SGN Gasholder Heritage Review

Blackwall Lane, Greenwich,

Historic Building Recording Phase I & II Final Report

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AOC Archaeology Group

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SGN Gasholder Heritage Review: Blackwall Lane, Greenwich

Historic Building Recording Report Phase I & II Final Report

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National Grid Reference (NGR):	**TQ 39276 79377**
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This document has been prepared in accordance with AOC standard operating procedures.

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SUMMARY

AOC Archaeology Group was commissioned by SGN to undertake an historic building survey of a redundant gasholder (No 1) at the former Blackwall Lane Gasworks, Millennium Way, Greenwich in Greater London.

Gasholder No 1 is a frame-guided gasholder 77m in diameter with four lifts and 28 wrought iron standards constructed in 1888 by Docwra & Son with input by Frank Livesey. Relatively plain and unadorned, it has double sets of diagonal bracing between the standards and stands six tiers high. Built on a mound, the tank is set approximately 4m above ground level, something which was necessitated by the ground conditions and realised when work began in 1884. It has a 13.3m deep tank which has a flat-topped, steep-sided dumpling within. The crown is untrussed and supported when the bell is completely down by a timber support frame with timber uprights set in concrete blocks. A 46m-diameter circular wall is present on the top of the dumpling.

The gasholder was built by the South Metropolitan Gas Company as an expansion to its Old Kent Road gasworks after it became too over-crowded to add any more gasholders there, as well as to keep up with the demands of the increasing London population. Gasholder No 1 was soon joined by a second larger gasholder – No 2 – which was constructed in 1892. This was demolished in the early 1980s.

Gasholder No 1 is a typical example of its type, a development of George Livesey's cylindrical shell design, first used at the Old Kent Road gasworks. However, this holder was plainer in styling and execution in its construction. It was one of the many large gasholders built by the South Metropolitan Gas Company in the late 19th century and, for a brief period of 5 years, was the largest gasholder in the world.

1 INTRODUCTION

1.1 Project Background

1.1.1 AOC Archaeology Group was commissioned by SGN to undertake a survey of the redundant gasholder (No 1) at the former Blackwall Lane Gasworks, Millennium Way, Greenwich. The work has been undertaken in advance of a wider programme involving the decommissioning and dismantling of the remaining redundant gasholders in the UK operated by SGN. This report synthesises the results of several phases of recording at the gasholder, including a Phase I survey, completed prior to any demolition works, and a Phase II survey, which was completed during demolition works in several stages.

1.1.2 The gasholder is not a listed structure and is among the sites allocated for redevelopment in the Royal Greenwich Local Plan Core Strategy (2014) (HE 2017b). A request for listing was made in 2007 although was not progressed (HE 2007). An assessment for listing was then undertaken in 2017, where it was rejected for listing status (HE 2017a; HE 2017b).

1.2 Site Location

1.2.1 Gasholder No 1 is located within a prominent waterside site between Millennium Way and the Blackwall Tunnel Southern Approach Road (A102) and to the north-west of Boord Street. It is centred in NGR: TQ 39276 79377 (Figure 1). To the south-east of the site is another compound and car park as well as several temporary buildings which are presently being used as a distribution centre for the Evening Standard newspaper (Montagu Evans 2017b). To the south of the site is the 'Studio 338' night club and to the north-west an area of wasteland and scrub.

2 OBJECTIVES

2.1 The objective of the historic building survey was to create a 'preservation by record' of the redundant gasholder through archive research, written, photographic and measured survey both before and during its demolition to create an archive record of the structure.

3 METHODOLOGY

3.1 Introduction

3.1.1 The work was undertaken to a brief provided by Montagu Evans (2017b) and included archive research for early or original plans and photographs of the gasworks and gasholder and an on-site written, photographic and measured survey record. A photographic record, written record and measured survey was undertaken of the gasholder during both Phase I and Phase II, which is outlined in more detail below.

3.2 Archive Research

3.2.1 A general map-regression exercise was undertaken on the site to determine the general history and development of the gasworks site. All publicly accessible Ordnance Survey maps were viewed, and a selection have been included in this report.

3.2.2 The following archives were consulted to identify early/original archives and drawings of the site/gasholders:

- The Heritage England Archives
  - No plans/drawings of the gasholder are known to exist in these archives, although two photographs dating to 1992 are present (Refs: BB92/07573 & BB92/07574).
- National Gas Archive, Warrington
  - A number of records for the former gasworks site are held within these archives. These have been listed in Appendix 2, and a selection have been reproduced within this report.

