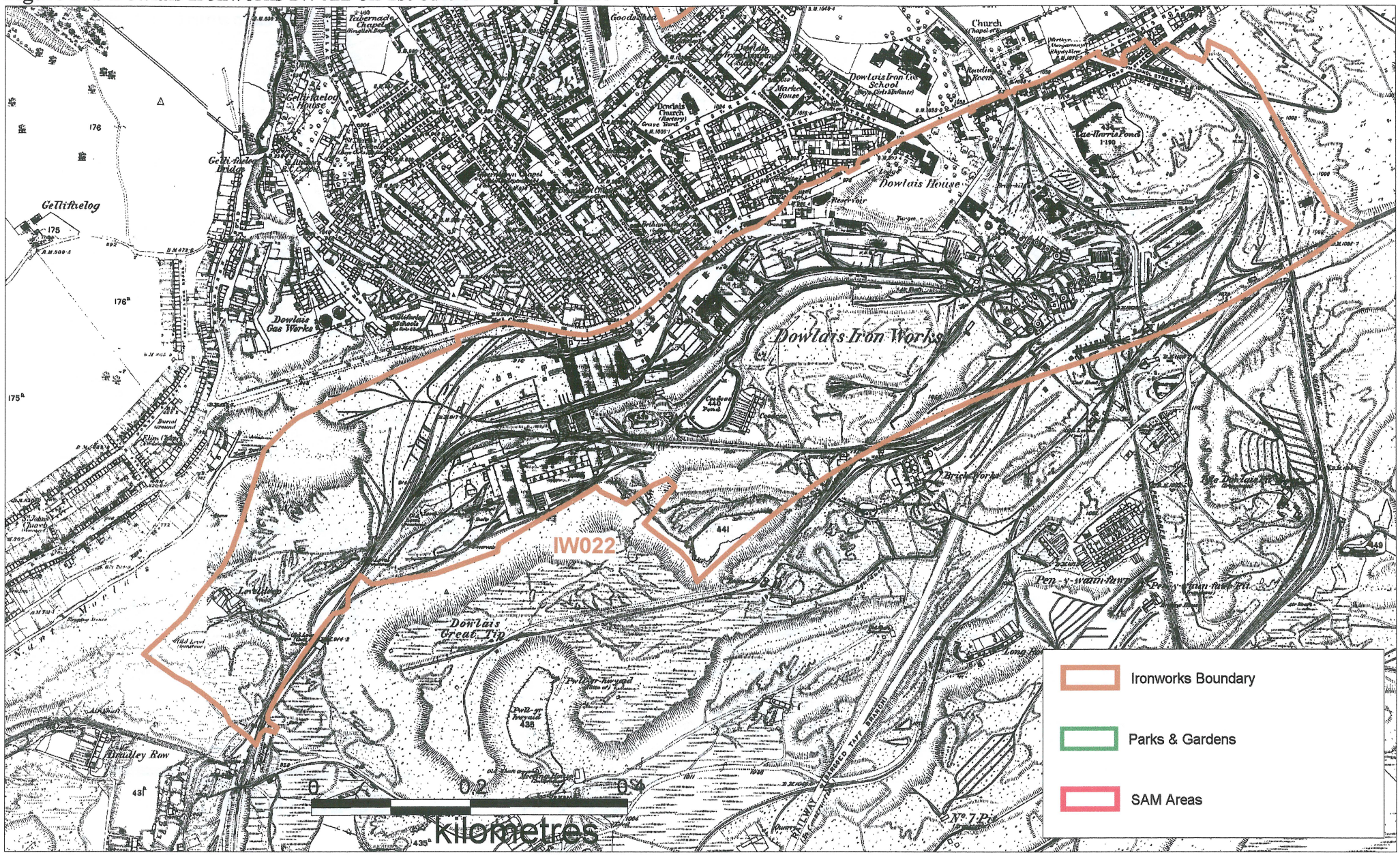
Figure 27b Dowlais Ironworks IW022 on 1st edition OS map base



