



Gasholder Station Hadleigh Road Industrial Estate Arkwright Road, Ipswich

Phases 1 and 2 Historic Building Investigation and Recording

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Hadleigh Road Gasholder Station, Ipswich: Phases 1 and 2

Historic Building Investigation and Recording

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Summary

Oxford Archaeology was commissioned by Montagu Evans LLP on behalf of National Grid to create an Historic Building Record of Gasholder 133 and its ancillary structures at the Gasholder Station, Hadleigh Road Industrial Estate, to the north-west of Ipswich town centre.

Gasholder 133, an above-ground spiral-guided gasholder with four lifts, was constructed in 1954 on the recently established industrial estate after planning permission was granted to provide the extra gas storage required by the existing town gasworks to the south-east of the town. The switch to natural gas throughout the country between 1968 and 1976 led to the closure of the gasworks, although this gasholder station and one gasholder at the former gasworks were retained for storage. By the turn of the 21st century, only Gasholder 133 remained but the redundant gasholder had been isolated from the mains and decommissioned for some time prior to its demolition.

The historic building recording focussed upon researching the history of the site and photographing the gasholder and its context before and during the dismantling. Phase 1 of the project comprised the recording of the gasholder and associated structures in their context prior to work on site and Phase 2 comprised the recording of the gasholder during its demolition. Due to the early stages of the lockdown imposed due to the outbreak of COVID-19, the photographs of the gasholder during its demolition were, with the approval of National Grid, provided by the demolition contractor, Erith Contractors Ltd.

The wider programme of recording work of the remaining gasholders across the country will allow a comparison of the structures between sites.

1 INTRODUCTION

1.1 Project Background

- 1.1.1 Oxford Archaeology (OA) was commissioned by Montagu Evans LLP, on behalf of National Grid, to undertake historic building recording of the decommissioned Gasholder Number 133 at the former Gasholder Station, Arkwright Road, Hadleigh Road Industrial Estate, Ipswich in two phases: Phase 1 of recording, prior to its demolition, and Phase 2 during the demolition work and incorporating the interior of the gasholder. Two small ancillary structures to either side of the gasholder were also recorded.
- 1.1.2 The work forms part of a wider national project agreed between Historic England and National Grid to record gasholders and gasworks prior to their dismantling, including those which are not listed or of only local interest.
- 1.1.3 Hadleigh Road Industrial Estate Gasholder Station, hereafter referred to as 'the site', is situated to the north-west of Ipswich town centre, approximately 1.86km or 1.15 miles WNW of Ipswich Town Hall (Figure 1).
- 1.1.4 Although the site is situated on Arkwright Road, the site has always been known as 'Hadleigh Road Gasholder Station' on site plans and the current site signage.

1.2 Aims and Objectives

- 1.2.1 The principal aim of this project is to document the history and development of the site and to record and interpret the structures on this site before and during their demolition. The information will be presented in the form of a written, illustrated report and archive.

1.3 Methodology

- 1.3.1 This report has been produced in accordance with the brief produced by Montagu Evans LLP on behalf of National Grid and is based upon on-site investigation and documentary research. As specified in the brief, a 'Basic Level 2 survey' was undertaken which was largely photographic and descriptive in nature. The level of recording undertaken in the wider project to record gasworks have previously been agreed with Historic England on a portfolio basis.
- 1.3.2 The 'Basic Level 2' record is adapted from the Historic England guidelines in *Understanding Historic Buildings: A Guide to Good Recording Practice* which states that a Level 2 is: '*... a descriptive record, made in similar circumstances to Level 1 but when more information is needed. It may be made of a building which is judged not to require a more detailed record, or it may serve to gather data for a wider project. Both the exterior and interior of the building will be seen, described and photographed. The examination of the building will produce an analysis of its development and use and the record will include the conclusions reached, but it will not discuss in detail the evidence on which this analysis is based. A plan and sometimes other drawings may be made but the drawn record will normally not be comprehensive and may be tailored to the scope of a wider project.*'¹

- 1.3.3 The work is comprised of three principal elements: a photographic, a drawn and a written record.

The *photographic record* is intended to act as a general record of the structures before and during their demolition and includes photographs of the exterior and interior, and details and fixtures. Digital photographs, in jpeg format, were taken using a camera with up to 24-megapixel capability.

For the *drawn record*, the surviving engineering site plans were made available to OA by the National Gas Archive. These drawings were used as a basis for the archaeological recording; locations of features being verified, the addition of further annotations for interpretation, and recording additional information.

The *written record* consists of field notes and annotations that complement the photographic and drawn records and add further analytical and descriptive detail. The written record also incorporates research carried out using other primary and secondary sources.

- 1.3.4 Very few records of the gasholder station survive. The National Gas Archive has supplied copies of any surviving records for the Ipswich gas supply; the only two which refer to the gasholder station rather than the gasworks which contain relevant information have been used in Figure 2 and in Plate 8.
- 1.3.5 Visits to the Science Museum archive and the Historic England archive prior to the Phase 1 survey did not find any documents relating to the gasholder. The Ipswich branch of the Suffolk Archives was closed, initially due to the COVID-19 lockdown followed by their moving to a new archive building; a search of their electronic catalogue and correspondence with the archive staff found that no relevant records have been deposited at this facility.
- 1.3.6 Images of the site are also available on Google Streetview and Google Earth dating to sporadic intervals between 2000 and 2020; these images have been used to determine changes within recent years.
- 1.3.7 This site is not included in Historic England's Monument Protection Plan (MPP) Step 3 report for the gas industry.
- 1.3.8 The site visit to record the structures prior to their demolition was carried out on the morning of 27th June 2018. The weather was clear with glaring sunshine and the enclosed nature of the site necessitated the use of a wide-angle lens for much of the photographic recording. No access to the walkway at the top of the tank was permitted.
- 1.3.9 The demolition of the gasholder was carried out during the early stages of the lockdown due to the outbreak of COVID-19, which prevented travel to the site to carry out the Phase 2 survey. With the approval of National Grid, photographs were provided by the demolition contractor, Erith Contractors Ltd, under the guidance of OA. These photographs were provided on the 31st March and the 7th, 20th and 21st April 2020.

