The Stratford Railway Workshops

From the Eastern Counties Railway to the Chobham Farm Container Depot.
Excavations at Angel Lane, Stratford

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Introduction

In October/November 2011, Pre-Construct Archaeology Ltd (PCA) undertook a programme of archaeological investigation in advance of development at Angel Lane, Stratford in the London Borough of Newham.[1] The site, located within the designated planning Delivery Zone 11 (PDZ11) of the London Olympic Park, was bounded to the east by Angel Lane, to the west and south east by railway land, and to the north by the access road from Angel Lane to the site (Figure 1).

Previous work indicated that the site lay within the boundaries of the former Stratford Works, a complex of railway workshops first developed in the 1840s by the Eastern Counties Railway (ECR).[2,3] It was therefore decided that the Phase 2 archaeological investigations would comprise a programme of stripping, mapping and sampling in those areas of development impact defined by the Written Scheme of Investigation.[4] The largest trenches (nos. 3 and 10) were located in the northeast and the southwest areas of the site respectively. Trenches 4–14 were positioned between Trenches 3 and 10, respecting the northeast-southwest alignment of Station Road (Figures 1–3, 5).

Historical land-use of the site

Historical maps indicated that the site was largely undeveloped during the early 19th century, the nearest residential development being concentrated some distance to the south around the junction of Angel Lane and Stratford Broadway. In 1838 the Eastern Counties Railway acquired land at Stratford in order to build an engine shed for locomotives working the company's new London to Colchester line. In the second half of the 1840s the company enlarged these facilities with the addition of new workshops for the construction and maintenance of its locomotives and rolling stock. Known as the Stratford Locomotive and Carriage Works, (Figure 4)[5] the complex remained in the possession of the Eastern Counties Railway until it was absorbed by the newly-formed Great Eastern Railway in 1862, following which it descended to the London and North Eastern Railway in 1923 and thence to British Railways when the railways were nationalised in 1948. The works were closed in the early 1960s, and the surviving buildings were demolished around the end of the decade. In 1970 the Chobham Farm Container Depot was built on the site, although this had fallen out of use by the mid-1990s and was itself demolished during the first decade of the 21st century.

Phase 1[6]: Natural sands and gravels

The earliest deposit recorded across the site comprised loose mid yellowish gravels, which were observed in Trenches 3 and 7.The level of the natural deposit was not seen in the remaining trenches owing to the heavily truncated nature of the site. The natural gravel was recorded in Trench 3 at a level of 5.62m OD[7], and in Trench 7 at 5.70m OD. No evidence of any un-truncated surface of the gravels was observed during either the evaluation or the archaeological strip and map programme.

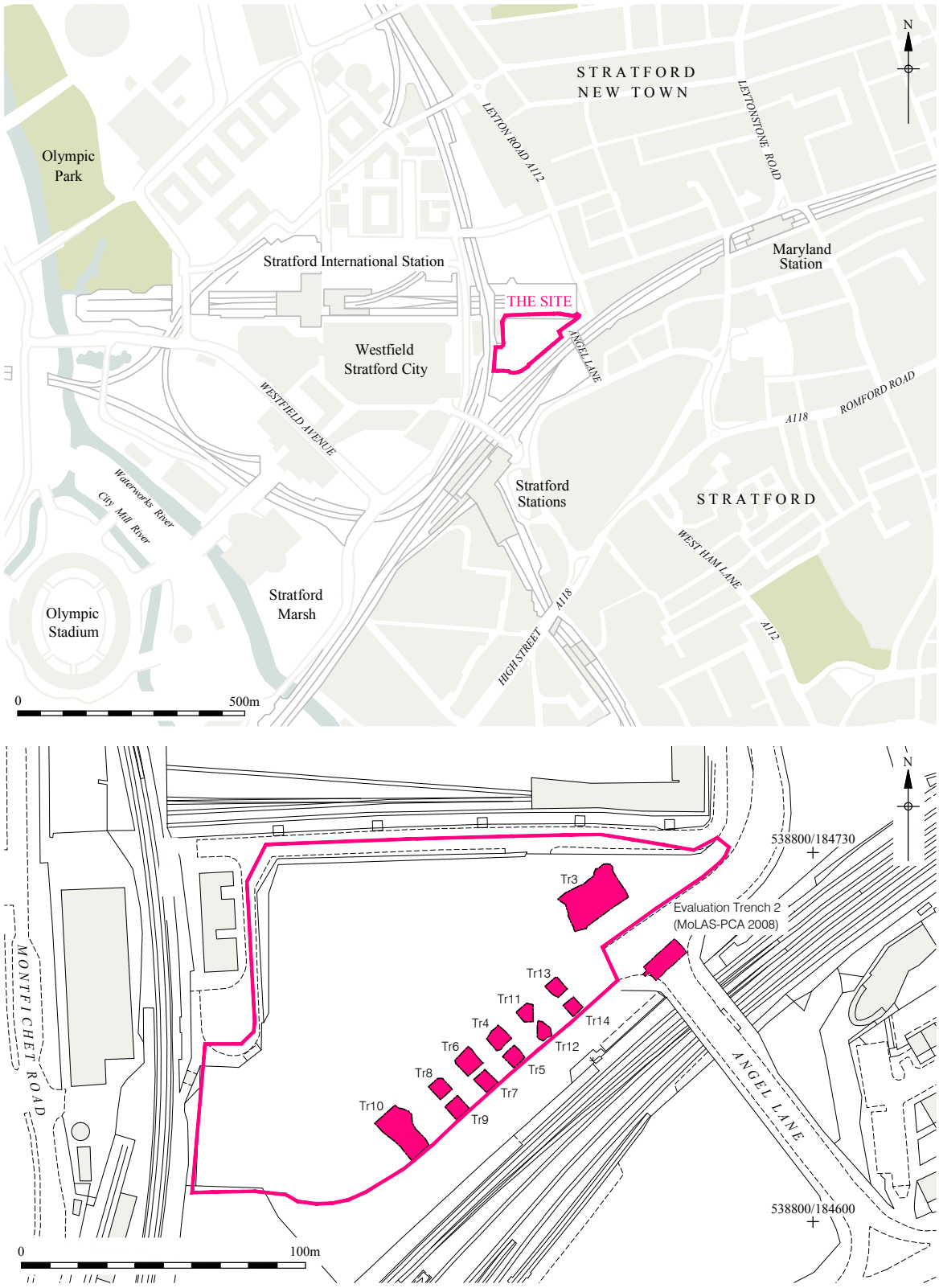

Figure 1. Site and trench location plan. 1:12,500 and 1:2,000

Phase 2: c.1847–c.1866 (Figure 4, 5a)

Historical context

In July 1836 a Parliamentary Act was passed permitting the development of a new railway line to link London, Colchester, Ipswich and Norwich. The Act was promoted by the Eastern Counties Railway Company, which appointed the prolific inventor and railway pioneer John Braithwaite (1797–1870) to act as Engineer to the scheme. Despite the fact that the chosen route contained no major topographical obstacles, construction of the line between London and Colchester progressed slowly, and it was not until July 1839 that the Stratford to Romford stretch opened to traffic. This was followed a year later by the opening of the London terminus at Shoreditch, although the continuing slow rate of progress led in October 1842 to Braithwaite's eventual dismissal from the company's service.[8]