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IW Number 023 Ivor Ironworks SO 06794 08120

General Description

The Ivor Ironworks (NPRN: 34,093) is currently a largely disused industrial area with surviving remains associated with Dowlais's subsidiary ironworks, the Ivor Works. Visible standing remains on the site are few and relatively late in date. The survival of buried remains at the site relating to the earlier phases of the works has yet to be confirmed, though remains a possibility. Opened in 1839 initially with four blast furnaces, the works formed part of a major expansion of Dowlais Ironworks between 1830s and 1860s and though relatively late, is as such of historic interest. During the second half of the 20th century the site of the Ivor Works was given over to a foundry (SO 06714 08144) operated by British Steel. The closure of the foundry in 1987 ended Merthyr's association with the iron industry, an association that had lasted more than 200 years. Most of the site was subsequently cleared and remains as a level open area.

Of particular note is a post-1915 industrial building (Grade II listed Cadw ref no. 27,086), the last remaining structure of the former Ivor Iron Works from the pre-British Steel period. This industrial building is of red brick with slate eaves roofs, comprising two sections both of 2-storeys, the taller E range of 5 bays and the lower W range of 6 bays. Bays divided into sunk panels by raised piers, the E range with panels each floor, the W range with full height panels. Stepped brickwork at top of each panel. Raised plinth broken forward over piers.

According to the listing details this building was possibly built as a blast engine house but more probably the sulphate of ammonia plant completed in 1928 as part of the coke and by-product plants constructed 1922-28. The building is not shown on the OS map of 1900 or a plan of the Ivor Works of 1910 but is marked on a plan of 1928 as a sulphate house. Sulphate of ammonia was one of the by-products of coke production, crude benzyl and tar being others. The building was converted some time between 1930 and 1949 to a general and electrical stores. Included for its special historical interest as the last remaining industrial building of the former Ivor Iron Works from the pre-British Steel period, probably a sulphate of ammonia processing plant.

Historical Background

The Ivor Ironworks was built as a subsidiary works to the main Dowlais Ironworks, completed in 1839 it consisted of four furnaces, forges, fitting shops and a foundry. The furnaces received their blast from a high-pressure beam-blowing engine with a 53in. x 9ft. steam cylinder and a 144in, blowing cylinder. This engine had a 22ft. 6in. flywheel and worked at 14 strokes per minute discharging 28,476 cu. ft. of air during the same period. Except for the 144in. blowing-cylinder, the engine was constructed by the engineers at Dowlais. In 1839 Harvey and Company of Hayle, Cornwall supplied Dowlais with two 24in. beam engines and an 80in. x l0ft**.** beam engine.

A detailed description of the Dowlais Ironworks was made in 1869; at this date it is recorded that the furnaces at the Ivor works were blown by a 144in. blowing cylinder engine and the works had three forges with puddling furnaces receiving their draught from eighteen Lloyd's fans driven in groups of two or three by independent engines. The Ivor Ironworks also possessed six mills, comprising a 24in. plate train, an 18in. rail mill, two l2in. trains and two 8in. guide mills (Ince 1993, pp 49-53).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on estate and other plans at the Glamorgan Record Office, including the Ordnance Survey Public Health Maps of Merthyr Tydfil, 1851 and the 1st and later editions of 1:2500 OS maps, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP are in the form of Housing development H20 and proposed development PD11: this would see the former Dowlais Foundry Site restored and re-graded leaving relatively flat even site for a mixed-use environment. Some industrial premises and office accommodation and remainder used for affordable housing.

The surviving historic industrial building(s), and pre-existing boundaries of the area, should be considered in any land-use reappraisal, and preferably retained. Sympathetic and sensitive alternative uses should be found for the surviving standing building(s), where possible.