2 HISTORICAL BACKGROUND

2.1 Hadleigh Road Industrial Estate, Ipswich

- 2.1.1 The history of the town of Ipswich has been extensively studied and published and so this historic description will concentrate solely upon the immediate area of the structure in question.
- 2.1.2 The site lies upon the sedimentary bedrock of the Newhaven Chalk Formation with superficial deposits of sand and gravel of the River Terrace Deposits. The River Gipping surrounds the industrial estate to the west, north and east.
- 2.1.3 The railway to the immediate west of the site is the East Suffolk Line of the Great Eastern Railway, opened in 1859. The Ipswich Chord was constructed on the site of the former bacon factory to the west of the site, opening in 2014, and joins the East Suffolk Line to the Great East Mainline to the west.
- 2.1.4 There are no records held by the Suffolk Historic Environment Record for this site which have been made available via the Heritage Gateway database, however, Palaeolithic implements were found in the general vicinity at some time prior to the 1920s. Neolithic implements were found in 1920 close to the recreation ground to the south-east of the site and Palaeolithic implements were found in 1918 close to the tramway depot. On the site of the former bacon factory, a Bronze Age urn was discovered around 1930 and an evaluation in 2004 uncovered further prehistoric activity. To the north-west of the site was, until approximately the mid-20th century, the 17th-century Boss Hall and the remains of a 14th-century moat and earlier occupation, now under the Boss Hall Industrial Estate. An Anglo-Saxon cemetery discovered on the site produced a gold and garnet brooch, the 'Boss Hall Brooch', which is on display in the Ipswich museum. Another Anglo-Saxon cemetery was also uncovered to the south of the industrial estate in 1906 when the Hadleigh Road was widened, from which grave goods are on display in the Ipswich Museum.
- 2.1.5 Much of the centre of Ipswich is part of one of the town's 15 conservation areas, however, the site is not within a Conservation Area and is neither associated with or intervisible with the two closest of these: Chantry Park Conservation Area, which is also a Grade II Registered Park and Garden, approximately 700m to the south-west and Norwich Road/Anglesea Road Conservation Area approximately 950m to the east. The closest listed or locally-listed buildings are not associated with or intervisible with the site.
- 2.1.6 A map regression of the Ordnance Survey (OS) maps of 1882 onwards shows the site in agricultural use prior to the construction of the gasholder, with development of the surrounding area beginning in the first quarter of the 20th century with industrial units constructed either side of the railway line.

2.2 Ipswich's Gasworks

- 2.2.1 Following some gas provision by private companies, the Ipswich Gas Light Company gasworks were constructed in 1820 between Old Foundry Road and Carr Street in the centre of Ipswich, however, due to objections by local residents the gasworks were moved in 1822 to a site between Patteson Road and Duke Street to the east of Ballast

Wharf to the south-east of the town centre. The gasworks expanded throughout the 19th century and into the 20th century.

- 2.2.2 By the first edition of the OS map, published in that area in 1882, there were two gasholders to the north of Patteson Road with numerous brick and metal buildings. In 1897, a gasholder with one million cubic feet capacity was constructed to the south-east corner of the site. The *Journal of Gas Lighting, Water Supply etc.* published articles in 1902 and 1903 on the new coke storing and conveying plant installed at the gasworks. Vertical retorts were added in 1914.
- 2.2.3 In May 1927, the *Gas Journal* reported on the first waterless gasholder to be erected in this country, which was expected to be completed in the July. This gasholder, constructed on a site to the south of Patteson Road, had a capacity of two million cubic feet and was of the MAN type, although the article does not state the manufacturer's name, only that some of the material came from Germany, with a British firm contracted to carry out the work. The article also detailed the by-products of tar for road surfaces and sulphate of ammonia for fertiliser.
- 2.2.4 The buildings on the gasworks site change with each edition of the map, following new technology and expansion of the gasworks. Five brick-built houses, referred to as Gas Board Cottages on a later site plan, first appear at the corner of Patteson Road and Cliff Road on the OS edition revised in 1938. Other small buildings preceded them; the houses are still extant.
- 2.2.5 Aerial photographs dating to the 1930s, available online via the Britain from Above project, show the two earlier gasholders to be column-guided and the 1897 gasholder to be frame-guided. The retort is shown to be in the centre of the site with the coal storage area to its west, and small tanks, likely to have been used for storing tar and other by-products, are to the south-west corner of the site.
- 2.2.6 In 1948, the Gas Act was passed, nationalising the gas industry the following year and forming 12 area gas boards; the Ipswich gasworks was then operated by the Eastern Gas Board.
- 2.2.7 Planning applications submitted in the mid-1950s show that further expansion of the capacity for gas storage was still necessary. The Eastern Gas Board submitted a planning application on the 5th February 1954 [54/00069/FUL] for the erection of a gasholder on the Hadleigh Road Industrial Estate which was granted on the 23rd February, although the permission for the erection of a governor house was not applied for until the 21st December 1955 and granted the following March [55/00612/FUL].
- 2.2.8 An Eastern Gas Board gasworks site plan of 1958 depicts the four gasholders but at some time during the 1960s, the smallest gasholder at the west of the site was demolished.
- 2.2.9 The change from town gas to natural gas between 1968 and 1976 caused gasworks across the country to be decommissioned; although some gasholders were retained for storage. The surviving Gas Board site plans have been altered later for other purposes and so it is unclear when the waterless gasholder to the south of Patteson Road and the Victorian gasholder to the north were demolished, although a site plan

dated 15 January 1976 which appears unmodified shows only the gasholder built in 1897. This plan is titled 'Holder Station...', and few other buildings are depicted, indicating that the gasworks had been wholly removed. Plant, presumably a gas distribution station, is still visible on the site to the south of Patteson Road on satellite images available on Google Earth dated September 2017, along with the concrete base of the adjacent former waterless gasholder.

- 2.2.10 In March 1978, planning permission was granted for part of the former gasworks to be used for storing timber and cargo [78/00243/FUL]. At the end of 1986, planning permission was granted for part of the former gasworks to be used for the manufacture of precast concrete building components [86/00916/FUL].
- 2.2.11 In the early 2000s the whole of the site to the north of Patteson Road was redeveloped for residential use; the remainder of the site to the south of Patteson Road is used for storage.
- 2.2.12 Gasholder number 133 and the Hadleigh Road Gasholder Station was retained for gas and materials storage however, improvements to distribution plant in recent decades have caused even the gasholders to become redundant and Gasholder 133 had been decommissioned and isolated from the network for some time prior to this project.

3 DESCRIPTION OF THE SITE

3.1 Introduction

- 3.1.1 The site is located at the western edge of the Hadleigh Road Industrial Estate and is bounded to the east by Arkwright Road, to the west boundary is the railway line, to the north and south boundaries are neighbouring businesses (Plate 1). The site boundary consists of metal palisade fencing installed between 2012 and 2014, replacing the cranked concrete posts and chain link fence which may well have been the original boundary fence (Plate 2).
- 3.1.2 The site contained the gasholder, two small concrete cabinets containing pumps and the concrete bases of since-removed structures. To the north of the site is the former governor house and gas distribution station which are now in a separate compound and in use by the gas distribution company, Cadent, and so were not accessible (Plate 3).
- 3.1.3 The site was covered with a mix of gravel, clinker and tarmacadam.
- 3.1.4 The upper part of the gasholder tank was visible beyond the river, rail tracks and embankment from the end of Boss Hall Road on the business park to the north-west of the site and a glimpsed view of the lift stairs was possible from a short length of Riverside Road on the housing estate to the north of the river.
- 3.1.5 Figure 3 indicates the location and direction of the images used as plates.