Braithwaite's ejection did little to accelerate the pace of development, so in October 1845 a group of disgruntled shareholders engineered the elevation of the railway tycoon George Hudson (1800–1871) to the chairmanship of the company.[9] Within days of his appointment, Hudson announced that the company's locomotive repair facilities, previously located near Hare Hall, Romford, were to be concentrated at Stratford, where Braithwaite had built a station and engine shed six years earlier.[10,11]

In August 1846 tenders were invited for the construction of the new locomotive workshops, the contract for which was awarded to Messrs Thomas and William Piper of Bishopsgate the following month.[12,13] The original contract for the works contained specifications for the construction of a Locomotive Erecting Shop, a Smiths' Shop, Machine Shop and Stores, a Boiler Shop, Foundry, Wheel Shop, Pattern Shop, Tender Shop and Painter's Shop, an Office/Entrance Building, as well as sanitation and drainage.[14]

By the end of May 1847 construction of the Stratford locomotive workshops was well under way, and accounts submitted to the railway company by the contractor suggested that all major works had been completed by November 1848.[15,16] Although the original contract was worth £58,740 0s.0d, Piper's final accounts revealed that the cost of additional fittings and labour had pushed the total cost of construction up to £79,149 7s.0d.[17] Additional works included the provision of an Engine House and turntables, together with numerous fittings not listed in the original outline specification, including copper and brass furnaces, an engine pit and weighing machine and the construction of a telegraph office.

The main works' buildings were depicted for the first time on an outline Ordnance Survey map of the area surveyed in 1848/9 (Figure 4). This shows the works to comprise three principal blocks, the central one flanked at its east and west ends by detached outbuildings. The centrepiece of the works was the Erecting Shop, a substantial brick-built structure of four bays, measuring 348 ft long and 142 ft wide, which could accommodate as many as 50 locomotives at any one time. A sketch plan of the works dating to the early 1860s showed approximately 40 narrow rectangular features inside the building, which correspond with the brick-lined engine pits detailed in Piper's specification. The Erecting Shop was flanked to the north by the Boiler Shop and Smiths' Shop and to the south by the Tender Shop and Engine Paint Shop. To the west the Erecting Shop was flanked by the General Offices and to the east by a smaller block, which later plans indicated contained the engine house and boiler house for the works.

The 1848/9 map did not show a group of smaller outbuildings which appear on later maps and plans standing to the east of the southernmost block (Figure 4). These buildings were shown on Edward Stanford's map of 1862 as two square blocks and an inverted L-shaped building, which contained the Iron and Brass Foundries and Pattern and Coppersmith's Shops, all of which formed part of Messrs Piper's final contract and which must therefore have been amongst the last elements of the complex to be built in the late 1840s.

Figure 2. Phase 3 site and trench plan showing features superimposed on 1867 Ordnance Survey map. 1:625

Archaeological evidence

Archaeological evidence associated with the construction of the Erecting Shop was recorded during the strip and map exercise in the form of a north–south orientated masonry wall foundation [102], which was observed in Trench 3 between levels of 6.32m OD and 5.59m OD. The wall was 14.27m long by 0.61m wide, and represented the eastern wall of the Locomotive Erecting Shop. Archaeological evidence of the above-ground structure of the building was recorded in the form of four square millstone foundations with square metal plates secured with four bolts on top of each, which supported circular iron column bases, each with a diameter of 0.34m.

The early 1860s sketch plan showed turntables located outside both the east and west entrances of the erecting shop. The heavily truncated foundation [111] of the base of the eastern turntable was discovered in Trench 3. Constructed of machine-cut red bricks set in mortar, the structure had a diameter of 6.15m (20.17 ft).

The eastern entrance of the Erecting Shop was defined by a northeast-southwest orientated masonry wall [120], which abutted the west facing elevation of the eastern wall of the Erecting Shop. This wall respected the outside edge of the southernmost of the two lengths of railway track that entered the shed from the turntable outside the eastern entrance. This corresponded with the track arrangement shown in the early 1860s sketch plan. No evidence of the early railway tracks themselves were encountered in Trench 3. Parallel and immediately to the east of the Locomotive Erecting Shop was a north–south orientated brick flue [127], which measured 6.50m long by 0.44m wide by 0.24m deep.

Remains of the original boundary wall of the Stratford Works were identified in Trench 2, in the form of a short stretch of masonry foundations. The location and northeast–southwest alignment of this feature corresponded exactly with the boundary wall depicted on Stanford's map of 1862.

A north-south orientated masonry foundation [279] in Trench 13 was interpreted as the eastern external wall of the original Coppersmith's Shop, which occupied the eastern end of the inverted L-shaped building. Remains of the foundation of the south-facing wall [272] of this structure were found in Trench 11.

Phase 3: c.1867–c.1873 (Figure 2, 5a)

Historical context

George Hudson was unseated by shareholders in February 1849, after which he was succeeded as Chairman by his deputy, David Waddington. Following Hudson's downfall, the individual with the greatest influence over the development of the Stratford Works was the Locomotive Superintendent, who was responsible for the procurement, management and maintenance of the company's locomotive stock and facilities. John Hunter, who had been appointed to the post by Hudson in 1846, left the company's service in June 1850 and was promptly succeeded by John Viret Gooch (1812–1900), brother of Daniel Gooch, later the Chairman of the Great Western Railway.[18] The most significant development of the Gooch era was the latter's decision to start building locomotives at Stratford.[19] The first locomotives to be assembled at the works were six Class A tank engines, designed by Gooch and completed in 1851.[20]

Gooch left the company in 1855, following which he was succeeded by Robert Sinclair (1817–1898), late of the Caledonian Railway. Sinclair's period of stewardship was defined by the formation of the Great Eastern Railway (GER) in 1862, which involved the amalgamation of the ECR with a number of small regional railway companies. Having inherited a variety of old locomotives and rolling stock, Sinclair set out to standardise the new company's locomotive fleet. In order to meet demand, the majority of locomotives designed and built during Sinclair's superintendence were built under contract by third party manufacturers, although a small quantity of engines destined for service on the North Woolwich line were built at Stratford.[21]