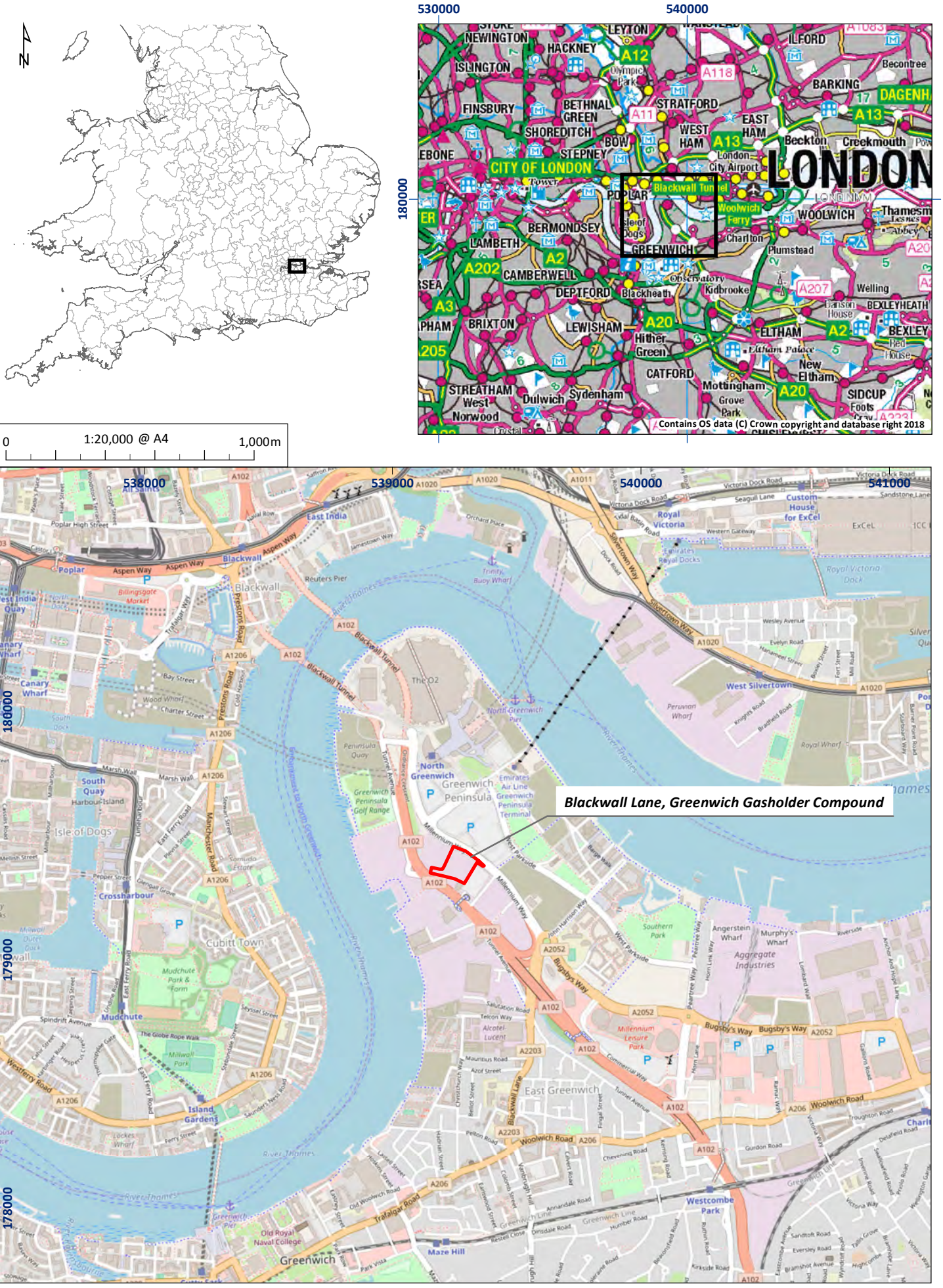


Figure 1: Site location plan

01/23686_L/REP_PII/01/01

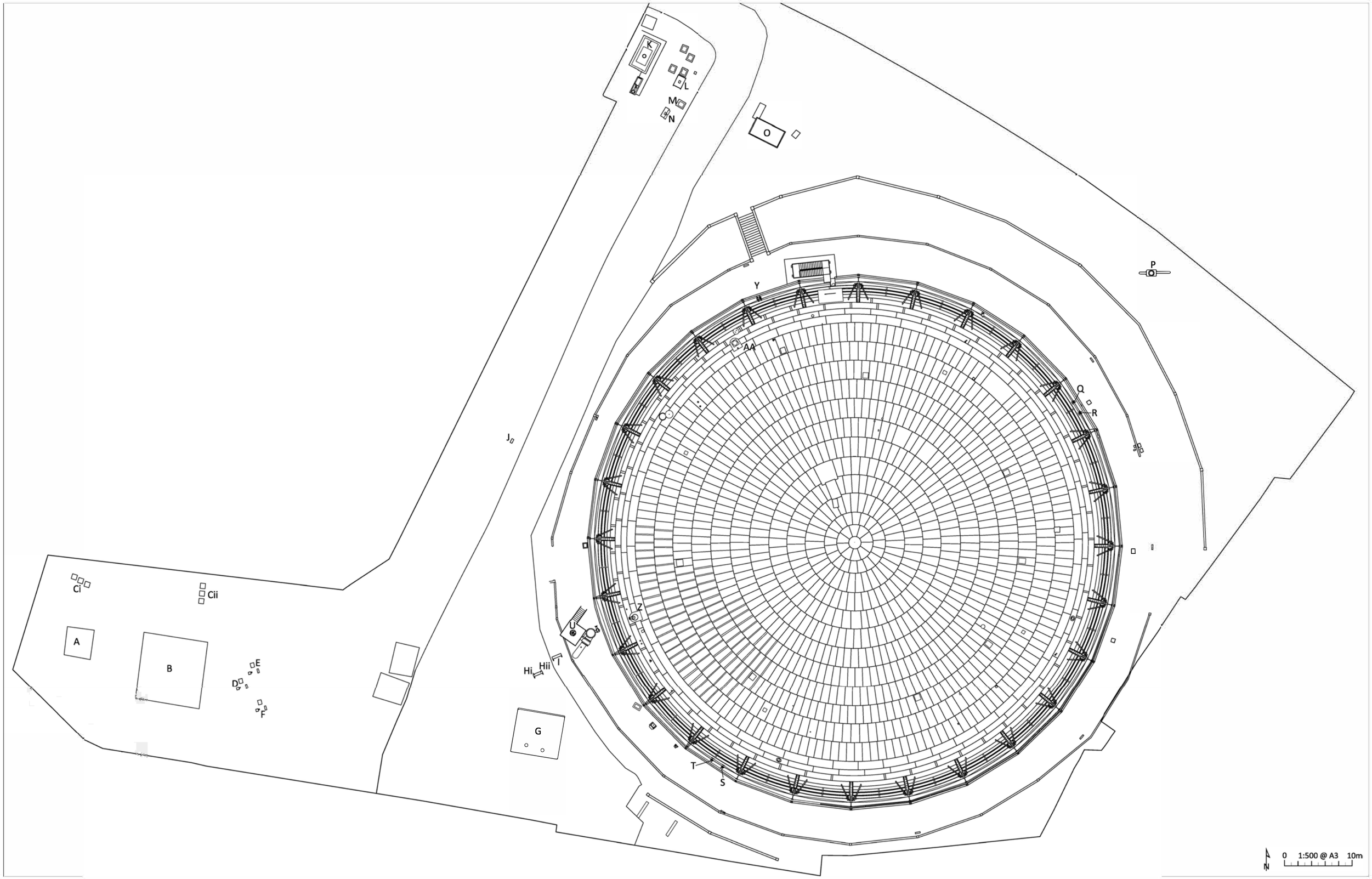


Figure 2: Blackwall Lane, Greenwich, Gasholder No 1, Site Plan

01/23686_L/REP_PII/02/01

- National Monuments Record, Swindon
    - No records (drawn or photographic) of the gasholder are known to exist in these archives (the structure is not listed).
    -

3.3 Photographic record

3.3.1 A general photographic survey was undertaken of the gasholder in colour digital using a digital SLR camera in both .JPG and .RAW format to a minimum 10 megapixel resolution. In addition, detail shots of features such as structural elements, pipework, standards, frame detail, stairs and roller carriages were also taken. A discreetly placed 2m, 1m or 0.5m ranging pole was placed in all shots where access and health and safety allowed for scale. All photographs have been given the reference 'GRE' followed by the reference number of the digital image.

3.3.2 A register of photographs was taken on site and can be found in Appendix 1, and a selection of digital photographs have been used as plates to illustrate this report (Plates 1 –51).

3.4 Written record

3.4.1 A written survey was undertaken of the exterior of the gasholder using AOC *pro forma* recording sheets with comment on condition, construction, features, fixtures and fittings, modern interventions, evidence for phasing and function and anything else pertinent to the historic record.

3.5 Measured Survey

3.5.1 The measured survey of the gasholder was undertaken prior to any demolition works using a Trimble TX5 3D laser scanner on 5th & 6th February 2018. From the data, detailed plan, section and elevation drawings have been created which have been reproduced in this report as Figures 24-25. In addition, as part of the Phase II works, a detailed measured survey was also undertaken of the framework supporting the crown of the gasholder as it was exposed during the Phase II works. This survey was undertaken using the Trimble TX8 laser scanner on 28th August 2019. From this data, detailed plans and sections of the framework have been reproduced here as Figures 26-29. A more detailed description and register of both surveys can be found in Appendix 3.

4 HISTORICAL BACKGROUND

4.1 The South London Gas Company was founded in 1814 when the potential for coal gas for heating and light was starting to gain recognition (Carpenter 1925). Their first gasworks was at Southwark, although only 10 years later the company folded and was taken over by the Phoenix Gas Light and Coke Company (*ibid*). This later transformed into the South Metropolitan Gas Company by 1880, the chairman at the time being the renowned gas engineer George Livesey, son of Thomas Livesey, George taking over from Thomas after his death in 1871. The company, under the leadership of Livesey, set about improving the quality of coal gas in the later 19th century by amalgamating with other gas companies, which meant their expansion was inevitable, and a site in Greenwich was chosen.

4.2 The East Greenwich Gasworks was established by the South Metropolitan Gas Company (which was originally founded in 1829) in 1881 (Montagu Evans 2017a). Prior to this, in the mid to late-19th century, the area was open fields to the east side of Blackwall Lane, although to the west there was already an extensive settlement of industrial sites, as can be seen in the 1873 Ordnance Survey map (Figure 3). The gasworks – with the two larger gasholders (No 1 and No 2) – can then be seen on the 1899 Ordnance Survey map (Figure 4). The gasholders dominate the site with only a sprinkling of small gasworks buildings around them. The smaller easternmost gasholder, No 1, is the one that survives on site today, and was constructed between 1886 – 1888 by Docwra and Son, with input from George's younger brother Frank Livesey. The frame was constructed by Ashmore, Benson and Pease of Stockton (*ibid*). The company minutes show that the

construction of the tank began in summer of 1884, and a two-lift gasholder had initially been agreed that year. However, the ground conditions necessitated that the tank had to be constructed partially above ground, hence the additional lifts to compensate for this (HE 2017b). It was built as a frame-guided holder, 77m in width and 54m in height, with four lifts, 28 wrought iron standards and a concrete tank, 4m of which was built above the ground level as mentioned above. The crown was constructed untrussed, instead resting on the frame built on the tank (*ibid*). It was built in a fairly plain and unostentatious design with double sets of diagonal bracing between the standards. At the time it was constructed it was the largest gasholder in the world with a capacity of 8,200,000ft³ (232,198m³), although was soon eclipsed in size by its sister to the west – Gasholder No 2 – which was built only a few years later in 1892. The No 2 holder had a capacity of 12,000,000ft³ (339,802m³) with six lifts, two of which were flying lifts, and was constructed in a similar style to No 1.

4.3 As mentioned above, the chairman at the time of the establishment and subsequent design and development of the gasworks and gasholders was George Livesey, who was instrumental in the mid-late 19th century in the expansion of the gas industry in London, working at Greenwich, Old Kent Road and the nearby Bell Green works at Sydenham. George Thomas Livesey (1834 – 1908) was the eldest son of Thomas Livesey, also renowned in the gas industry of the 19th century. In 1855, George was made assistant engineer at the South Metropolitan Company (apprenticed under his father since the age of 14) and gradually took over the management of the company's works in the next seven years, appointed as an engineer in 1862 (Institute of Civil Engineers 1908). At the time, he personally oversaw the expansion of the gasworks site at Old Kent Road. He was appointed secretary of the company after his father's death in 1871 and over the next 10 years was responsible for many innovations and inventions in the gas industry including the 'Livesey Washer' and the 'Livesey Scrubber' (*ibid*).

4.4 In 1900, additional land was purchased by the company enlarging the gasworks site at Greenwich to 150 acres.

Figure 3: Extract from Ordnance Survey map, 1873 (the future position of Gasholder No 1 (to the east) and Gasholder No 2 (to the west) are circled in blue)

Figure 4: Extract from Ordnance Survey map, 1899 (Gasholder No 1 is circled in red)

4.5 Into the 20th century, little on the site changed, and the two gasholders were the only holders ever to inhabit the site. A basic site plan from the National Gas Archive shows the gasholders in place in 1902 (Figure 5). An archive photograph also exists of the gasholder during the First World War in 1916 which has been reproduced here as Figure 6.

Figure 5: Archive plan of the Blackwall Lane Gasworks, 1902 © National Gas Archive