3.2 Gasholder Number 133

- 3.2.1 The gasholder was an above-ground spiral-guided gasholder in a steel tank with four lifts. It had a capacity of 2 million cubic feet and was 46.48m in diameter (Plate 4). The foundation pad was slightly lower than ground-level, resulting in a dry bund around the gasholder between the steel tank and the surrounding area (Plate 5). The bund was lined with concrete slabs with a pair of concrete steps to either side of the inlet and outlet pipes at the north-east and south-west of the gasholder (Figure 2). The inlet and outlet pipes were set in brick-built dry wells (Plates 6 & 7).
- 3.2.2 Only the tank was visible during the Phase 1 survey as the lifts were retracted into the tank, although the upper part of the top lift is visible on Google Streetview images taken in March 2009 (visible in Plate 2). An undated aerial photograph supplied by the National Gas Archive shows the gasholder almost fully extended; although the details are not all clear, the photograph shows that the lifts were constructed from fairly small sheets of steel with the spiral guides in alternating directions (Plate 8). This photograph probably dates to the 1980s according to the structures on the adjacent site, and so the gasholder would have been in use for natural gas storage at the time of the photo.
- 3.2.3 The walkway was not accessible during the Phase 1 survey. The crown is visible on satellite images (Plate 9) and a photograph of part of the crown was included in an inspection report by BNP Paribas in 2018 (Plate 10) and it can be seen that the structure was standard for gasholders, being a concave structure covered with concentric circles of small, riveted steel sheets.

- 3.2.4 Railings were around the perimeter walkway at the top of the tank and each lift. The staircase from ground level to the walkway and the steps to the top of each lift were to the north of the gasholder (Plate 11). The walkway was supported on the steel standards which were bolted to the tank; the railing around the walkway was independently bolted to the tank (Plate 12).
- 3.2.5 The tank was formed from six concentric circles of steel plates riveted top and bottom with a single row of round-headed rivets and to the adjacent panels with differing rows of rivets according to the height: six rows to the three lower bands, three rows to the central band and two rows to the two upper bands. The lower two bands were riveted via a reinforcing plate (Plate 13). The riveted joints were staggered in relation to the joints above and below.
- 3.2.6 A manufacturer's plate to the east side of the gasholder indicated that it was built by Newton, Chambers and Co Ltd of Thorncliffe near Sheffield, manufacturers of gas works and chemical plant, heating apparatus and, amongst other things, Izal disinfectant (Plate 14).
- 3.2.7 To the east and west of the gasholder, a pair of pipes ran between the gasholder and the small concrete cabinets containing electric pumps, described later (Plate 15). At the north-west of the gasholder, to the immediate north of the concrete cabinet, was the interceptor - three below-ground settling tanks which removed contaminants from any overflow water from the gasholder and which connected to a drainage ditch alongside the railway line.

Interior:

- 3.2.8 The interior of the gasholder was photographed by Erith Contractors Ltd. during its demolition, as detailed in 1.3.9.
- 3.2.9 Following the cutting of the tank and outer lift, it was confirmed that the lifts rotated in alternating directions (Plate 16). The lifts and tank and the guide rails were all riveted (Plates 17 & 18), as was the base of the tank (Plate 19). The inlet and outlet pipes were visible, as were the vertical steel stays supporting the inner lift (Plate 20).
- 3.2.10 The riveted plates of the domed crown were supported on a frame of concentric steel rings supported in turn on alternating principal and intermediate trusses. The principal trusses spanned between the central post and the inner lift and were formed from a tie bar braced vertically with steel angles and diagonally with further bars. The intermediate trusses spanned between the mid concentric ring and the inner lift and was formed from two steel bars braced in the same manner as the principal trusses; all joints were riveted (Plates 21 & 22).
- 3.2.11 The central post was formed of a funnel and cylindrical-shaped steel structure to which the trusses were riveted and supported the crown structure as it rose and fell. This in turn was supported on a steel frame in the centre of the tank when the gasholder was empty (Plate 23). The frame was square in plan and braced diagonally in alternate directions on opposite sides.

3.3 Concrete Cabinets

- 3.3.1 The concrete cabinets housing the pumps to the east and west of the gasholder were on concrete bases and were constructed from pre-cast concrete panels with a sloping roof. Two iron loops were cast into the concrete roof to allow the slab to be lifted into place (Plate 24). Two wooden ledged and braced doors were to one elevation (Plate 25).
- 3.3.2 The concrete cabinets do not appear on any site plans, including the engineering plan of 1958 which shows the pipework into and out of the gasholder (Figure 2); they do appear on the c1980s aerial photograph and so it may be that they are associated with the later phase of the storage of natural gas. As the top of the tank was not accessible, it was not possible to establish the connections with the gasholder, however, it is probable that the pumps were part of the simple system to circulate the water in the tank to reduce the likelihood of the water freezing in cold weather.

3.4 Governor House

- 3.4.1 The governor house is in the north-east corner of the site and was fenced-off from the rest of the site between 2016 and 2017; it is now associated with the current gas distribution system and not part of the demolition programme. It is a pitch-roofed, single storey brick building in Flemish bond, with doors in the north, east and south elevations (Plates 26 & 27). The corrugated roof and the barge boards are of asbestos cement with circular finials at either end of the ridge. The double doors to the north and south elevations and the single door to the east are later replacements or have been covered with board, although the door furniture has been retained. The high-level windows are original and are likely to be steel-framed, although no access to the compound around the building was possible. A vent is in the gable to the west elevation.
- 3.4.2 The governor house housed the equipment which controlled the mains pressure which supplied the town.

Interior:

- 3.4.3 An engineering drawing dated 1958, included here as Figure 2, shows the internal partitions in the building which form three rooms in the north half of the building and one full-length room in the southern half; no other indication of plant or features is available.

3.5 Concrete Bases and other Equipment

- 3.5.1 At the south-west corner of the site were ten modern square concrete pads with concrete slabs to their eastern ends and an earlier concrete base to the north of the pads (Plate 28). No structures related to the modern bases were included on any site plans, although Google Earth images show shipping containers in this location which appear between 2003 and 2006; the smaller container is removed between 2016 and 2017 and the larger removed at some point before the Phase 1 survey.
- 3.5.2 Plant which may be associated with the earlier concrete base appears on the 1958 engineering plan (Figure 2). The empty base is visible on the 2000 Google Earth image,

and was later used for hardstanding for one of a number of small containers on the site.

- 3.5.3 A small green fibreglass cabinet was to the east of the easternmost concrete cabinet, however, any equipment had been removed and so its use is unknown.