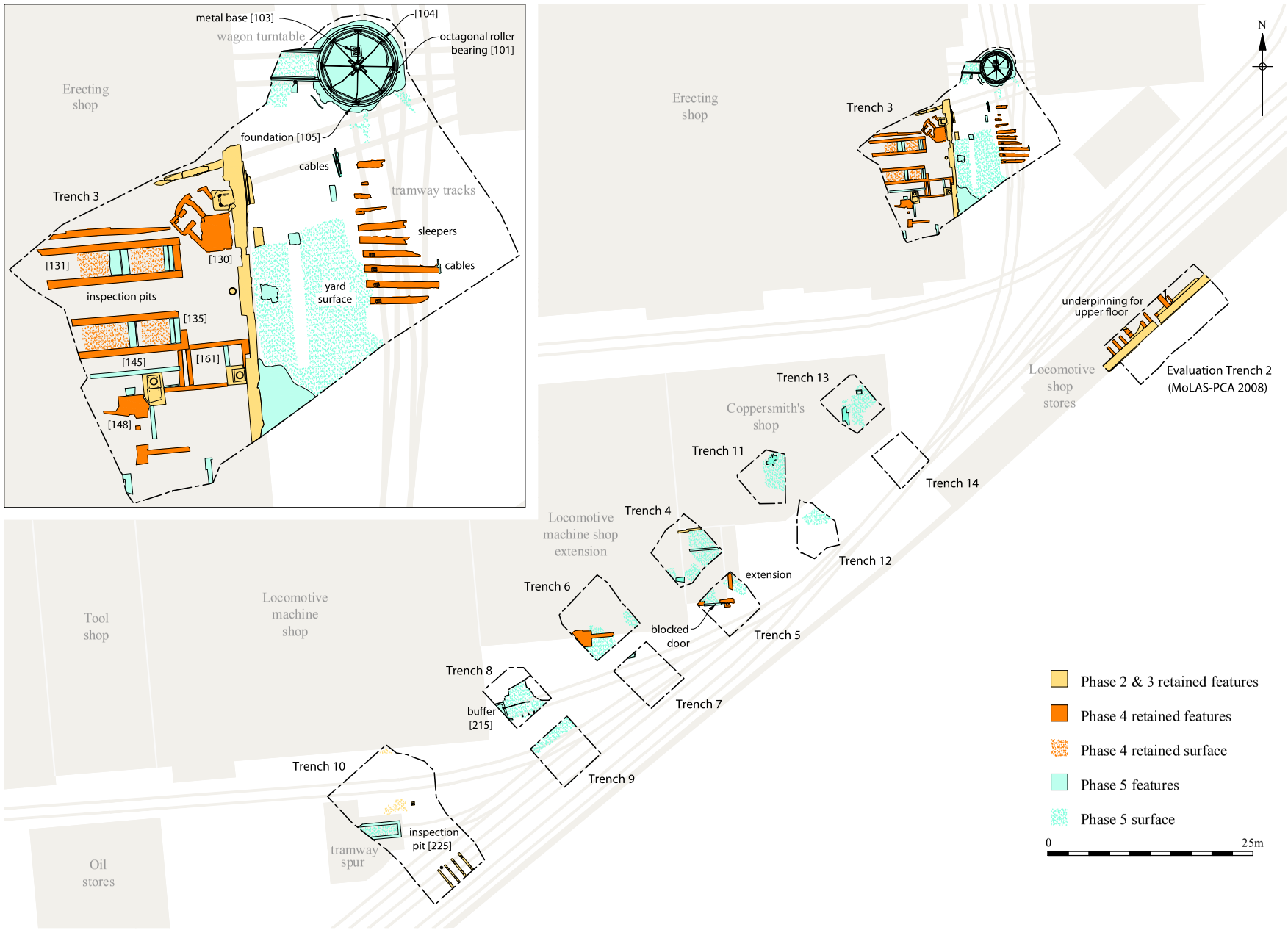

Figure 3. Phase 5 site and trench plan showing features superimposed on 1915 GER plan. Main plan 1:625, detail 1:250

Sinclair resigned as Locomotive Superintendent in September 1865, following which he was succeeded in quick succession by William Kitson and Samuel Waite Johnson (1831–1912). The latter was responsible for a number of improvements made to the facilities at Stratford; these included the enlargement of the iron foundry during the spring and summer of 1867, as well as the replacement of the existing 15′ diameter engine turntables with 18′ diameter models two years later.[22,23]

Historical maps suggest that further changes were made to the Stratford Works during the period that Gooch, Sinclair, Kitson and Johnson occupied the post of Locomotive Superintendent. Comparison of the early 1860s sketch plan with the Ordnance Survey map of 1867 suggests that additional sidings accommodation may have been laid down to the south and south-east of the 1840s locomotive works buildings, on an alignment parallel to Station Road. Similarly, comparison of the Ordnance Survey map with Edward Stanford's map of 1862 suggests that the inverted L-shaped building that housed the Coppersmith's Shop, Brass Foundry and Pattern Shop may have been altered at this time.

Archaeological evidence

The archaeological investigations confirmed that the building that housed the Coppersmiths' Shop, Brass Foundry and Pattern Shop had been partially rebuilt, a north-south masonry foundation [273] truncating wall foundation [272]. The former was interpreted as the east wall of the Pattern Shop (Figure 2).

A section of one of the northeast–southwest orientated railway sidings first shown on the 1867 Ordnance Survey map was exposed at the southeast end of Trench 10 (Figure 2). Although the rails had been removed, a number of timber sleepers and cast iron chairs [24] had survived. Measurement confirmed that the track was standard gauge (4′8½″: 1.43m). A brick floor [222] found a short distance to the north-west of the track was interpreted as the surface of an external yard area on the south side of the Engine Paint and Tender Shops (Figure 2). The Ordnance Survey map of 1867 (Figure 5a) indicated that this yard area was traversed by the east-west orientated length of track, along which engines and tenders were manoeuvred in or out of the Tender and Engine Paint Shops.

A north-south orientated masonry foundation in Trench 6 was interpreted as part of the eastern wall of a detached rectangular building shown on both Stanford's and the 1867 Ordnance Survey maps, (Figure 2) which was identified on the early 1860s sketch plan as a 'Warehouse (Old Store)'.

The introduction of the southwest–northeast orientated track sidings, together with the construction of a rectangular building shown on the 1867 Ordnance Survey map abutting the southeast facing boundary wall, necessitated alterations to the original eastern boundary wall. A substantial northeast–southwest wall was observed in Trench 2 was interpreted as part of the boundary wall shown on the map.

Phase 4: 1874–c.1905 (Figure 5b)

Historical context

In July 1873 S.W. Johnson was succeeded as Locomotive Superintendent by William Adams (1823–1904), formerly of the North London Railway. Faced with a shortage of locomotives and growing demand for new stock to work the company's suburban services, Adams proposed that henceforth all of the Great Eastern's engines, carriages and wagons should be built at Stratford.[25] The Board concurred, and on 25 March 1874 expenditure of £22,020 was authorised to build a new boiler shop, to enlarge existing buildings, and to procure new machine tools for the works.[26,27]

Adams also called for a number of infrastructural improvements to be made to the tracks and sidings that served the locomotive works. In December 1874 he recommended that the company adopt tramways[28] to shunt materials and parts around the works, a system similar to that used by the London and North Western Railway (LNWR) at its works at Crewe.[29,30] Adams proposed that parts of this new shunting