Figure 28a Ivor Ironworks IW023

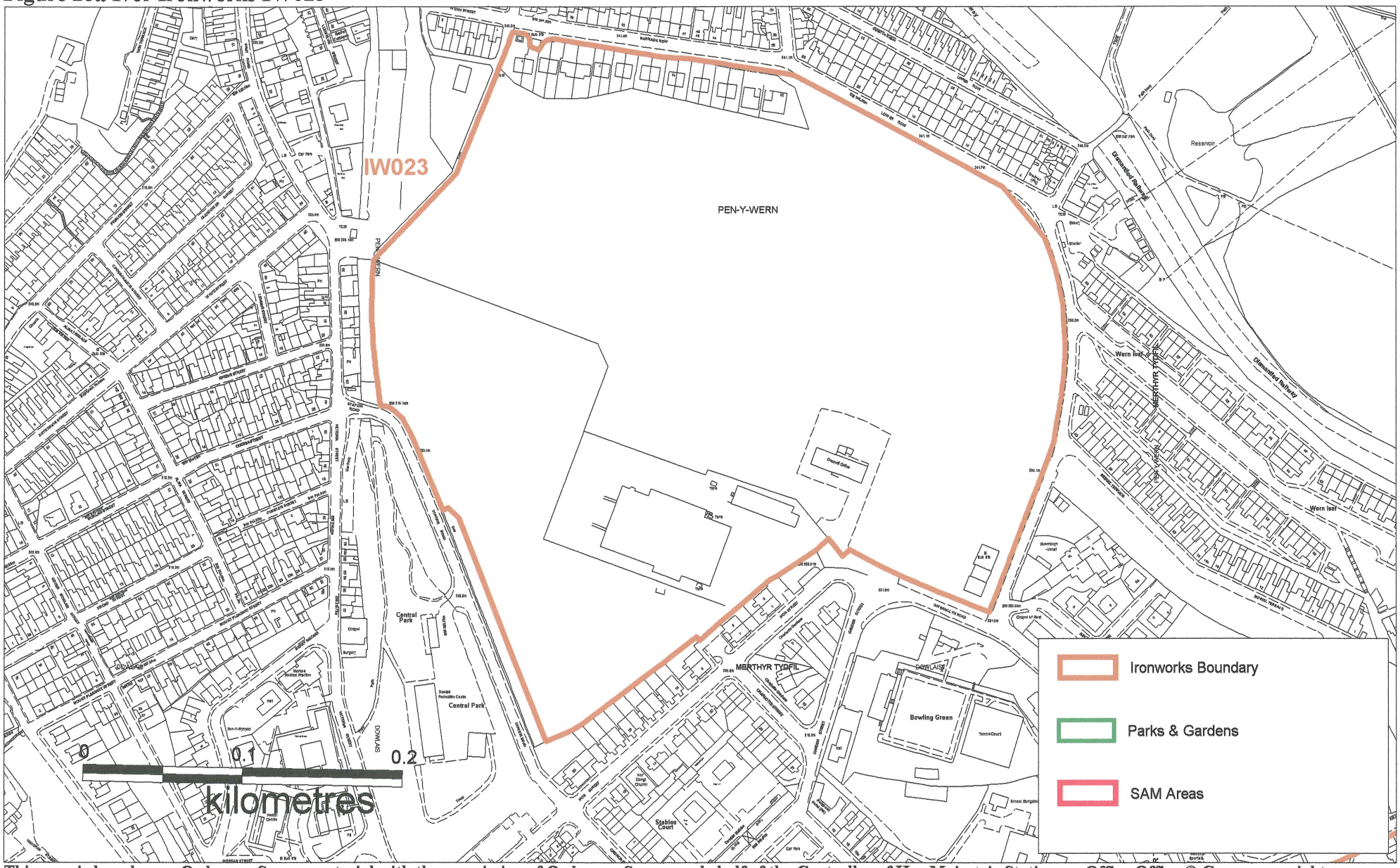

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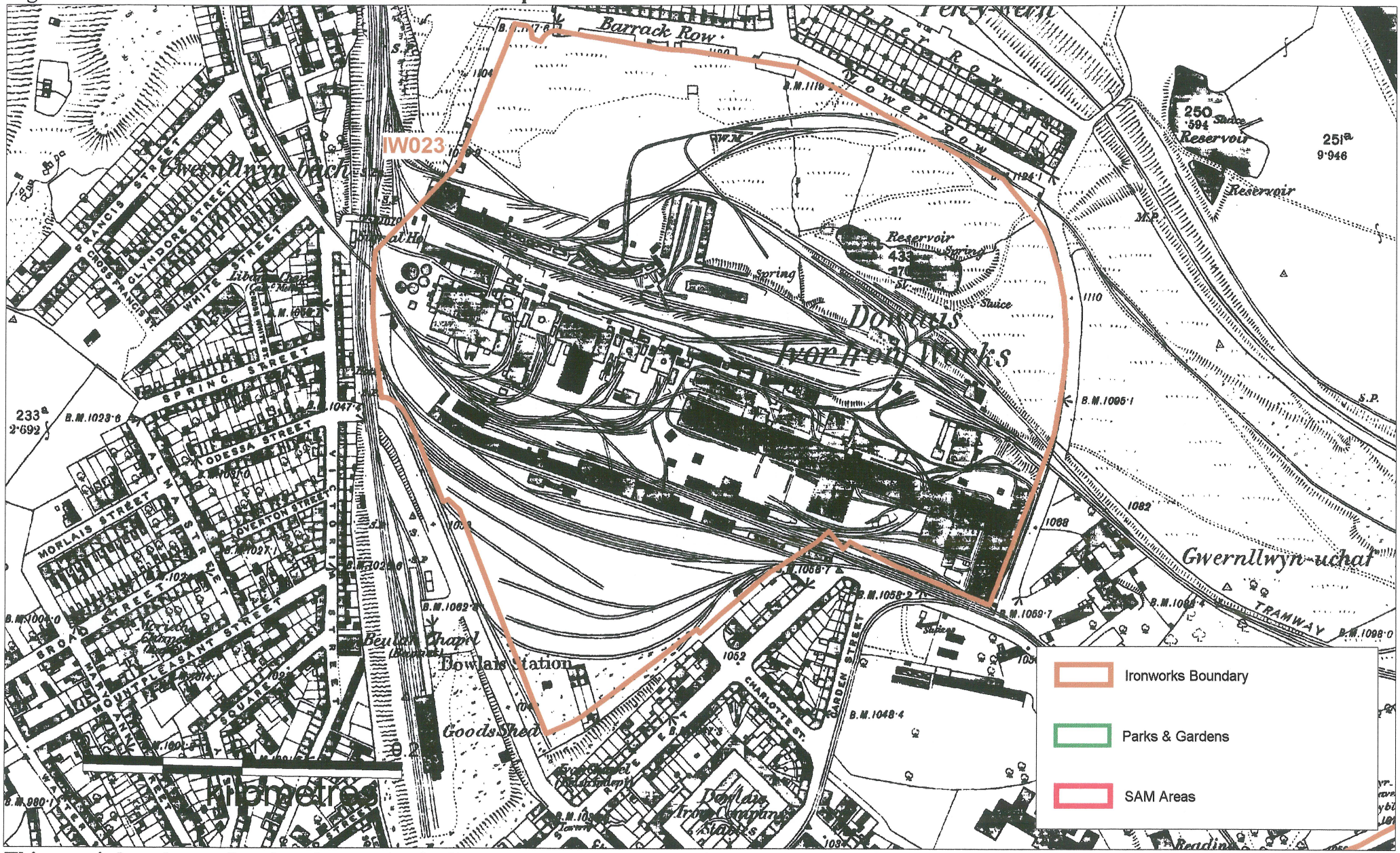
Figure 28b Ivor Ironworks IW023 on 1st edition OS map base



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IW Number 024 Hirwaun Ironworks (01109m) SN 9577 0592

General Description

The Hirwaun Ironworks (NPRN: 40,381; PRN 01109m) is an important ironworks of national and international significance; as the first coke–fired ironworks in South Wales, being founded in 1757. The site is also notable for its historic associations with numerous ironmasters associated with the early development of the South Wales coke fired iron industry.