4 CONCLUSION

- 4.1.1 In 1954, Gasholder 133, an above-ground spiral-guided gasholder with four lifts, was constructed at Hadleigh Road Industrial Estate Gasholder Station, Ipswich to an established and widespread design by Newton, Chambers and Co Ltd on a greenfield site adjacent to a new industrial estate to the north-west of the town to provide the extra gas storage required by the expanding town gasworks to the south of Ipswich.
- 4.1.2 The gasworks, established in 1822, already contained four gasholders, including the first waterless gasholder in the country, constructed in 1927. The switch to natural gas between 1968 and 1976 led to the closure of the gasworks, although part of the gasworks site was converted to a gasholder station and one gasholder dating to 1897 was retained; the Hadleigh Road gasholder station was also retained.
- 4.1.3 By the end of the 1990s, only the gasholder station and Gasholder 133 remained in Ipswich but the improvement of natural gas distribution plant in recent years rendered the gasholder redundant and it was isolated from the mains and decommissioned for some time prior to its demolition.
- 4.1.4 This Historic Building Recording project has researched the history of the site and created a photographic record of the structures and their context before and during their dismantling. An archive has been collated to provide a permanent record of the gasholder and ancillary structures which will be accessible at both the county and national research centres.
- 4.1.5 The wider programme of recording work of the remaining gasholders across the country will allow a greater comparison of the structures between sites.
- 4.1.6 There are no identical gasholders in the range of gasholders surveyed by OA to date, however, two gasholders had some similarities:
- Gasholder 1 at Adderley Green in Stoke-on-Trent was also by Newton Chambers and built between one and eight years after Gasholder 133. Also of riveted construction and with four lifts, the construction of the standards were similar, although with differences in the assembly, and the riveted plates between panels of the tank were a different shape. The trusses and the funnel-shape of the central post of the crown were similar, although Adderley Green lacked the additional support frame when empty.
 - Gasholders 3 and 4 at the former gasworks in Clayton Road, Lincoln were both by Newton Chambers and, although built some time before, 1931 and 1940 respectively, both had superficial similarities in the appearance of the standards, although Gasholder 3 had only three lifts and the crown structure did not resemble that at Ipswich. Gasholder 4, however, had a similar crown structure and support to Ipswich, other than the intermediate trusses.

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APPENDIX B A SUMMARY OF GASWORKS' PLANT AND PROCESSES

INTRODUCTION

This account of the general development of the gas industry and the functions of gasworks plant and gas holders is based largely on several articles and presentations available online by Professor Russell Thomas, particularly *The History and Operation of Gasworks (Manufactured Gas Plants)*, as well as the Monuments Protection Programme Step 1 report and the London Gasholders Survey by Malcolm Tucker.

Gasworks followed a general form, however, the types of each building, plant and equipment and the layout of each site varied widely according to the location, type of coal available, the likely size of the supply required and the manufacturer of the plant. The advancement of technology and the continuous obsolescence and replacement of plant resulted in a regular rebuilding of many gasworks operations.

This appendix describes the general operation of a gasworks and the principle functions of its plant, however, it does not seek to describe every combination of plant available and research should be carried out when investigating each site.

DEVELOPMENT OF THE GAS INDUSTRY IN BRITAIN

General history

The origins of the use of gas for artificial lighting lie in the 1790s when William Murdoch first used coal gas to illuminate his house in Redruth, Cornwall. Murdoch produced the gas by burning coal in a small retort in his back yard. In the following years he continued to experiment with gas lighting by improving the technology and in the first decade of the 19th century his methods were used to illuminate various mills and industrial works.

Other important individuals were also helping to develop the industry in this period including Samuel Clegg, an engineer whose work led to several technical advances, and Frederick Winsor who established the Gas Light and Coke Company in 1812. Winsor's vision, which was for an industry where gas was supplied to many customers from a single large gasworks, differed from Murdoch's which was for individual smaller plants supplying single sites.

Initially, gas was used for streetlighting and to light industrial works and the homes of the wealthier population, although municipal operations became widespread and by 1820 the principal English and Scottish towns were lit by gas; by 1830, over 200 and by 1859 there were over 1000 public gasworks built across Britain. The industry developed in the later 19th century with various innovations such as the vertical retort plant, which allowed continuous operation and used gravity to create a process flow, the gas mantle light and the greater use of by-products from the gas production process.

The Second World War had a major impact on the industry, particularly through bomb damage and loss of workers to the war effort and in an attempt to rebuild the industry after the war the Labour Government passed the Gas Act of 1948 which nationalised the 1064 local gas undertakings into 12 area gas boards. The boards would subsequently merge in 1972 to form British Gas, which was privatised in 1986.

In the later 1960s it was decided that the United Kingdom would phase out gas produced from coal and would instead move to an industry based on natural gas, some imported, and some obtained from North Sea gas fields. This led to extensive works during the 1970s to clear redundant facilities from gasworks and adapt or convert other plant which was to be reused; this change also resulted in the physical conversion of every gas appliance in the country. By the mid 1970s there were very few surviving sites where town gas was still being produced; these were mainly in remote parts of Scotland and the last site closed in 1981.

Some gasworks were partially demolished to create a gasholder station to store the natural gas, removing the gas production buildings and equipment but retaining the gasholders, transmission plant and distribution network. By the early 2000s, gas distribution technology had improved which rendered even the gasholder stations redundant and a programme to dismantle the gasholders was commenced.

ELEMENTS OF A GASWORKS

Introduction

A typical gasworks where coal gas was produced comprised many different elements of plant and processes, and followed the same basic principle, although some of these may only have been included at the larger sites.

Not all coal was suitable for gas manufacture and some coal fields were more suited to different types of retorts and so the gasworks design would be adapted to the coal available. The transport of the coal was also important: the proximity of canals, and later the railways, or sometimes docks in coastal areas, was essential. Many gasworks had their own railway sidings.

The retort

The retort is fundamentally a sealed container where coal would be heated to drive off moisture, gases and various other by-products. The retort house held 'benches' of retorts and the retort construction advanced from cast iron to fireclay to silica giving improved performance and the ability to withstand higher temperatures.

Retorts went through several stages of design; early retorts were horizontal and heated by radiant heat from the furnace below at relatively low temperatures. The coal shrank as it was heated and the resulting coke was raked out of the retort and more coal put in; mechanical stoking equipment was introduced with through-retorts. Inclined retorts were angled at 32° to horizontal, in theory creating less wear and tear and easier to load and unload, but they could be difficult to operate and were only suitable for certain types of coal and so were short-lived.

Vertical retorts were attempted throughout the 19th century but became successful by the turn of the 20th century. There were several types, but the basic principle was that tapered continuous vertical retorts, filled by hoppers above the retort, were heated by burning gas from separate producers. These could carbonise the coal continuously as it descended and the coke was extracted at regular intervals from the bottom of the retort, the residual heat sometimes being used for other purposes. The coke and breeze (the finer ash) which was not needed for reuse on the site was sold as fuel to industrial and domestic customers.

The gas extracted from the coal rose through an offtake pipe at the top of the retort.

Condensers

There were numerous designs for condensers, some using air, some using water, but all of which were used to reduce the temperature of the gas and also begin the process to remove the tarry impurities.

Exhausters

Exhausters drew gas off the retorts and pushed it through the purification system. This was essential to prevent the building up of pressure in the retort.

Cleaning and purification

The gas produced by heating the coal had many impurities which had to be removed before it could be transferred to the gasholder, including, but not limited to, ammonia, tar, hydrogen, sulphide, benzole and hydrocyanic acid.

Numerous machines and systems were patented for this purpose. The method employed was used according to the impurity, and included passing the gas through water or oil in the form of bubbles (washing) or passing the gas over a large area covered in the solvent liquid (scrubbing); in the later part of the 19th century, the distinction between the two was lost and tended to be referred to simply as 'washing'.

Dry purification involved passing the gas through trays of granular lime or iron oxide.

The impurities extracted were often valuable as by-products, such as coal tar, sulphate of ammonia, sulphuric acid, benzole, hydrocyanic acid and the spent lime from the purification, and these were also sold to other industries.

Metering, storage and distribution

The amount of gas produced would then be measured by the station meter before being stored in the gasholder.