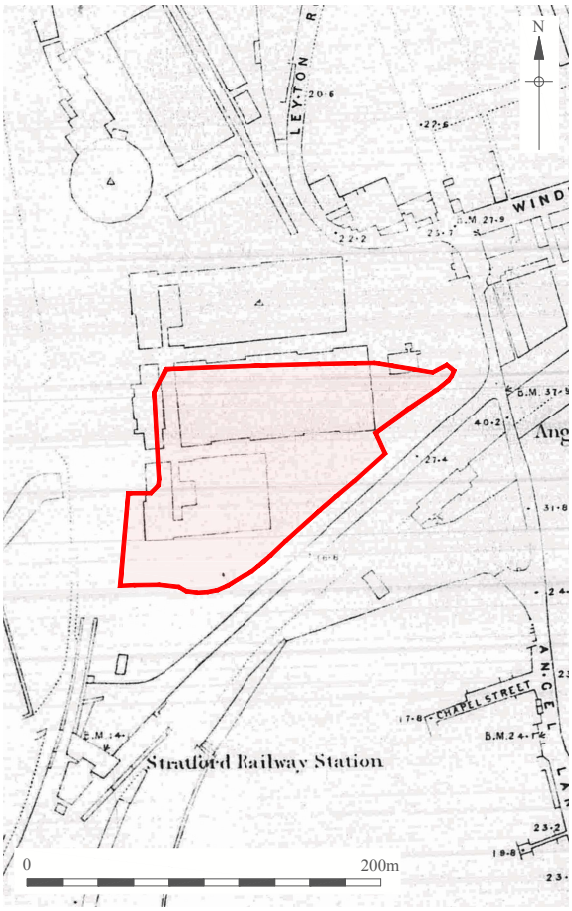

Figure 4. Environs of London map, 1848/49. 1:4,000

tramway should be laid down as curves, in order to avoid the time consuming use of turntables to manoeuvre engines, tenders and wagons into and out of the shops. Shortly afterwards the Great Eastern sanctioned the outlay of £890 for the tramway, the curves and a number of new pits in the Tender Shop.[31]

A contract for the construction of the tramway curves was awarded to Neilson and Company of Glasgow in January 1875.[32] Neilsons were also awarded contracts to build three Class 209 short-wheelbase standard gauge shunting locomotives for use at the works, a further four of which were built at Stratford between 1897 and 1903.[33] The Ordnance Survey map of 1893 (Figure 5b) indicates that the curves upon which these engines ran allowed the company to dispense with four turntables on the track to the south of the Tender and Engine Paint Shops and one at the south-east corner of the Erecting Shop.

In April 1875, the Board of the Great Eastern approved Adams' proposal to cover an open area of ground between the Iron Foundry and the Tender Shop with a roof in order to double the size of the former.[34] Two months later a contract was awarded to William Bangs and Company to extend the Locomotive Machine Shop; together these extensions appear to have bridged the gap between the outbuildings at the eastern end of the southernmost of the 1840s blocks, creating the distinctive 'stepped' configuration of the south elevation of the range shown on the 1893 Ordnance Survey map (Figure 5b). Machinery for the newly enlarged shops was ordered from a number of manufacturers during August, September and November 1875.[35]

Adams played a pivotal role in the development of the Stratford Locomotive Works, and also made a number of important contributions to locomotive design, not least the introduction of the 2-6-0 'Mogul' wheel configuration. Despite this record, only a handful of locomotives were built at Stratford during the period of his superintendence, while the first 'Moguls' were not built until after he had left the Great Eastern's service.[36]

Massey Bromley (1846–1884) succeeded William Adams as Locomotive Superintendent in February 1878, remaining at Stratford until he resigned from the company's service in August 1881. Bromley appears to have made few, if any major changes to the layout of the locomotive works, and on his departure in August 1881 he was temporarily succeeded as Locomotive Superintendent by the Works Manager, Mr M. Gillies, until Thomas William Worsdell (1838–1916) assumed the post in a permanent capacity in February 1882.[37]

By the time that Worsdell entered the company's service a total of 160 locomotives had been built at Stratford during the preceding 35 years, more than a third of which were assembled during Bromley's short superintendence.[38] Worsdell became the first Locomotive Superintendent of the Great Eastern to realise Adams' goal of building all the company's locomotive stock in-house. Although brief, Worsdell's superintendence saw a number of significant improvements being made to the facilities at Stratford, including the enlargement of the Boiler Shop and the extension of the Engine Paint Shop.[39,40]

Worsdell was succeeded in May 1885 by James Holden (1837–1925), who is regarded as having taken Stratford into the top rank of British railway works in terms of speed and efficiency of production.[41] The working practices pioneered by Holden were manifested in such feats as the assembly of a class Y14 tender engine within the space of less than ten hours in December 1891.[42] 1890 saw the completion of the 500th locomotive built at Stratford; within ten years the works could boast of having built 1,000 locomotives in less than 50 years.[43]

Archaeological evidence

The archaeological investigations revealed extensive evidence of the improvements made to the Stratford Works during this period, including a number that the documentary record indicates were initiated by William Adams. These included significant alterations made to the internal arrangement of the Erecting Shop, including the addition of new inspection pits and modifications to others, as well as improvements to the drainage of the building.

Two east–west orientated rectangular brick-built inspection pits [131] and [135] were discovered in Trench 3, both within the footprint of the former Erecting Shop. Two further brick structures [148] and [130] found to the south and east of the pits were interpreted as foundations for new machinery installed in the Erecting Shop during this phase.

Archaeological evidence for the removal of the turntable facing the eastern entrance of the Erecting Shop and its replacement with tramway tracks was also discovered. Remains of two parallel north-south aligned lengths of track were found in the form of a number of timber sleepers and cast iron rail chairs; the sleepers were sufficiently long to carry two parallel tracks.

During this phase the buildings to the south of the Erecting Shop (the Coppersmiths' Shop, the Iron Foundry building and the Warehouse building) were integrated into a single structure with the larger 1840s building to the west. Archaeological evidence for the reorganization of these buildings was seen in Trenches 4, 5, 6, 11, 12 and 13, where concrete floor surfaces together with a drainage system and new building extensions were recorded. In Trench 4 a north–south orientated brick structure [258] was interpreted as an inspection pit and in Trench 5 a building extension with a door opening in the south elevation which faced the tramway was observed. In Trench 12 two segments of wall were interpreted as a boundary separating the Coppersmiths' Shop from the tramway lines to the southeast.