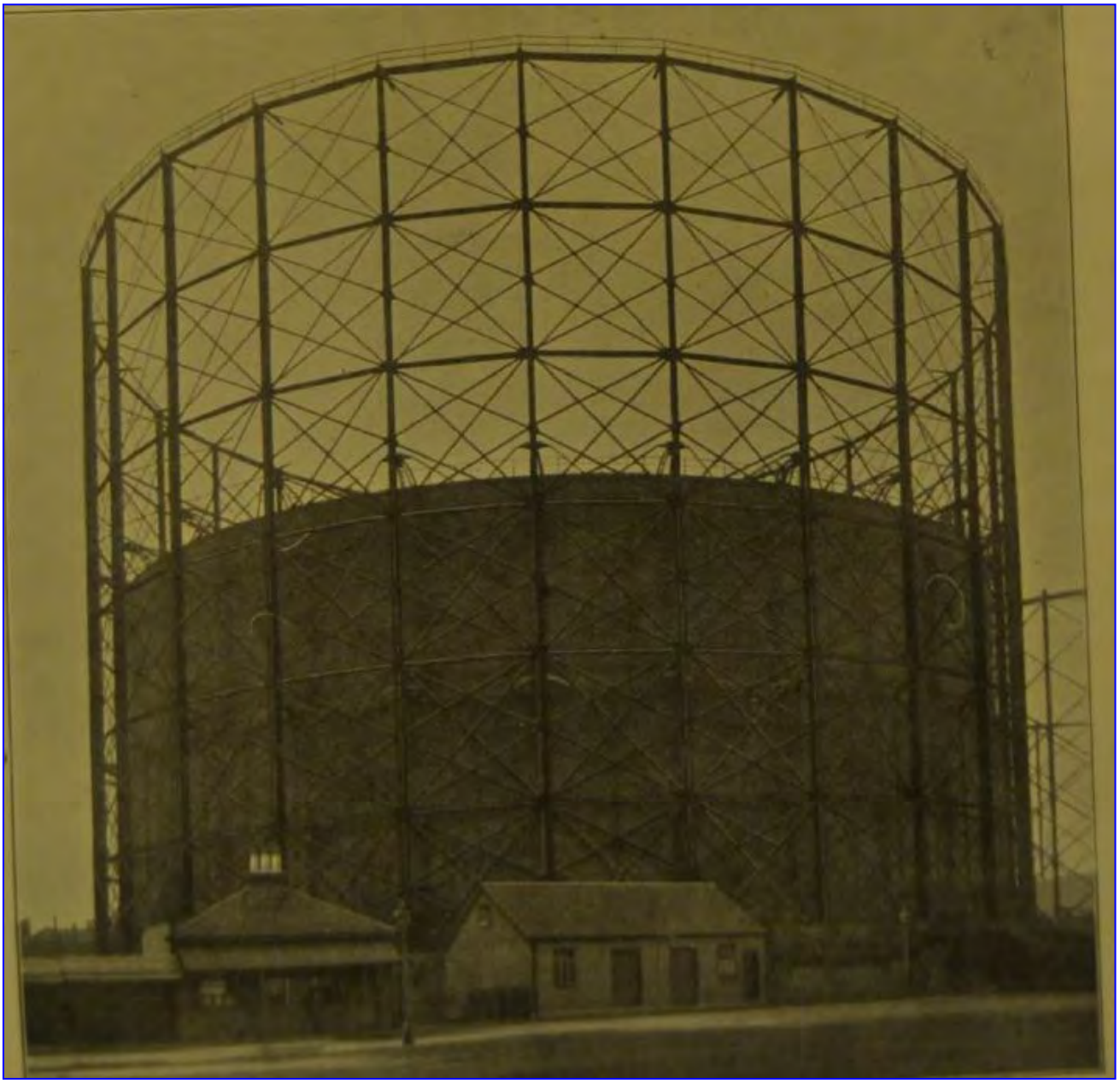


Figure 6: Archive photograph of Gasholder No 1, 1916, after Montagu Evans 2017, Figure 3.7

4.6 In 1917, both holders were damaged when there was an explosion at the London's East End Silvertown TNT factory, which instigated a programme of refurbishment in the 1920s. Perhaps instigated by the damage, a survey was completed by the South Metropolitan Gas Company between 1917 and 1919 recording Gasholder No 1 in plan, elevation and section with details of the below ground, timber crown rest frame (Figures 7 - 9). By the 1920 Ordnance Survey map, tenements had also been added to the south-east side of Gasholder No 1, showing the general expansion of the surrounding area (Figure 10).

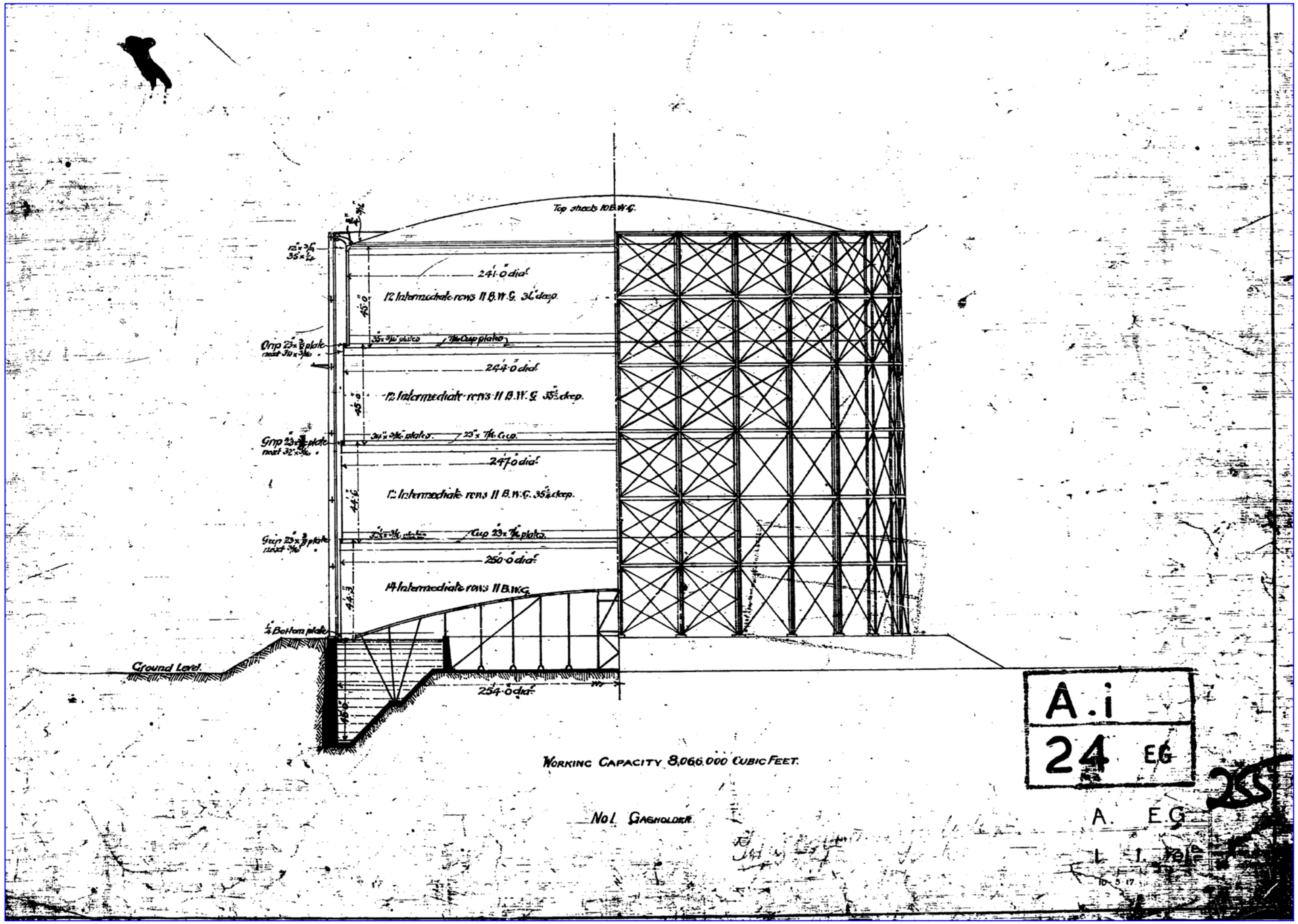


Figure 7: Drawing of Gasholder No 1 (SGN Archive 043-253-258_Gasholder Maintenance 3-6, 1917)

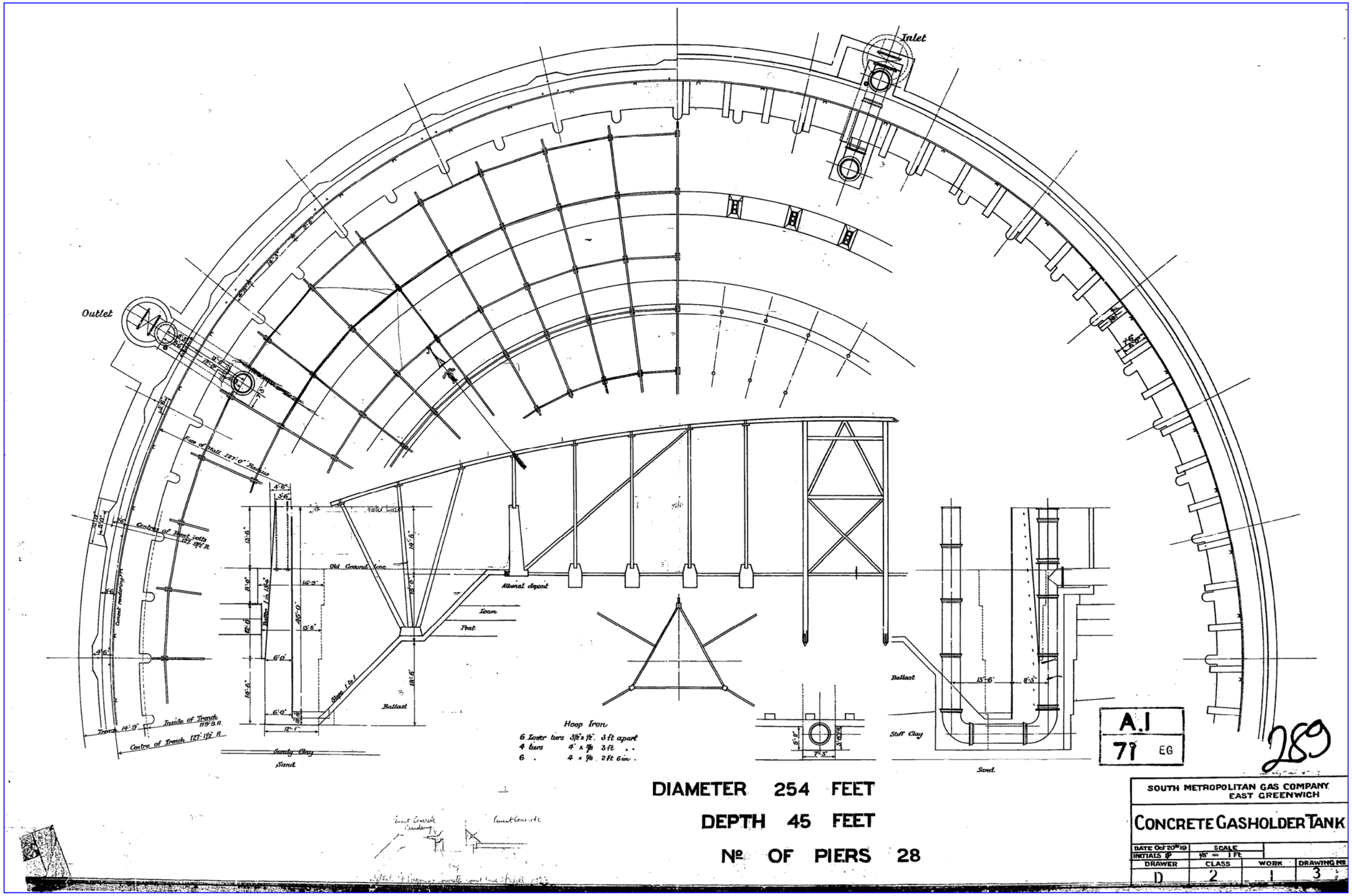


Figure 8: Drawing of Gasholder No 1 crown support frame (SGN Archive 049-289-294_Gasholder Maintenance 1-6, 1919)