The gas was stored in a gasholders to cope with peaks and troughs in demand and to ensure that there was always a ready supply; their form and function will be discussed in the following section.

The station governor maintained the pressure of the gas leaving the holder when distributing it into the gas mains. Using a similar principle to the gasholder, the pressure was controlled using weights set onto a floating bell, although as with most other gasworks equipment, designs varied. Booster pumps were later developed to increase the pressure of the gas flowing into the gas main and were particularly used when the area supplied was far from the gasworks or where a gasholder station was used for the storage of gas between the gasworks and the remote location.

GASHOLDERS

Introduction

The introduction of gasholders removed the need for continuous gas production, the storage also acted as a buffer for periods of high demand and during halts in production and contained enough gas supply for 24 to 36 hours.

The basic principle of a gasholder is that it consists of two parts: a tank containing water and a cylindrical vessel called a 'lift'. The water provided a seal to prevent the gas from escaping and acted as a resisting surface to the incoming and exiting gas; the lift held the gas, rising and lowering according to the volume. The weight of the lift determined the pressure of the gas in the mains - and the back pressure on the gas making plant if no exhaustor was used. Weights could be added to the lift or lifts if additional pressure was required, such as at times of high demand.

History

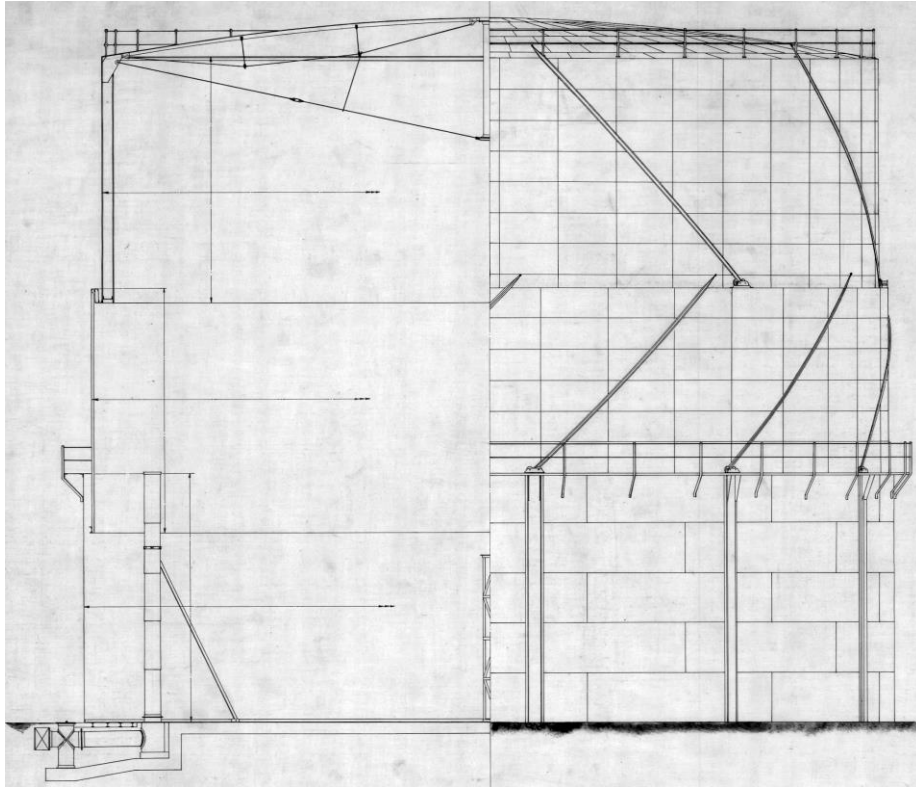
The earliest gasholders were small and built of iron or wood with the moving vessel guided by counter weights on chains. The wooden tanks particularly, sometimes repurposed from the brewing industry, were unreliable and prone to leaking.

From the early 19th century, the gas produced in retorts was stored in large holders and in the early phase of the industry these tended to be housed within separate buildings due to fears of explosion. In truth however the dangers of leaking gas becoming trapped and then exploding was considerably greater when the gasholder was enclosed by a separate building and this gradually led to the external cylindrical gasholder which became the most recognisable feature of any gasworks (Appendix Figure 1).

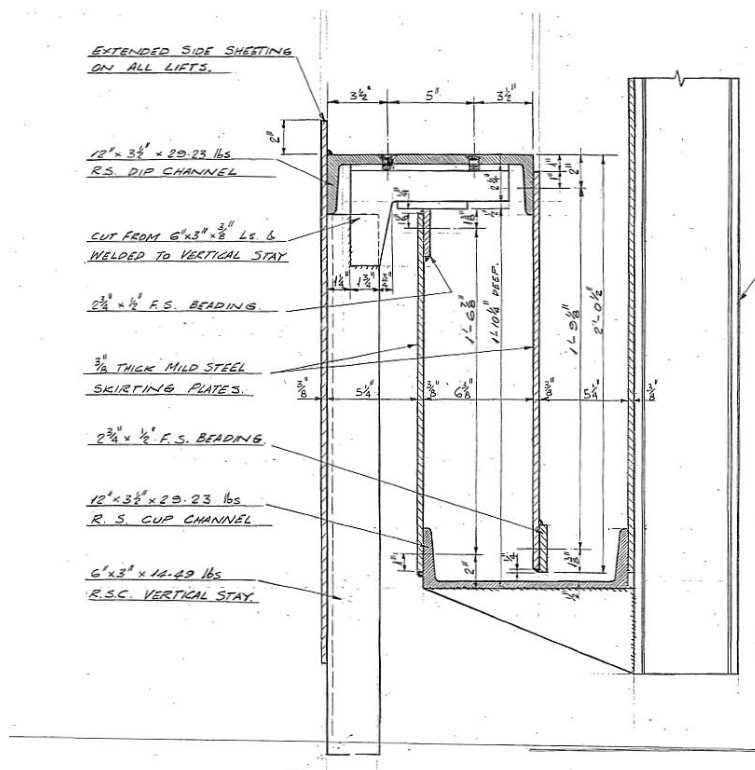
By the time the industry became established, above ground tanks were usually made from steel on a circular concrete slab. The steel floor plate was laid on top of the slab and the steel plates forming the sides of the tank were attached to the floor plate using a steel curb. The sides of the tank were constructed from rows of steel sheets, the bottom row thicker than those above it which often decreased in thickness with the height of the tank. The plates were usually rivetted, although some later tanks were welded.

Below-ground tanks were also used, built of brick, stone or concrete and sometimes cut into bedrock if it was suitable; each method must be made watertight, usually using puddle clay or render. The centre of the tank need not be excavated, leaving a dumpling in the centre of the tank.

The gas was prevented from escaping by a water seal in the tank and around each lift. The top of the tank and each lift returned towards the centre of the gasholder, called a 'dip' and the base of the next lift returned towards the outer edge of the gasholder, called a 'cup' (Appendix Figure 2). When the lifts rose, the cup and dip, which contained water, would interlock and form a seal against the gas within the gasholder.