Archaeological evidence in Trench 2 indicated that the long, narrow rectangular building constructed between the northwest facing elevation of the Stratford Works boundary and the railway tracks to the northwest had been modified during this period. A number of concrete foundations abutting the site boundary wall were recorded. They were all parallel and northwest–southeast orientated and were interpreted as possible foundations/underpinnings associated with the construction of an upper floor above

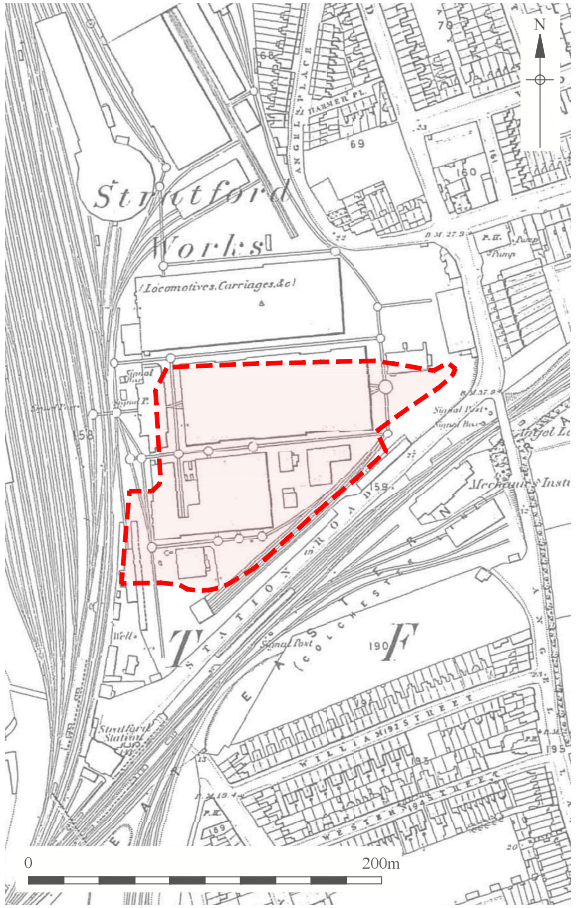

Figure 5a
First Edition Ordnance Survey map, 1867

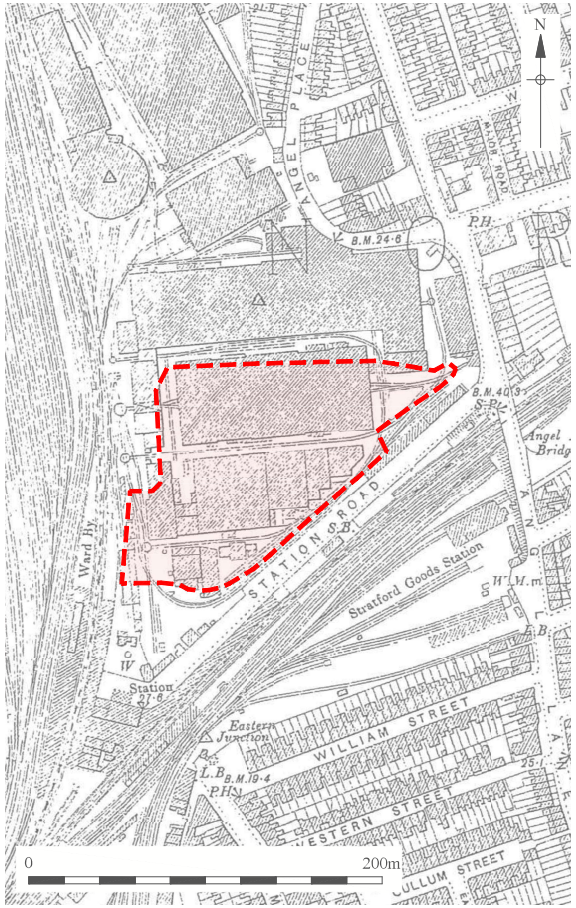

Figure 5b
Second Edition Ordnance Survey map, 1893

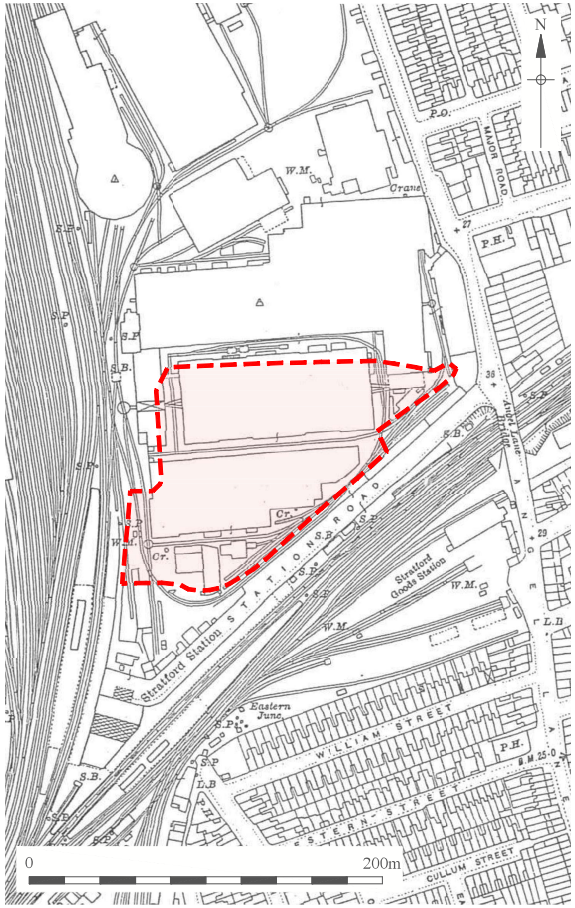

Figure 5c
Third Edition Ordnance Survey map, 1913

Figure 5. First, Second and Third Edition Ordnance Survey maps. 1:4,000

the building, which was identified as the Locomotive Shop Stores on a plan of the works dated January 1914.[44]

Phase 5: c.1906–c.1914 (Figure 3)

Historical context

Having used gas lighting since the beginning of the railway era, it was not until the last decade of the 19th century that railway companies began to invest in electricity as a means of illuminating their premises. In 1905 the Great Eastern authorised the construction of a substantial new 'power house' at a site on the south bank of the Channelsea River, which was intended to supply electricity to the company's works at Stratford. The contract for the supply and installation of electrical power cables was awarded to W.T. Henley's Telegraph Works Co. Ltd of London and Gravesend in February 1906.[45] Construction of the power station, offices, workshops and accommodation continued throughout 1906.[46,47]

The completion of the Stratford power house was one of the last acts of James Holden's superintendence. In 1908 Holden was succeeded by his son Stephen (1870–1918), who oversaw the introduction of the Great Eastern's first 4-6-0 wheel configuration locomotives.[48] Although Stephen Holden's tenure was brief, a number of significant alterations were made to the fabric of the Stratford Works during his watch. In June 1910 Holden complained about the inconvenience and costliness of the iron foundry at Stratford, which owing to its location in the southernmost block was impossible to extend or improve.[49] In its place, Holden proposed to build a new iron foundry and pattern shop to the west of the main line at Stratford, on a site then occupied by sidings and temporary buildings. Holden argued that the relocation of the foundry would greatly reduce congestion within the locomotive works by removing the need to bring raw materials and castings destined for the carriage and wagon works into the locomotive department's premises. The proposed scheme also permitted the enlargement of the already crowded locomotive machine shop into the premises occupied by the old foundry. A budget of £30,000 was approved for the works, which were eventually completed in February 1912, some months ahead of schedule.[50]

Following Stephen Holden's resignation, Alfred John Hill (1862–1927) was appointed acting Locomotive Superintendent in October 1912.[51] Hill's appointment was made permanent soon afterwards and his title was changed to Chief Mechanical Engineer (CME) three years later. Under the leadership of Hill and General Manager Henry Thornton, the Great Eastern became busier than ever before, as passenger traffic in particular increased during the short period leading up the outbreak of the First World War. As demand grew for ever-larger locomotives, it was decided to build a separate Engine Repair Shop by the side of the locomotive works. The new shop was completed shortly before the beginning of the First World War.