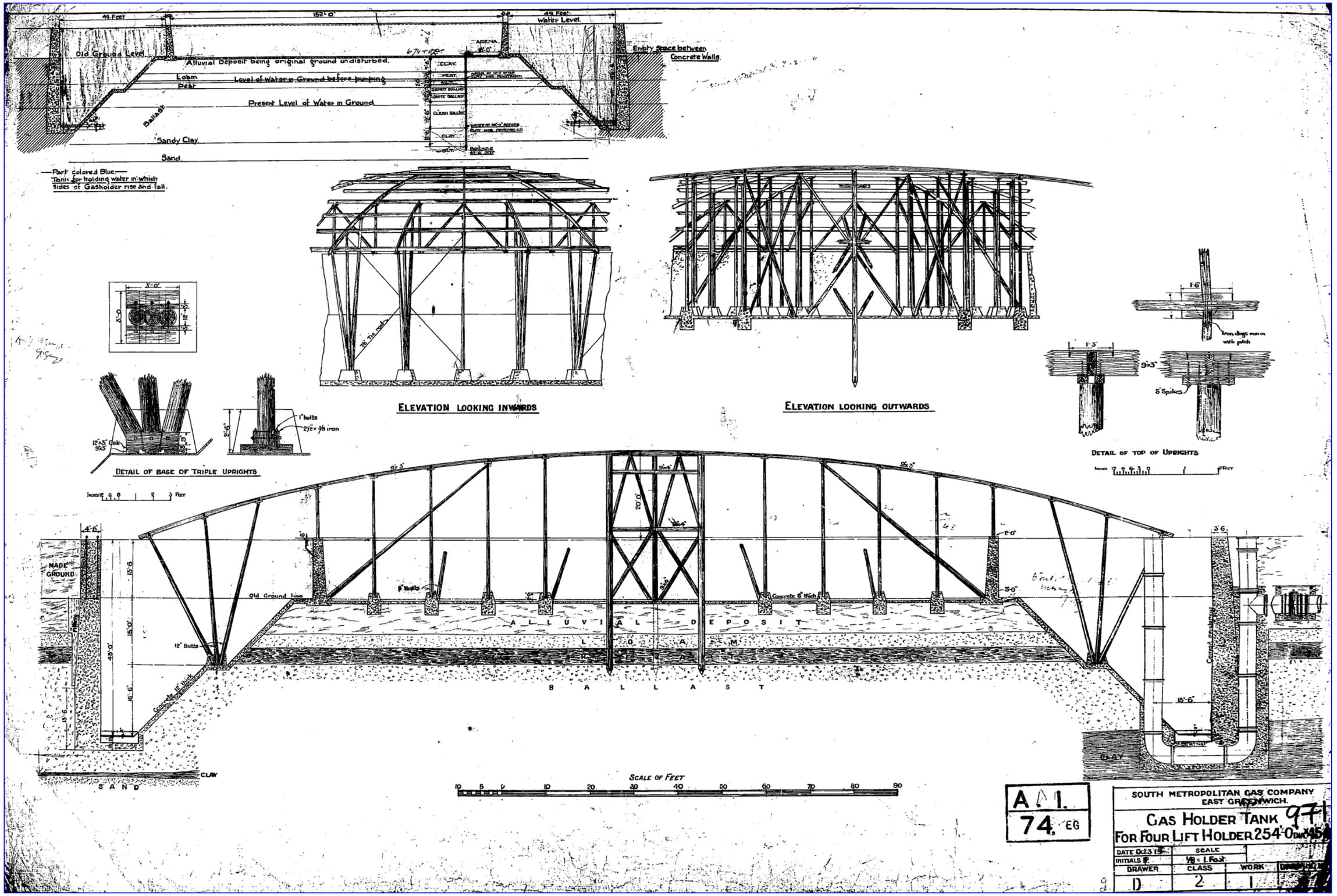


Figure 9: Drawings of Gasholder No 1 crown support frame (SGN Archive 166-966-970_Gasholder Maintenance 6-6, 1919)

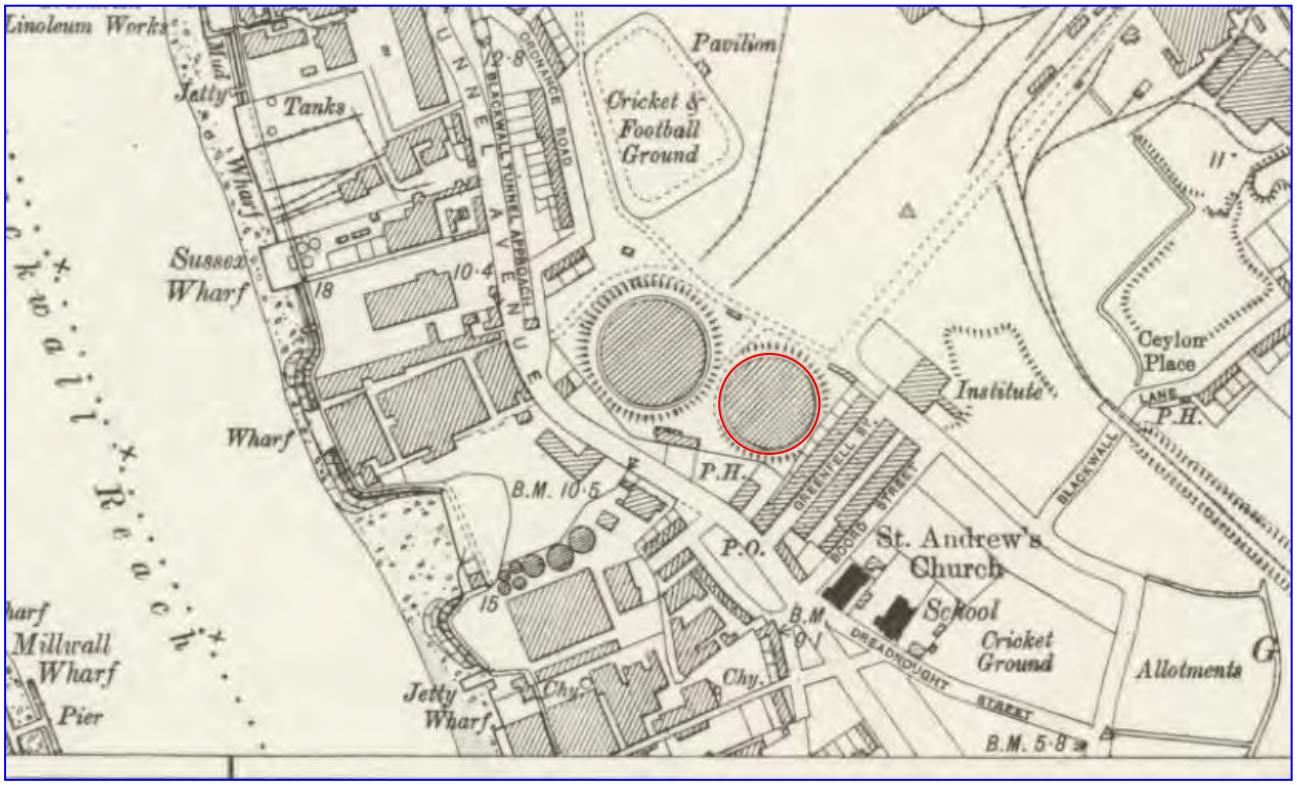


Figure 10: Extract from Ordnance Survey, 1920 (Gasholder No 1 is circled in red)

4.7 In 1925, a pamphlet was produced by the South Metropolitan Gas Company describing the works at the time (Carpenter 1925). It notes the gasholders on the site as being '*…of impressive proportions, one of which* [Gasholder No 2] *is the largest of its kind in Europe*.' The coal was bought in from the foreshore from a pier 200 yards (182m) in length and transported to the gasworks via a system of tramways where coal gas was produced (Figure 11). The gasworks at the time covered 150 acres in total and also contained a chemical works and a tar works. About 2,500 tonnes of coal were processed through East Greenwich – about half the company's stock - which was shipped down from Durham, the quality of the coal tested at Newcastle. After being unloaded by crane and passing over a weighbridge, the coal was taken to the five retort houses on the site 160 yards x 24 yards (146m x 22m) in size (Figure 12). Moving through a system of washers and scrubbers to extract ammonia, the coal was then moved to the purifiers to remove sulphureted hydrogen, then more washers to remove the naphthalene and then into the gasholders (Figure 13). The capacity of the gasholders at this time was 20,000,000 ft³ (566,337m³) with 168,000 therms (units of heat energy) of gas made daily (*ibid*). A general photograph of the holders is also present in the pamphlet (Figure 14). Carpenter then goes on to describe the process by which the gas was distributed and the gas levels controlled at the Greenwich Works:

> *'…the pressures at which the gas is distributed* [is] *… controlled by governors. In order to maintain the required pressure on the district of supply during the hours of maximum consumption, the pressure given by the gasholders has to be considerably augmented above that given by their weight. For this purpose large boosting fans, driven by gas engines, are used. The peak point is generally reached during the hour of 11 – 12 noon on Sunday…*' (Carpenter 1925, 17).