The site comprises four ruinous blast furnaces (NPRNs: 85,173-6), protected by inclusion in a scheduled area (SAM BR157); these furnaces survive as overgrown earthen mounds showing variable amounts of outer brickwork, both in *situ* and fallen. Aligned WNW-ESE they are separated from the charge bank by a blast passage, which runs the full length to their rearand a blast passageway. The furnaces, like much of the site are in an overgrown state of disrepair and dereliction.

In addition to the ruins of the blast furnaces, the site retains the former manager's house, Ty-mawr, a massive tramroad causeway and two limekilns. The Tramroad causeway (NPRN: 34,847) and bridge are notable as an early example of railway engineering; the latter is a Grade II Listed structure (Cadw ref no. 26,827) and lies within the scheduled area (SAM BR157). This high single-track causeway is approximately 100m in length and is carried over the Afon Cynon by a single span bridge with segmental arch and narrow dressed-stone voussoirs and coursed rubble revetments. The flat deck is a footpath retaining some stone sleeper blocks (overgrown at the time of inspection). This structure was built 1806-8 by the engineer George Overton to replace an earlier bridge, sited immediately south of the present bridge, of a tramroad built in 1793, upon which raw materials were carried to the furnaces of Hirwaun ironworks and limestone was brought from the quarries at Penderyn.

The ironworks area identified for the purpose of this study extends beyond the area currently protected through legislation (ie beyond the SAM area) and includes the standing buildings of the managers house Ty-mawr, and the site of the works tramroad and locomotive shed, as well as the site of associated tips and a row of now demolished terraced worker's housing to the west at SN 96601 06039 (probably those identified as PRN 01801m). These features are all depicted on the first edition 1:2500 OS.

Historical Background

The Hirwaun Ironworks dates from 1757 when John Maybery leased land at Hirwaun to erect a furnace. The furnace at Hirwaun was initially constructed on a site just outside Bute land but a new lease in 1760 incorporated the land on which the single furnace stood. The partners, John Wilkins, John Maybery and Mary Maybery passed the Hirwaun Ironworks to John Wasse and William King in 1775. Their lease was to run for fourteen years and this new partnership agreed to repair the waterwheel and cylinders that blew the furnace. These and other conditions were unfulfilled and the lease was terminated in 1777.

In 1780 the concern was leased to Anthony Bacon of Cyfarthfa. It is unclear as to whether Bacon was responsible for the conversion of the works from charcoal to coke, or whether this change in fact dated to the previous occupiers, the Mayberys. However, it is known that Bacon put the works in repair and continued the production of iron on the site until his death in 1786. The lease of Hirwaun then passed to Samuel Glover of Abercarn. Although the ironworks was assessed as

producing 1,050 tons of iron in 1796, production seems to have seldom risen to over 10 tons per week.

In 1805, when under the control a new partnership (Francis William Bowzer, Simon Oliver, Lionel Oliver and Jeremiah Homfray, later George Overton) the ironworks remained a single furnace affair, producing 450 tons of iron. The site is thereafter developed and when the Hirwaun Ironworks was put up for sale in 1813 it comprised of two well constructed furnaces each 40ft. high, two cast houses, one 45ft. by 40, the other 36 by 33ft, an air furnace and two fineries, a blast engine on Boulton & Watt's principle 38in. x 6ft. 8in, with a 78in. blowing cylinder working through a water regulator, a forge 157ft. by 44ft. at one end and 34ft. at the other with ten puddling furnaces and five balling furnaces and a Trevithick steam engine working with a 6ft. stroke, two pairs of puddling and a pair of finishing rollers capable of rolling 80 to 100 tons weekly, (this engine was obviously put in during Homfray's involvement with the works as he and Birch were building Trevithick type engines for sale at their Abernant Ironworks, Aberdare). Other property in the sale included a counting house, a further forge, pattern room, drying sheds, carpenters' and smiths' workshops, a waterwheel for turning a lathe for the rollers and grinding clay, a brick kiln, four calcining kilns, mineral yard, coke banks, two counting houses, three limekilns, four collieries, iron ore levels, cottages and tenements.