Plans of the works prepared by the Great Eastern Railway in 1914 and 1915 suggest that a number of minor alterations were made to the tramways in the vicinity of the locomotive workshops (Figure 6).[52,53] These modifications included the addition of a small wagon turntable outside the eastern entrance of the Erecting Shop, which was first shown on a plan dated to January 1914.[54] The turntable was shown on photographs of the works taken during the First World War.

Archaeological evidence

Evidence of the early electrical power network was revealed in Trench 3 (Figure 2, 3, 5c), where two small lengths of electrical power cable were observed running parallel on each side of the north-south orientated tramway. The cables were truncated to the east and north by modern services and extended to the north under the east-west orientated tramway. Sheathed in lead and laid in a protective timber conduit, the cables measured approximately 50mm in diameter and comprised four cores. Owing to the truncation, it was not possible to confirm where the cables led.

Figure 6. GER Stratford works plan 1915. 1:2,000

In Trenches 13, 11, 4, 5 and 6 evidence of a new concrete floor surface was found in the former Locomotive Machine Shop Extension and the Coppersmiths' Shop; the drainage system of this area was modified at around the same time. These works were presumably associated with the enlargement of these premises following the relocation of the iron foundry. A door opening dating to Phase 4 recorded in Trench 5 was blocked with masonry during this phase.

A well-preserved wagon turntable was recorded in Trench 3, in the location indicated on the 1914 and 1915 works plans (Figure 6). The turntable mechanism was enclosed in a cylindrical metal housing [104], which measured 3.98m (13′) in diameter and 0.60m (1.97′) deep. This was built on top of a circular concrete foundation [105] found at 6.10m OD, and contained an octagonal metal base [103] which measured 3.48m diagonally and 1.34m on each side. At the centre of this was bolted the metal pivot that formerly supported the platform of the turntable (since removed). Around the pivot rotated the octagonal roller bearing [101], which comprised eight radiating spokes, braced at their outermost extent by cast iron struts. At the outermost end of each spoke was a racer wheel, which ran along a circular racer track/guide rail to rotate the turntable.

A stretch of the track connecting the turntable with the works' internal tramway was recorded in Trench 3, the rails extending beyond the northwest limit of excavation (Figure 3). The track comprised bullhead I-section rails laid in a tramway type configuration, which ensured greater stability for wagons as they were shunted along the curving track.

A new concrete surface had been laid on the external yard area between the east wall of the Erecting Shop and the tramway exposed in Trench 3. This surface was recorded at 5.78m OD, and had been laid over the backfilled Phase 2 north–south aligned brick flue (Figure 3).

Evidence of modifications made to inspection pits in the Erecting Shop was also observed (see Phase 4 discussion). The length of the pits had been reduced, presumably in order to make available extra space in the east end of the Erecting Shop. As a result, there were probably some modifications to the drainage system associated with the inspection pits identified with the construction of masonry structures [161] and [145]. Other wall segments located in the south of Trench 3 and dated to the same period were observed. However, owing to later truncation that affected their original context and their relationships, their exact purpose remains uncertain.

Evidence of an additional tramway spur to the south of the Locomotive Machine Shop, first shown on the 1914 Ordnance Survey map, was observed in Trench 10. Excavation revealed that the spur terminated at an inspection pit [225] at the eastern end of an unidentified building, which had itself been built at some point between 1867 and 1893.

Phase 6: c.1915-1962 (Figure 6)

Historical context

During the First World War large areas of the works at Stratford and Temple Mills were adapted for the manufacture of equipment and munitions for the armed forces (Figure 7–10). In August 1914 the Railway Executive Committee (REC)[55] offered to make capacity available at railway workshops across Britain for work beneficial to the war effort.[56] At first the work was confined to making specialist military rolling stock such as ambulance trains and general service goods wagons.[57] The following year Stratford began to manufacture rifle parts, howitzer carriages, gun limbers and trench mortars (Figure 8–10) for a number of defence contractors, including Vickers, the Royal Gun and Carriage Factory at Woolwich Arsenal and the Royal Small Arms Factory at Enfield.

The number of government contracts undertaken by the railway workshops increased considerably in 1915, following a political scandal caused by a shortage of high-explosive artillery shells on the Western

Figure 7. General Service water tank cart beside the entrance to the Stratford works, circa 1915

Front. This led to the establishment in June that year of the Ministry of Munitions, which ordered the Railway Executive to provide sufficient capacity at the workshops for the manufacture of 2,250 shells per week.[58] At Stratford the new Engine Repair Shop was given over to the machining and reforming of artillery and small arms munitions; by the end of the war workers there had reformed 3½ million cartridge cases and forged 18,800 4.7″ shells.[59] With more than a quarter of the works' staff serving with the armed forces, women were increasingly recruited to undertake tasks previously performed by men; by June 1915 more than 60 were employed by the Locomotive, Carriage and Wagon Department at Stratford.[60] Most of the female employees were engaged in munitions work, machining fuse bodies, machining copper driving bands for shells and reforming cartridge cases.

By the end of the war many of the machine tools (Figure 8) in the Stratford locomotive shops were worn out and in need of replacement. A few days before the Armistice, Hill calculated that the cost of replacing exhausted machinery at Stratford alone would be in the region of £30,000.[61] Although munitions work at Stratford continued for a couple of months after the war ended, the shops were soon inundated with repairs and orders for new work. Production of locomotives, which had been suspended during the early stages of the war, did not resume until 1920.

Shortly before the Great Eastern was subsumed into the London and North Eastern Railway (LNER) at the beginning of 1923 it was decided to cease the manufacture of locomotives at the Stratford shops altogether. In total, Stratford built 1,702 locomotives over the course of 75 years, at an average rate of 23 per annum.[62]

The decision to convert the works to a repair-only facility necessitated the purchase of substantial quantities of new machine tools and the reorganisation of parts of the works. Many of the new acquisitions were substantial pieces of kit and often necessitated the construction of new foundations and fixings on the floors of the Stratford shops.[63] During the thirteen months after April 1934 the Locomotive Committee authorised expenditure of more than £25,480 on equipment for the Stratford shops alone,

Figure 8. Stratford works 5-ton steam hammer, circa 1916

the greatest proportion of which was accounted for by lathes of various descriptions.[64] The majority of these tools were installed in the Locomotive Machine and Locomotive Fitting Shops, the latter of which was built between 1920 and 1940 on the site of the siding that had previously separated the central and southernmost of the 1840s blocks.[65]