Figure 11: Archive photograph of the jetty from which coal would have been brought into the Blackwall Lane Gasworks, 1925, after Carpenter 1925, Figure 2 © National Gas Archive

Figure 12: Archive photograph of one of the retort houses at the Blackwall Lane Gasworks, 1925, after Carpenter 1925, Figure 4 © National Gas Archive

Figure 13: Archive photograph of the purifiers at the Blackwall Lane Gasworks, 1925, after Carpenter, 1925, Figure 5 © National Gas Archive

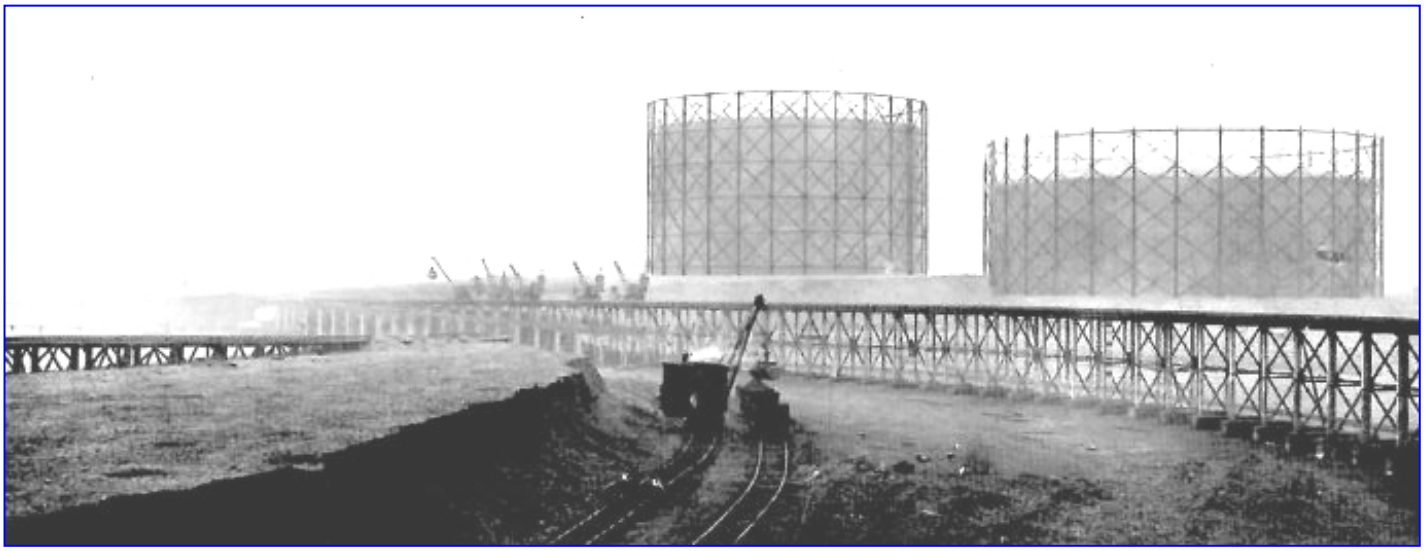


Figure 14: Archive photograph of Gasholders No 1 (to the left) and No 2 at the Blackwall Lane Gasworks, 1925, after Carpenter 1926, Figure 6 © National Gas Archive

4.8 Plans of the gasworks from 1937 and 1940 respectively held in the National Gas Archive show a detailed layout of the site at the time showing the extent of the tramways and the retort houses and the washer and purifier houses with the gasholders to the south-east side (Figures 15 & 16). The 1947 Ordnance Survey map also shows the wider gasworks and the surrounding area, little having been changed from the 1920 map (Figure 17).

Figure 15: Archive map of the Blackwall Lane Gasworks, 1937 © National Gas Archive

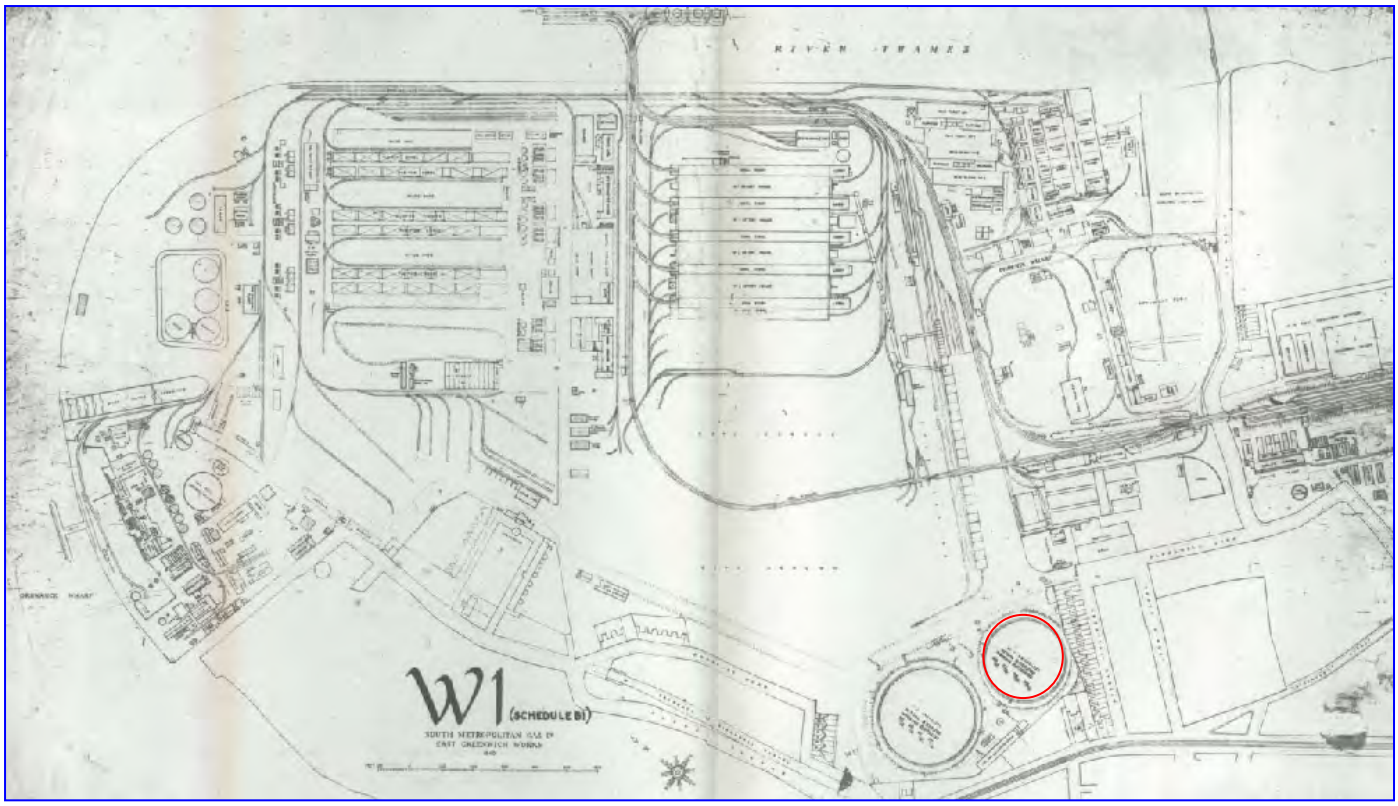


Figure 16: Archive map of the Blackwall Lane Gasworks, 1940 © National Gas Archive