Appendix Figure 1: A section and elevation of an above-ground two-lift spiral guided gasholder (Extract of drawing EA/SA/FEG/E/T/1 National Gas Archive)



Appendix Figure 2: A cross-section of the cup and dip seal of the lifts of a gasholder which would be filled with water when the gasholder was in use (Extract of drawing NW/MA/DNE/E/E/6 National Gas Archive)

Originally, gasholders used a single lift, but later the telescopic gasholder was invented whereby separate close fitting vessels would be located within one another so that each inner lift would rise when the outer one reached its capacity. This allowed increased storage on the same footprint.

Initially the upper lifts of the early types of telescopic holders were guided by columns or frames; guide rails on the inner face of the columns guided wheels on arms attached to the top of the lifts, keeping the lift in place as it rose and fell. A short-lived cable-guided gasholder was developed whereby the lift was guided by a system of wire ropes and pulleys, although their use was not widespread.

In the late 1880s the spirally-guided gasholder was invented comprising a series of lifts which would rotate and spiral up or down with each chamber guided by the one below. Each lift would have diagonal guide rails fixed to its side which would engage with roller carriages fixed to the top of the vessel beneath. These guide rails could rotate the lifts in alternating directions or in the same direction, according to the design.

Waterless or Dry Gasholders were developed in the early 20th century which used an internal piston which moved with the aid of guide rollers within a static tank and fixed roof; three main types were developed: the MAN gasholder used a tar or oil seal, the Klönne used a grease seal and the Wiggins used a rubber seal.

There were many styles of gasholders, but with the exception of the waterless gasholders, the chief distinction between the types was regarding the method of guiding and support of the lift or lifts.

The crown

The nature of the support for the domed crown is among the most interesting aspects of any gasholder and it is also an area where a variety of approaches evolved in the 19th century.

The interest is partly as a result of the structure being required to function under two quite different conditions. When a holder is inflated the crown is naturally supported by gas pressure so in this situation there is no need for a large superstructure but when the holder is empty the crown needs to be supported.

Early holders tended to have a trussed crown with radial structures where the dome was self-supporting, albeit with a fixed prop which could support the centre of the crown when the holder was lowered. These trussed crowns were often technologically sophisticated and in the middle decades of the 19th century the spans of the larger holders often rivalled or exceeded the largest spans of industrial sheds or railway stations. This is of course a misleading comparison because the structure was supported by pressure when the holder was inflated and when it was deflated there was a fixed stanchion at the centre to help support the crown.

However, in c1850 another approach, that of the 'untrussed crown' was introduced (Tucker, 2000) in which the crown was either supported by gas pressure (when the holder was inflated) or by a fixed 'rest frame' when the holder was empty. The frame, of either timber or

ironwork would not rise with the crown when the holder inflated, and this type of holder was widely used in the 1860s and 1870s.

Another slightly different approach to the trussed crown was introduced in the 1870s with 'radial girders'. These were ribs with plates or lattice webs beneath and the central fixed prop as with trussed crowns. All three types of crown continued to be used into the 20th century (Tucker, 2000).

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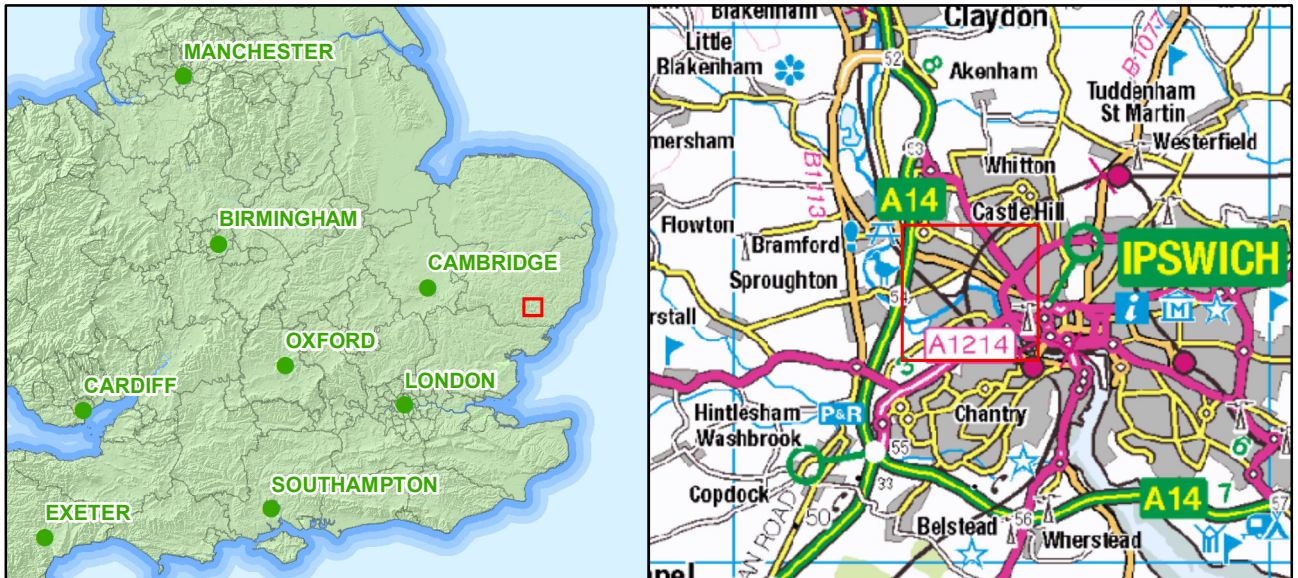
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APPENDIX C OASIS FORM

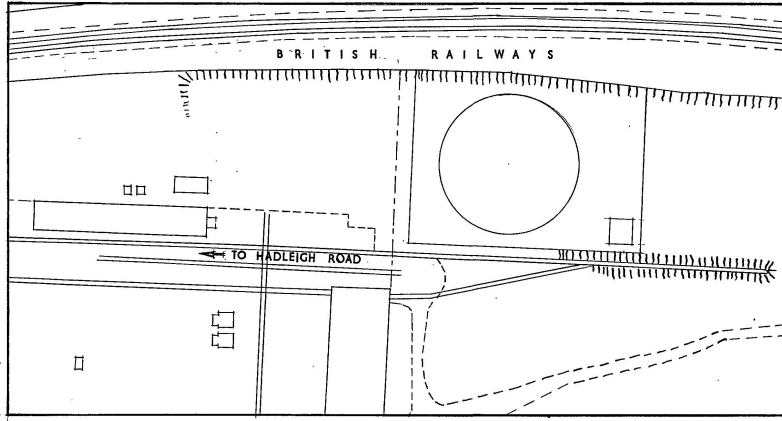
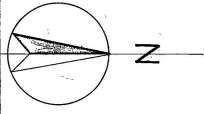
PROJECT DETAILS		
Project name	Building Recording of gasholder at Hadleigh Road Gasholder Station, Ipswich.	
Short description	<p>Oxford Archaeology was commissioned by Montagu Evans LLP on behalf of National Grid to create an Historic Building Record of Gasholder 133 and its ancillary structures at the Gasholder Station, Hadleigh Road Industrial Estate, Ipswich.</p> <p>Gasholder 133 was an above-ground spiral-guided gasholder with four lifts, constructed in 1954 to provide the extra storage required by the existing town gasworks.</p> <p>This forms part of a national programme of recording these distinctive structures which have formed familiar landmarks in towns and cities throughout much of the 19th and 20th centuries. The archive record that is being produced will allow comparison between different sites. The project has also included research on the history of the site.</p>	
Project dates	Site work undertaken on 27 June 2018 with demolition images taken March-April 2020	
Project type	Building recording	
Previous work	None	
Future work	Potential for further historic investigation	
Monument type	Non-listed structure	
Significant finds	N/A	
PROJECT LOCATION		
Site location	Hadleigh Road Gasholder Station, Ipswich	
Study area	The area containing the gasholder is approximately 58m x 55m	
Site co-ordinates	TM 14424 45068	
PROJECT CREATORS		
Name of organisation	Oxford Archaeology	
Project brief originator	Montagu Evans	
Project design (WSI) originator		
Project Manager	Jonathan Gill	
Project author	Angela Warner	
PROJECT ARCHIVE		
		Content
Physical	Suffolk Historic Environment Record	Site records, report, notes, digital photos
Paper		
Digital		