As the threat of war with Germany once again loomed in the mid-1930s, the Government asked the principal railway companies whether capacity existed in the railway workshops for the manufacture of materials useful to the forthcoming war effort.[66,67] All four companies were willing to help, and as early as May 1938 Sir Nigel Gresley (1876–1941), Chief Mechanical Engineer (CME) of the LNER expressed an interest in manufacturing mountings for 2-pdr anti-tank guns in the company's workshops.[68] By the beginning of October 1939, the LNER carriage shops at York and Cowlairs were manufacturing airframe components for the Air Ministry, while the company's locomotive works at Doncaster was refurbishing 300 locomotives destined for service overseas.[69]

While the volume of government war work undertaken by the LNER's other workshops grew as the war progressed, Stratford's primary function remained the repair of the company's locomotives and rolling stock. In part this may have been a consequence of the site's vulnerability to attack from the air, which was the reason given for the removal of the iron foundry and many of its workers to Gorton in Lancashire in 1942.[70] A report compiled by the Ministry of Labour and National Service in July 1942 found that 95% of the work undertaken at the locomotive works involved the repair and maintenance of locomotives, with the remaining 5% accounted for by "machining large gun components".[71] The proportion of munitions work carried out at the locomotive works declined further as the volume of repairs, maintenance and even construction of locomotives grew, following a decision to transfer these tasks from Doncaster to Stratford in order to allow for more munitions to be manufactured at the former works. In November 1943 it was reported that machining gun components accounted for only 1% of the Stratford plant's workload.[72]

Figure 9. Jacket for Quick-Firing (QF) 3" gun on turntable at Stratford Locomotive Works, circa 1915–18

West Ham was heavily bombed during the Second World War, and the Stratford area was particularly severely hit. The locomotive works was first hit on the third night of the Blitz (9–10 September 1940), while the foundry was bombed exactly a month later.[73] On 12 January 1941 a large number of incendiary bombs caused fires in the Main Offices, also damaging the Erecting Shop and destroying the CME's Chemical Laboratory.[74,75]

Following the end of the Blitz in May 1941, the works enjoyed a respite from enemy bombing until 1944. A number of V1 flying bombs landed on company property near the locomotive works in the summer and autumn of that year, followed by as many as four V2 rockets that fell in the vicinity between October 1944 and the following February.[76] On Friday 17 November the blast from a V2 that fell on Buxton Road, more than 700m to the north-east of the works, damaged the Boiler Shop, Brass Foundry and Brass Stores.[77]

Following the nationalisation of the 'Big Four' railway companies at the beginning of 1948, the Stratford Works passed into the hands of the Eastern Region of British Railways. Although the years of austerity that followed the end of the Second World War saw expenditure on railway infrastructure decline, the decision to retain steam traction in the Eastern Region gave the Stratford Works an extended lease of life, for a while at least.

The continuing expansion of suburban electric traction and the introduction of diesel traction across the rest of the Eastern Region in the mid-1950s signalled the end of the line for the Stratford Locomotive Works. By 1955 one bay of the Engine Repair Shop had already been converted for the repair of diesel locomotives.[78] Owing to the earlier-than-anticipated delivery of diesel locomotives to the Eastern Region, in May 1959 the Eastern Area Board of the British Transport Commission approved the construction of a new diesel maintenance shed at Stratford, shortly after which it approved the expenditure of a further

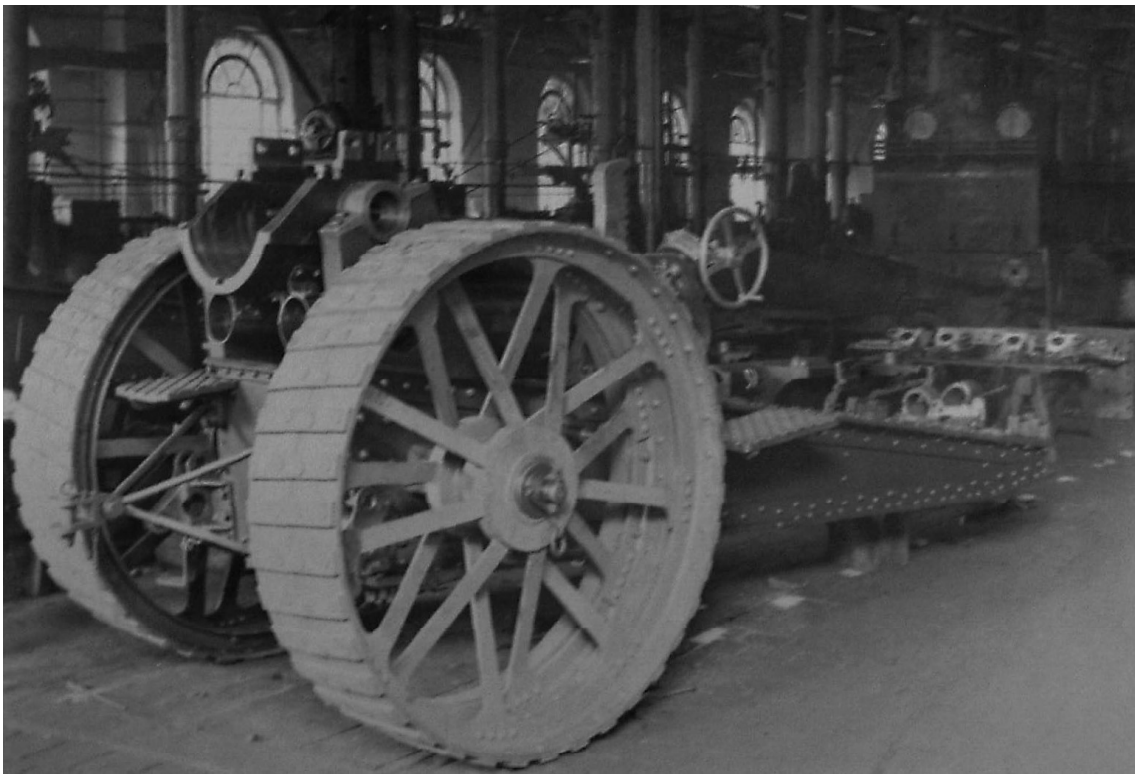

Figure 10. 6" Howitzer carriage with gun cradle mounted under construction at the Stratford works circa 1915–18

£90,000 for new diesel locomotive servicing facilities at the Temple Mills depot.[79] The fate of the old works now sealed, facilities at Stratford were rapidly run down. The works was finally closed in 1962, although the majority of the buildings were still standing two years later and the site was not fully cleared until c.1970.[80]

Archaeological evidence

Archaeological evidence from this period was observed in Trench 3 only. A number of concrete and masonry foundations were identified inside the former Erecting and Fitting Shop, some abutting the west facing elevation of the east wall of the building and others positioned in the southwest corner of the Trench. These features were interpreted as the bases of machine tools installed in the shops after the cessation of locomotive manufacture in the 1920s and 1930s. Evidence of modifications to the drainage system of the shops in the form of a new manhole and ceramic drain pipes was also recorded.

Evidence for the closure of the inspection pits in the former Erecting Shop was also observed. Following the backfilling of the pits, a new concrete floor was laid across the Erecting Shop plot. The surviving fragmented floor was found between 6.08m OD and 5.96m OD.