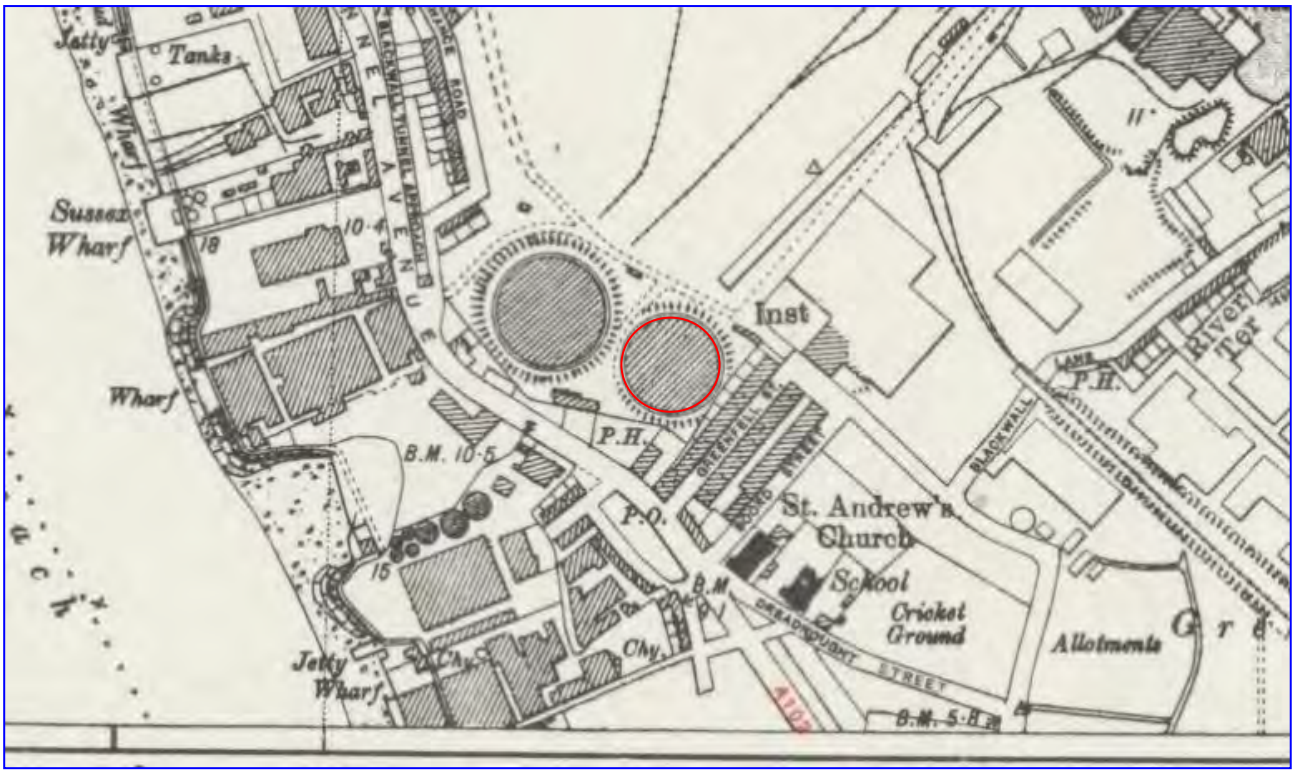


Figure 17: Extract from Ordnance Survey map, 1946

4.9 The South Metropolitan Gas Company carried out surveys of several of their gasholders during the early to mid-20th century including comparing sections through the tanks in 1925 and various architectural features during 1941, presumably to have a full record in case repairs were necessary due to the possibility of bombing during WWII. Sections across crown rest frames and dumplings, and details of features such as cup-and-grips, top and bottom kerbs, and sections through standards were all recorded (Figures 18 - 20).

4.10 The gasholder was inspected regularly with examination reports kept detailing dimensions and architectural features. One such record states that the lifts were rebuilt by Ashmore, Benson, Pease & Co in 1928 (0527_1960_01_00_RPR_GHNo1Sheet). A set of drawings for proposed cementation of the ballast under Gasholder No 1 exists for the same year (051-301-306_GASHOLDER MAINTENANCE 1-6; Figure 21). There are drawings of the cup-and-grips for each lift from 1936 and it is unclear whether they are just a record or a proposed new design (Figure 22). In 1979, after an IRA bomb attack in the Blackwall Tunnel, both gasholders were damaged and No 1 caught fire with damage to the bell and guide frame standards on the west side. Repairs were carried out in 1980 by Clayton, Son & Co Ltd of the Moor End Works in Hunslet, Leeds. They extensively detailed the new design of the replacement standards and lifts (Figure 23; Appendix 4).

4.11 Gasholder No 2 was dismantled between 1981 and 1985, and the area extensively redeveloped in the late 1990s to make way for the Millennium Dome (O2 Arena) to the north of the site.

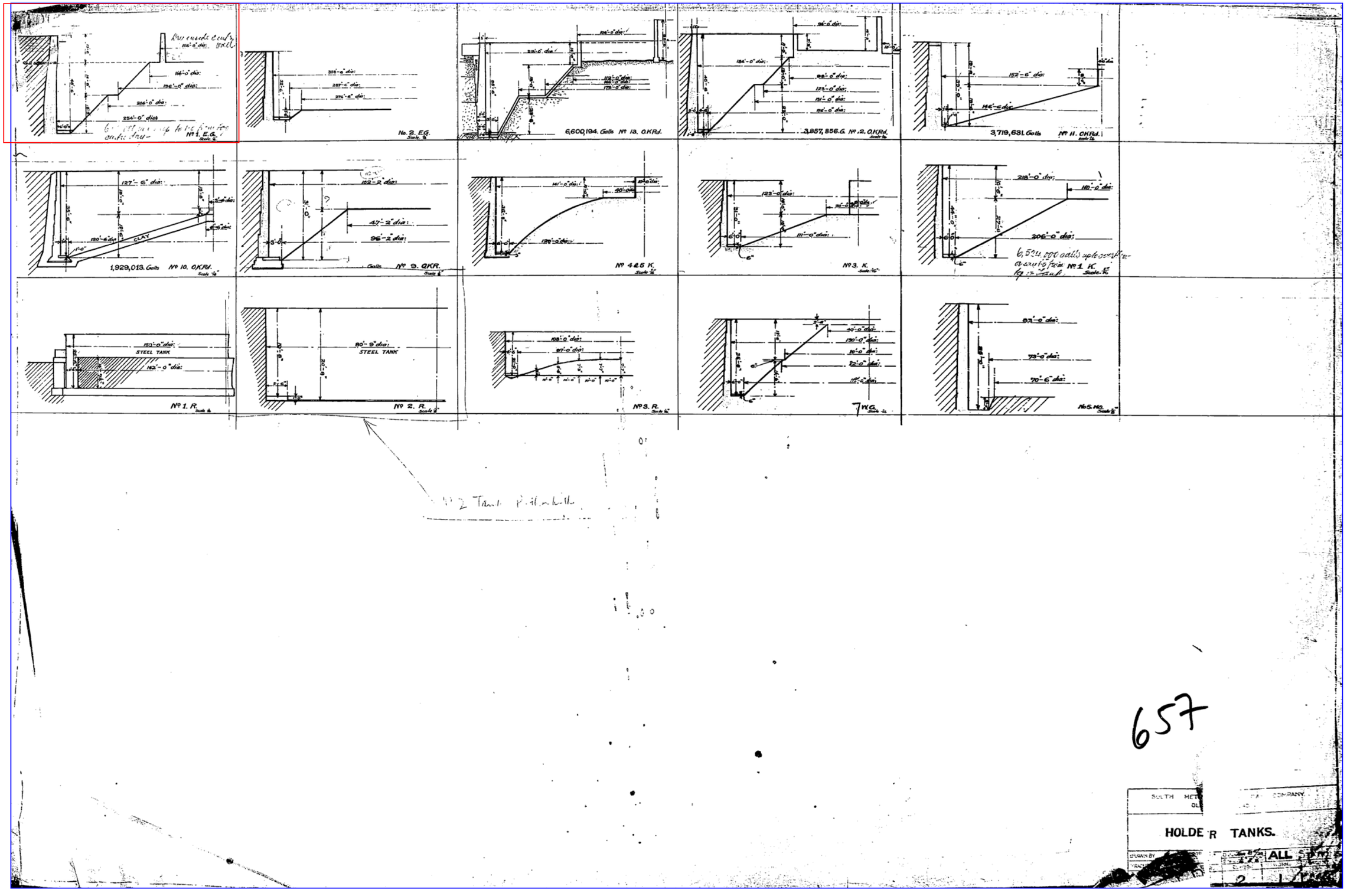


Figure 18: Drawn sections across various gasholder tanks including East Greenwich No 1 (SGN Archive 110-655-660_GASHOLDER MAINTENANCE 3-6, 1925)

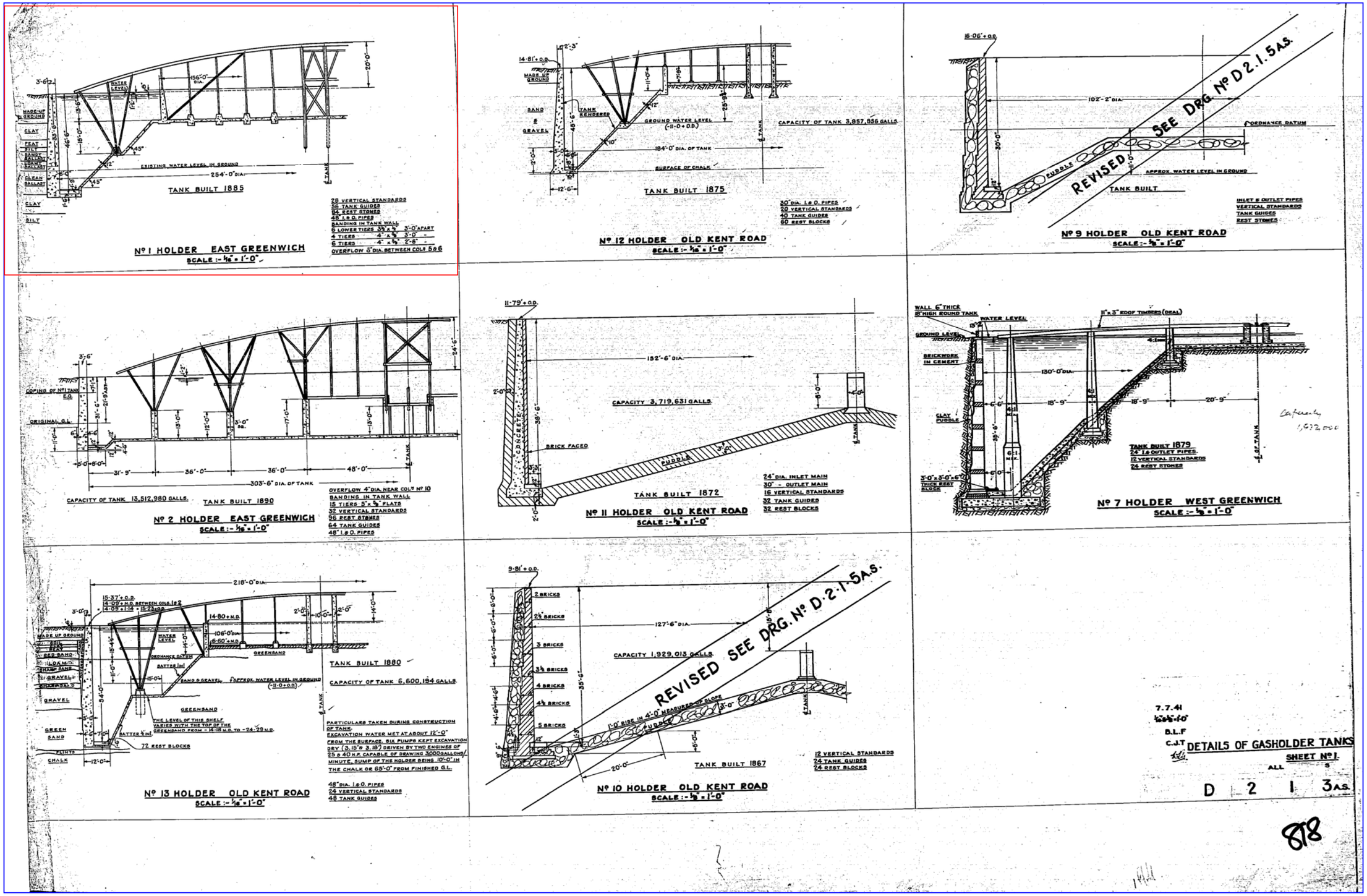


Figure 19: Drawn sections across various gasholder tanks including East Greenwich No 1, 1941 (SGN Archive 137-817-822 GASHOLDER MAINTENANCE 2-6)