Contains OS data © Crown Copyright and database right 2020
 Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,

Figure 1: Site location

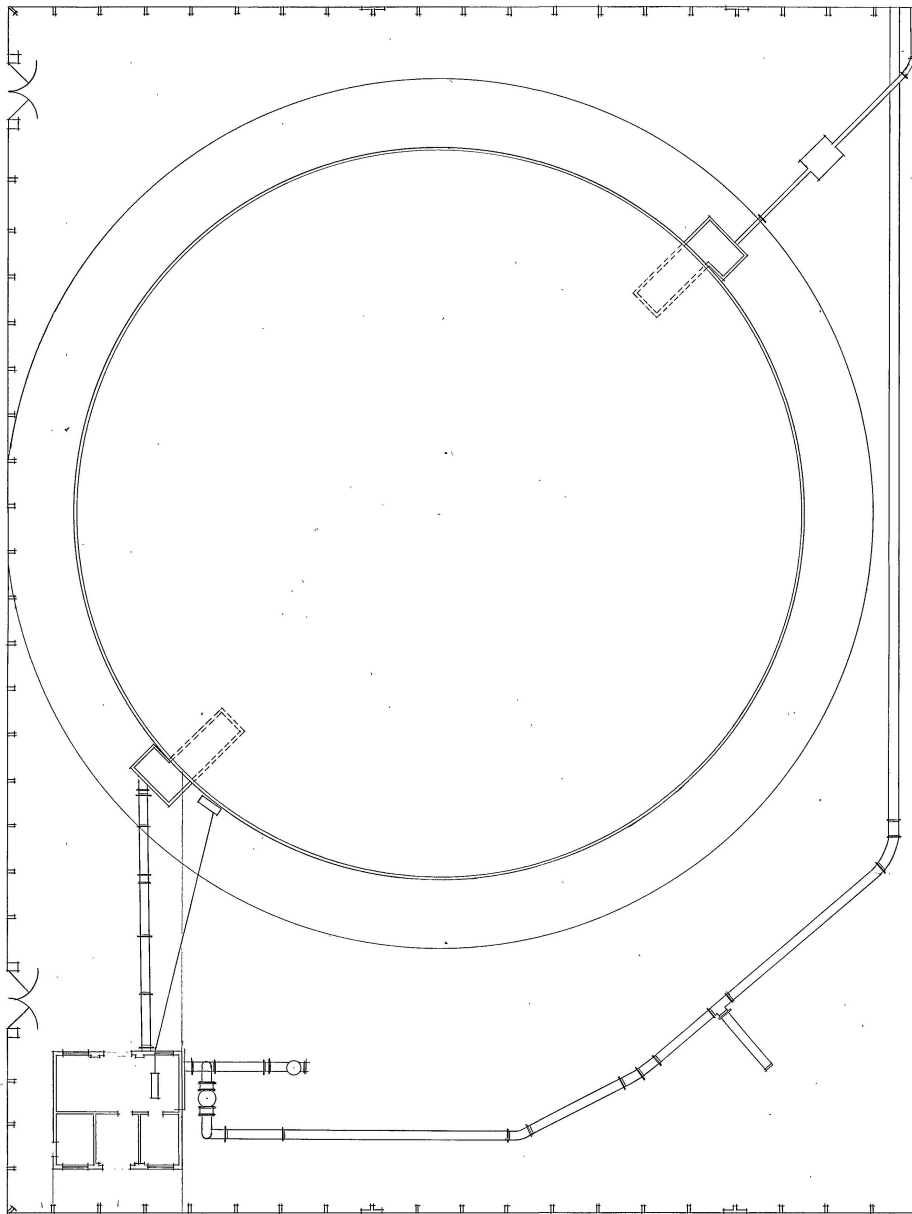
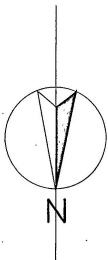
O:\L_codes\IPGASBS\Phase 2\Figure 1_Master.mxd\charles.rousseau\22/09/2020



SITE PLAN. SCALE: 1/1250.



TO
HADLEIGH
ROAD



BRITISH
RAILWAYS

EASTERN GAS BOARD. PROPERTY PLAN.

AREA. SOUTH ANGLIA
 TOWN. IPSWICH.

PROPERTY. HOLDER STATION. HADLEIGH RD.

SCALE. 20 FEET TO 1 INCH.

DATE. 1958.

REF. NO.

S 125/4

Figure 2: Engineering site plan of 1958. National Gas Archives Document Reference: EA/SA/IPG/E/E/1