The site was unoccupied between 1814 and 1819, when William Crawshay of Cyfarthfa took over the lease. The two furnaces were rebuilt and a powerful 52½in. beam blowing engine (Neath Abbey Iron Company) was constructed. Output was improved, some 4,160 tons of iron being produced in 1823, and the site developed with more furnaces built in 1822. Output continued to rise with 7,020 tons of iron being produced in 1826 and 9,370 tons in 1830. The four furnaces continued in blast during the 1830s and 1840s and Ince suggests a second Neath Abbey 52½in. blowing engine was installed in 1839 and certainly a 24in. x lft. high pressure engine was purchased by the Hirwaun Ironworks from Neath Abbey in 1849.

Hirwaun was never a very profitable concern for any of its owners and during the mid 1850s relations between the Marquis of Bute, who owned part of the site, and Francis Crawshay became strained with severe consequences for the works; the blast furnaces and mills were on Bute property with the furnace yard and limekiln on Crawshay property. The Crawshays were thereafter intent on abandoning Hirwaun in favour of their Trefforest plant.

The furnaces were in blast for the first six months of 1859 and then the Crawshays abandoned the site. The works reverted to the landowner, the Marquis of Bute, and later in 1864 was leased to Handel Cossham and Thomas Challender Hinde who put two furnaces in blast. Between 1865 and 1866 when the works was under the control of the Hirwaun Iron and Coal Company the remaining two furnaces were repaired. However, operations were short lived and in 1867 the word iron was dropped from the title of the company. When the Hirwaun Ironworks was advertised for sale in 1870 it was described as having four furnaces with a powerful blast engine, arrangements for utilising waste gases, hot air stoves, a spacious forge and mills with powerful engine, trains of rolls, nineteen puddling furnaces, forges and steam hammers. No interested parties came forward and the Hirwaun Coal Company was wound up.

The ironworks site remained unoccupied until 1880 when the Stuart Iron, Steel and Tin Plate Company took it over. The Hirwaun Ironworks was renamed the Stuart Ironworks and some work was carried out on the furnaces. These were altered to make them 54ft. high and 16ft. in

diameter across the boshes with six tuyères. It was thought that the efficiency of a furnace could be improved if the volume of air thrown into the structure could be increased, hence the multiplication of the tuyères. However, the result of adding more tuyères at Hirwaun is not known as little production of iron took place and the works later became a general foundry (Ince 1993, pp 33-35; Rees 1969, p74; NMR information).

Ironworks Boundary

The ironworks boundary, as defined for the purpose of this report, is essentially based on the core area of activity shown on the 1st and 2nd edition 1:2500 OS map, though tied into current boundaries as depicted on landline mapping data.

Identified Threats

Threats to the area as identified from the UDP for the area are in the form of Land reclamation URPB1a, housing development HP2, HP1L HP1Kt: HP1L offsite water main and trunk sewer before housing development dependant on construction of Penyard link. HP1K Boundary of Hirwaun ironworks reclamation scheme, improvement to sewers first. URPB former ironworks subject of draft development brief to reclaim area for mixed use.

The majority of the site, including the scheduled area, is currently in an overgrown state and dereliction poses an obvious and serious threat to the survival of the remains. Part of the threat to the site comes in the form of erosion from off-road vehicular activities (motorcycles), but also from active vandalism, including the removal of facing stones from standing structures.

The area would benefit from an increased level of management/conservation to include a programme of archaeological work, a full survey of surviving remains and remedial conservation work to above ground remains, ie selective vegetation clearance and consolidation of standing remains under archaeological supervision.