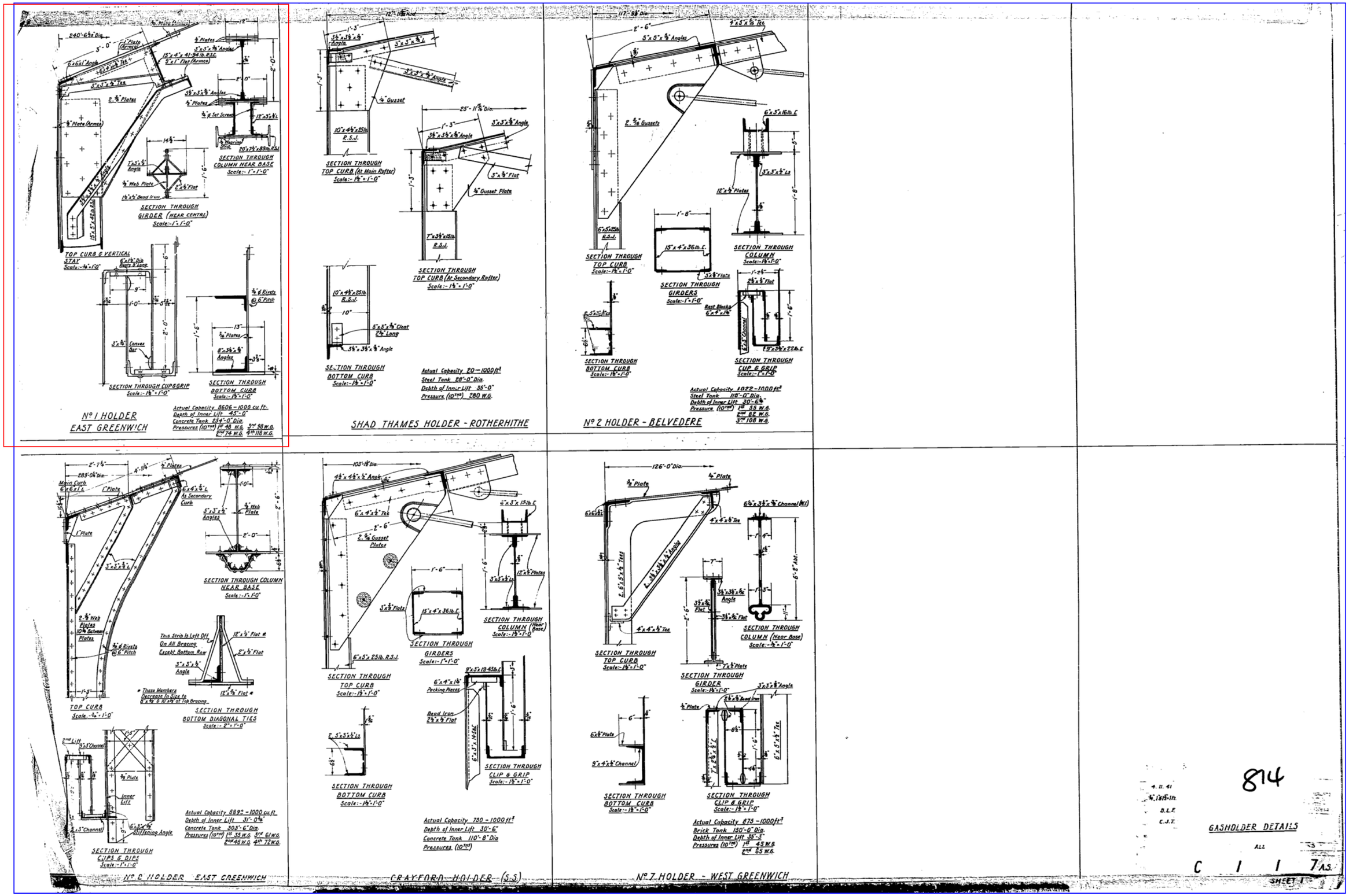


Figure 20: Drawn features of gasholder tanks from various sites including East Greenwich No 1, 1941 (SGN Archive 136-811-816)

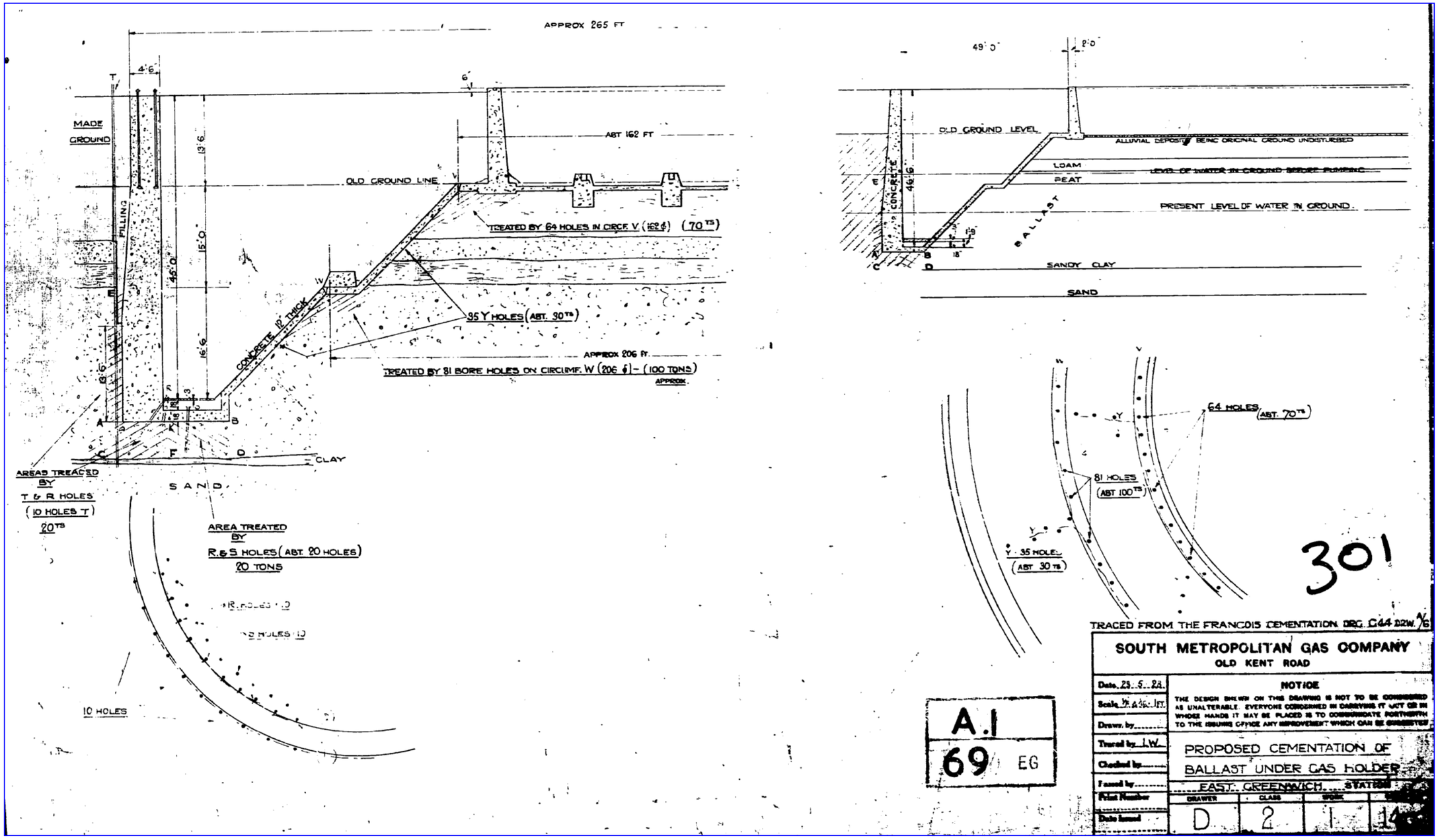


Figure 21: Designs for proposed cementation of ballast under Gasholder No 1 East Greenwich, 1928 (SGN Archive 051-301-306)