Phase 7: c.1963–1969

Historical context

The decision to close the Stratford Locomotive and Carriage Works in the late 1950s presented an opportunity for British Railways to redevelop the Stratford railway lands. In 1965 it was decided to build a new container facility at High Meads known as the Stratford Freightliners Terminal. Goods received at this terminal from overseas were transferred to the old locomotive works, which had been renamed

the Stratford Continental Depot, for inspection by customs officers prior to onward distribution by road or rail.[81]

In 1967 the London (Stratford) International Freight Terminal (LIFT) was built on the site of the old iron foundry on the north bank of the Channelsea.[82] The new terminal contained purpose-built freight interchange and customs facilities, rendering the Stratford Continental Depot surplus to requirements. In 1969 HM Customs cover was withdrawn from the depot, enabling British Rail to dispose of it soon afterwards.[83]

Archaeological evidence

The only archaeological evidence related to Phase 7 came from Trench 10 where a concrete slab was recorded between 5.92m OD and 5.89m OD. The concrete was located in the northern half of Trench 10 and was interpreted as resurfacing following the closure of the Locomotive Works and its short-lived conversion to the Stratford Continental Depot.

Phase 8: 1970–2003

Historical context

In April 1970 a newly-incorporated company called London (East) ICD Ltd acquired the site of the former locomotive works in order to develop the Chobham Farm Container Depot, which was reputed to have been the largest container building in Europe when completed. The new depot became the focus of industrial unrest in May 1972, when dock workers picketed the site in protest at the employment of non-registered dock labour at the Depot.

Following the resolution of the 1972 dispute, the Chobham Farm Depot continued to be used throughout the 1970s and 1980s. By the mid-1990s it had fallen out of use, remaining empty until it was demolished in the first decade of the 21st century.

Archaeological evidence

A number of the concrete foundations of the Chobham Farm Container Depot were recorded during the archaeological investigation. The structure comprised a southwest-northeast orientated concrete foundation with five parallel square concrete segments all aligned on the northwest side of Station Road. The overall size of the uncovered foundation recorded in Trenches 4 to 13 was 82.27m southwest–northeast with a width of between 0.91m and 0.49m. The square concrete footings were built at a distance of between 11m and 11.17m to the south of the main southwest-northeast concrete foundation, and at intervals of 5.78m from each other (in Trench 10) and were mounted by square and rectangular steel plates, respectively, secured to the concrete with bolts. These features represented the footings for the superstructure of the Container Depot.

The Chobham Farm Container Depot was demolished in the early 21st century. The concrete slab surface representing the current ground level was constructed across the site sealing the earlier building. The modern concrete surface was recorded between 6.37m OD in Trench 10, towards the southwest area of the site, and 6.39m OD in Trench 13, towards the northeast area of the site.

Conclusions

Documentary records produced by the railway companies that operated the Stratford locomotive works made it possible to reconstruct the historical development of the works, from its construction in the late 1840s until its demise in the early 1960s. Many of the episodes identified in the historical record were recognised archaeologically, and for the main part the excavated evidence supported the historical

research, despite the fact that the excavated area covered only a relatively small proportion of the entire works.

Detailed documentary research revealed the pivotal role played by Locomotive Superintendent William Adams in the development of the works. This research indicated that the wholesale reorganisation of the works began earlier than previously thought, and proved central to the interpretation of the archaeology encountered on site. In 1874 Adams embarked upon an ambitious programme of reconstruction, elements of which were well represented in the archaeological record. The most significant of these developments were the shunting tramways, which allowed short-wheelbase shunting locomotives to transport parts and components around the workshops, supplanting many of the existing labour-intensive turntables.

The Stratford Works reached a peak of efficiency and productiveness during the superintendence of James and Stephen Holden in the late 19th and early 20th centuries. One of the more significant developments that took place during this period was the introduction of electric lighting following the construction of the works' power station in 1906, archaeological evidence for which was found in the form of electrical cables running alongside a stretch of tramway discovered in Trench 3. Interestingly the reinstatement of a turntable at the eastern entrance to the Erecting Shop in the first half of the second decade of the 20th century does not appear to have been documented in the relevant records of the Great Eastern Locomotive Committee, which was responsible for approving this type of acquisition at Stratford.

Documentary evidence indicated that during the First World War the manufacture of munitions was confined to the newly built Engine Repair Shop, which was situated to the north of the main works. In contrast, the locomotive workshops were used mainly for the repair of locomotives and the machining of components and armaments for the war effort. Historical documents suggested that these activities utilised existing machine tools, and did not require any radical changes in the type or configuration of machinery at the works.

Wartime wear-and-tear, followed by the cessation of locomotive manufacture at Stratford in the early 1920s, necessitated the acquisition of significant quantities of new machine tools and the reorganisation of parts of the works during the inter-war period. Archaeological evidence of this phase of activity included the backfilling of redundant inspection pits, as well as the remains of masonry bases built to anchor the newly purchased tools to the floor of the shops.

It was evident from the documentary record that the locomotive shops at Stratford were used less extensively for munitions and armaments work during the Second World War than they had been during the First. This appears to have been a consequence both of the works' vulnerability to attack from the air and of the overriding need to ensure that the locomotives and rolling stock of the LNER were kept in service during the war. The small proportion of armaments works that was carried out in the shops involved the machining of gun components, albeit on a much smaller scale than during the previous conflict. As in the First World War, this work did not require the use of new or specialist machinery, which probably explains why many of the machine tools purchased in the 1920s and 1930s were still in service in the mid-1950s.

Post-war austerity ensured the survival of the works as a going concern into the early 1960s, although the rapid introduction of diesel traction on the Eastern Region ensured that its days were numbered by the end of the 1950s. Despite the cessation of railway services, historical maps indicated that the tracks and tramways were left in place until at least 1964. Archaeological evidence suggests that these were buried beneath new concrete surfaces during the brief period that the buildings were known as the Stratford Continental Depot, a road freight depot and customs post for international goods received by the container terminal at High Meads. Little is known about this short-lived operation, and it is not clear which of the existing buildings were retained for customs or road freight purposes. Similarly it remains

uncertain how many of the buildings were still standing in 1970, when British Rail disposed of the property and the surviving structures were demolished.

Of the thirteen locomotive works in England acquired by British Railways on nationalisation in 1948, eight were closed in the six years after 1962. Of the latter, Bow, Brighton, Darlington, Gorton, Stratford and Wolverhampton Works were subsequently demolished, while the principal buildings of Ashford and Horwich were put to alternative uses within the British Rail organisation and were retained. A search of the Archaeological Investigations Project (AIP) database of unpublished investigations revealed that other than the recent excavations at Stratford, the only one of these works to have been subject to archaeological monitoring was the Ashford Works, the buildings of which were recorded by English Heritage in the early 1990s (http://csweb.bournemouth.ac.uk/aip/aipintro.htm).

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25 TNA RAIL 227/14 GER Shareholders and Board of Directors minutes 1878, p 39
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