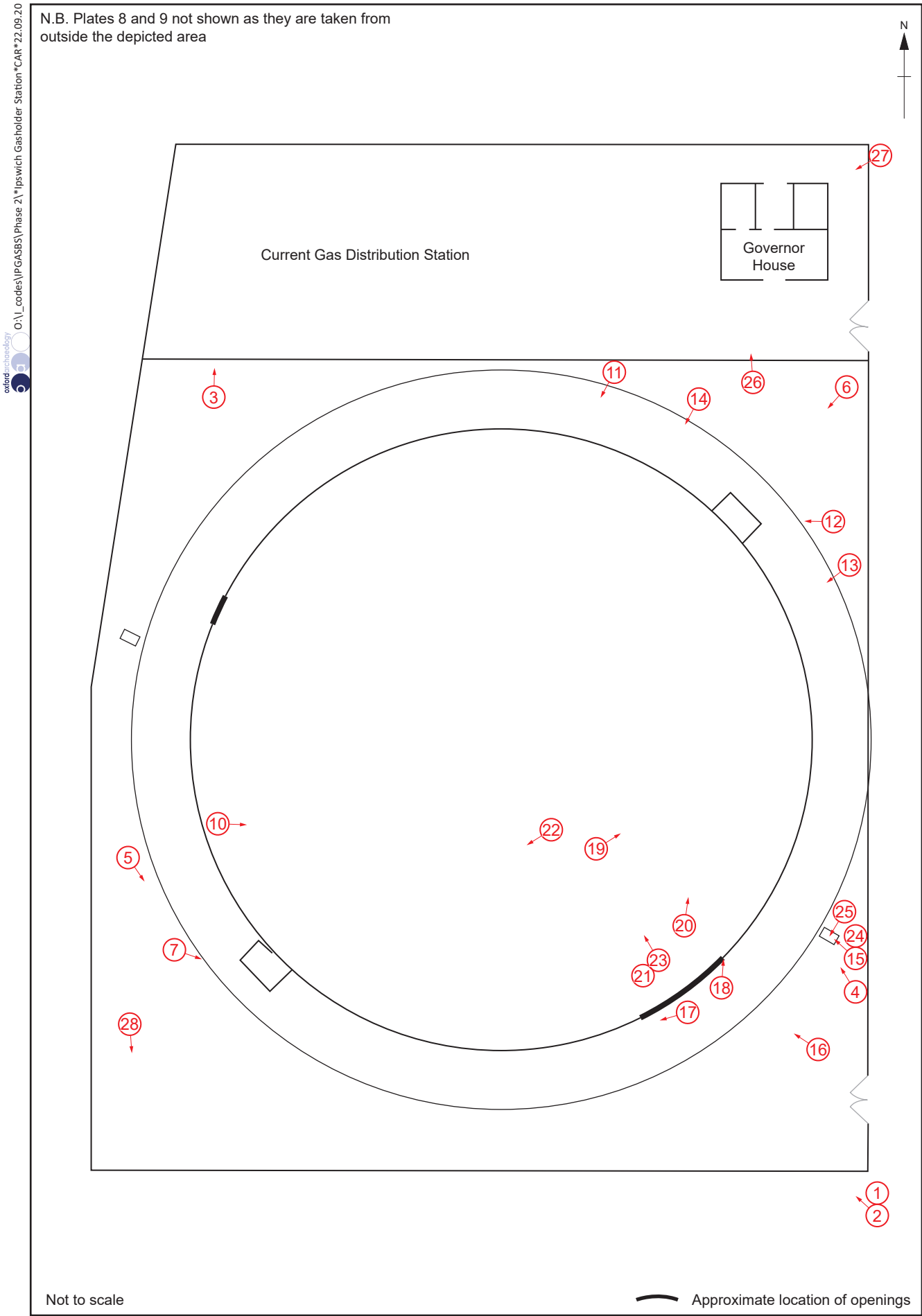


Figure 3: Photograph locations of plates



Plate 1: Gasholder Station viewed from the south-east



Plate 2: The top lift partially visible and the original boundary fence, viewed from the south-east in March 2009. Taken from Google Streetview. ©Google



Plate 3: Gas Distribution Station



Plate 4: Gasholder viewed from the south-east



Plate 5: Bund surrounding the gasholder, west side of the gasholder



Plate 6: Gasholder viewed from the north-east



Plate 7: Steps and dry well to the south-west of the gasholder



Plate 8: The gasholder almost fully extended. National Gas Archives
Document Reference: EA/DX/E/F/5/xg02861



Plate 9: The gasholder station from above. Taken from Google Earth. ©Google



Plate 10: The crown. ©BNP Paribas Real Estate



Plate 11: The access stairs viewed from the north-east



Plate 12: An example of a column and walkway fixing

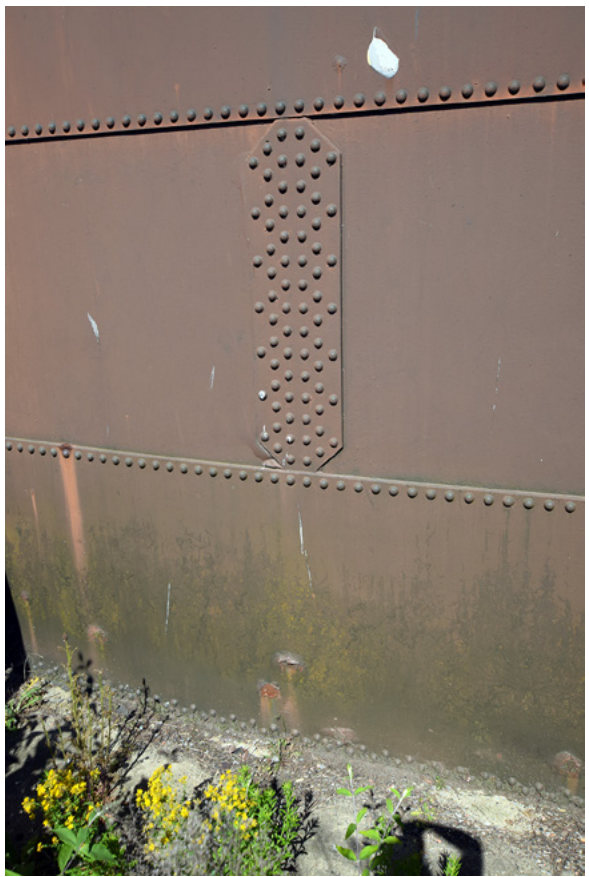


Plate 13: An example of the riveting



Plate 14: The two sides of the manufacturer's name plate



Plate 15: The concrete cabinet and pipework to the south-east of the gasholder



Plate 16: The gasholder during cutting. Photograph provided by Erith Contractors Ltd



Plate 17: A cross section of the tank and lifts. Photograph provided by Erith Contractors Ltd



Plate 18: A cross section of the tank and lifts. Photograph provided by Erith Contractors Ltd



Plate 19: The base of the tank and inner lift. Photograph provided by Erith Contractors Ltd



Plate 20: An inlet/outlet pipe and inner lift. Photograph provided by Erith Contractors Ltd



Plate 21: The crown and trusses. Photograph provided by Erith Contractors Ltd



Plate 22: The trusses. Photograph provided by Erith Contractors Ltd



Plate 23: The crown support. Photograph provided by Erith Contractors Ltd



Plate 24: The concrete cabinet at the south east of the gasholder



Plate 25: The doors of the concrete cabinet and the pump within



Plate 26: South elevation of the governor house, viewed through the railings

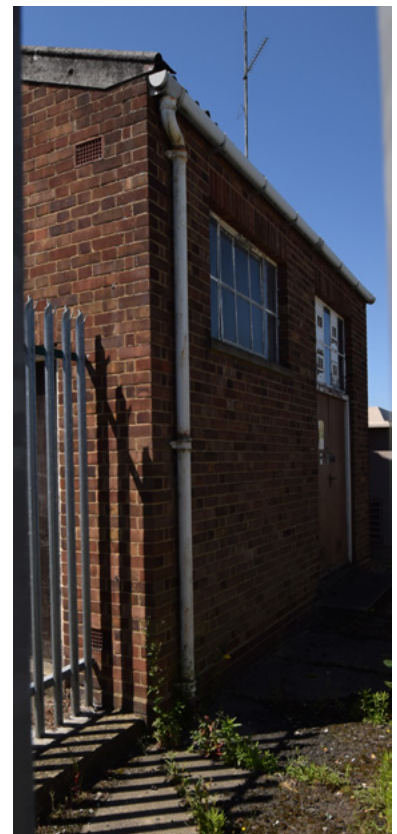


Plate 27: North elevation of the governor house, viewed through the railings



Plate 28: The concrete bases at the south-west of the site, viewed from the north



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