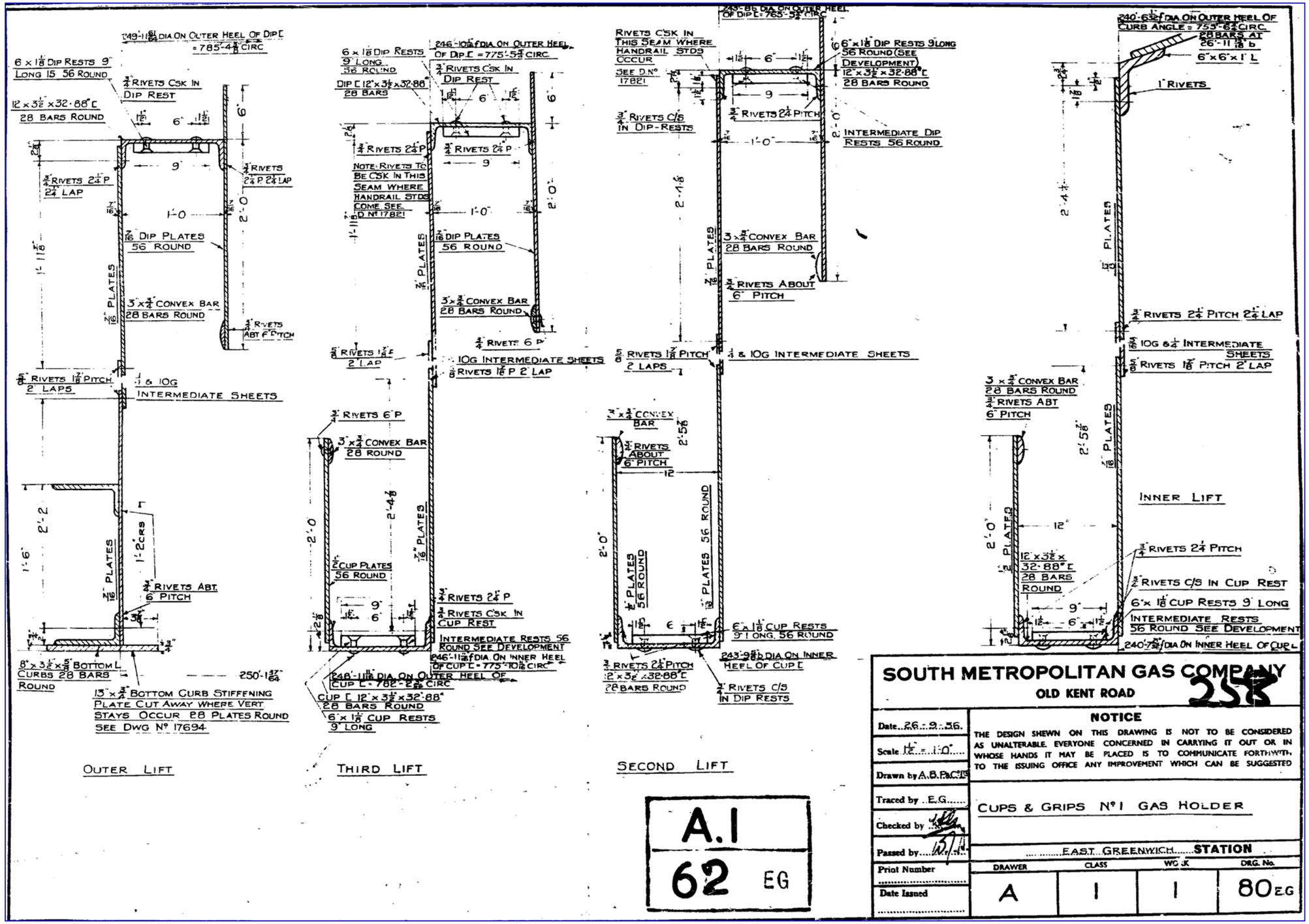


Figure 22: Cup-and-grip design for each of the four lifts at East Greenwich Gasholder No 1, 1936 (SGN Archive 043-253-258__GASHOLDER MAINTENANCE 6-6)

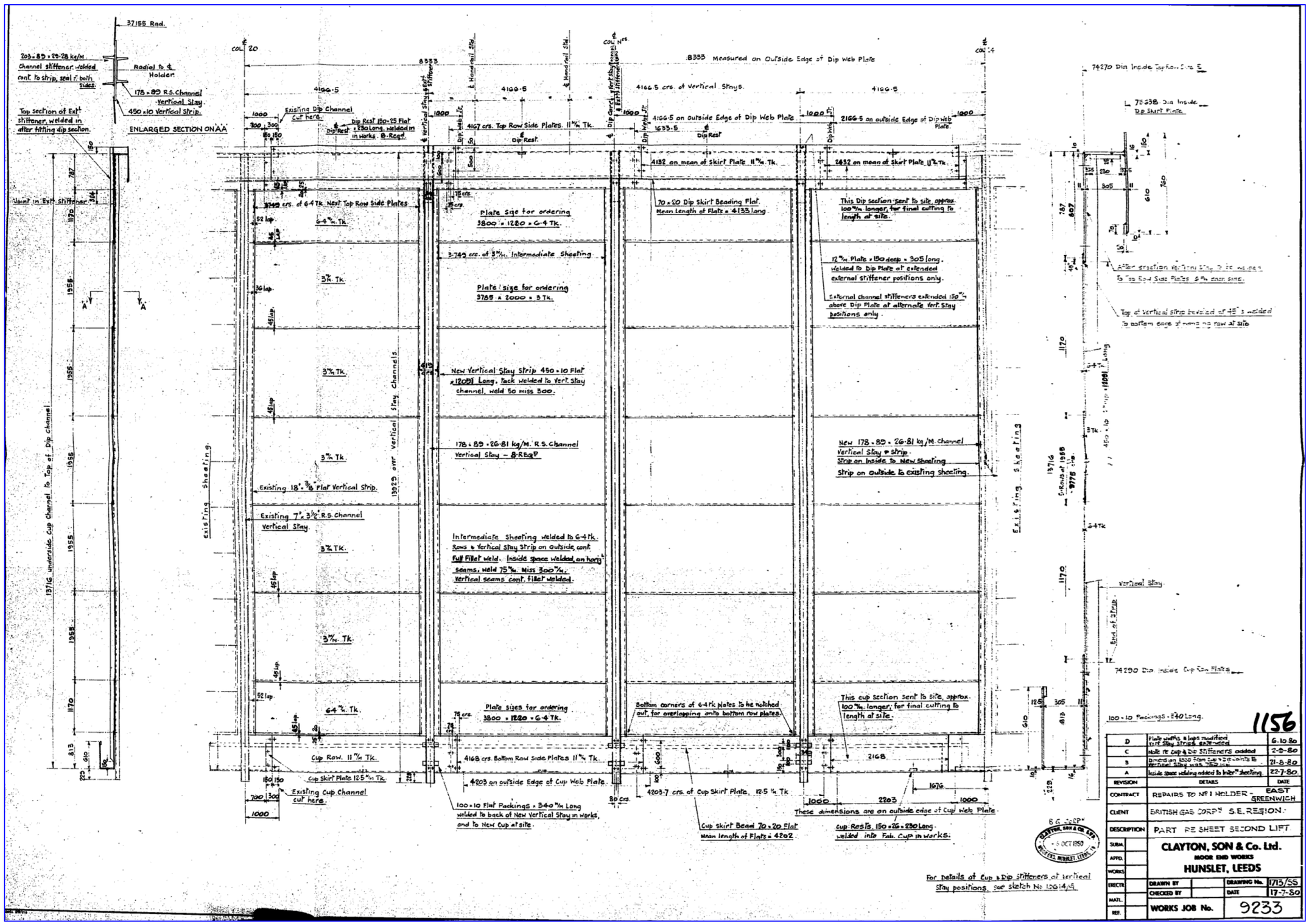


Figure 23: Drawn record of proposed repairs to the second lift by Clayton, Son & Co. Ltd. (SGN Archive 199-1156-1161, 1980) The other three lift designs can be found in Appendix 4

5 GASHOLDER NO 1

5.1 Gasholder No 1 is a frame-guided gasholder with a below-ground concrete tank and four lifts. It has 28 I-section wrought iron standards which rise to six tiers in total and is relatively plain in style for its date of construction (1888). Each standard is crudely numbered in marker paint, although some earlier more formal square plaques still survive (although are unlikely to be original). The standards are held in place by double sets of diagonal bracing, which over-weave each other on the inner and outer sides of the standards, a structural necessity given the size of the gasholder and the structural engineering and capacities of the time (Figures 24 - 25; Plates 1 - 5). Vertical strip bars are also present to the centre of the diagonal bracing which hold it together to each section of each tier.

5.2 As mentioned above in Section 4, the tank rises 4m above ground level and, as such, the gasholder is set on a raised area of land which is approached by a set of steps to the NNW side of the holder between No 1 and No 2 standards (Plate 6). The standards are plain I-section wrought iron riveted beams with large flitch plates to connect the diagonal bracing (Plates 7 - 10). Three of the standards (Nos 21 - 23) have been replaced to the west side where they were damaged by the IRA bombing in the Blackwall Tunnel in 1979.

5.3 There is a single stair to the NNE side of the holder between No 2 and No 3 standards. It is approached by a set of external steps which rise to an angled vertical stair with intermediate gantry levels accessing the lifts (Plate 11). The crown of the gasholder comprises riveted steel sheets (Plates 12 & 13). There are then a number of gas and air vents within it, including one 8" (203mm) vent, four 2" (51mm) vents and three 3" (76mm) vents (SGS 2000).

5.4 The guided rollers are located behind each standard, and consist of three sets of flanged radial rollers (Plates 14 – 16).

5.5 Other additional features noted during the works include two sets of knock-off switches, Q & R, which are located between No 7 and No 8 standards and S & T, which are located between No 19 and No 20 standards (Figure 24; Plates 17 – 19). The gas main (U) is located to the WSW of the gasholder (Plates 20 - 22).

5.6 During the Phase II survey works it was possible to see into the 13.3m deep steel tank due to the removal of the steel-sheeted, untrussed crown (Plate 23). Within the tank is a timber crown rest frame comprised of upright posts supporting a latticework dome (Figures 26 - 28). The latticework has the illusion of 48 spokes and 12 rings radiating out from the centre of the tank with a zig-zag pattern between them. The spokes and rings are not continuous but made up of short lengths of cut timber planks resembling zig-zag sections between them (Plate 24). The point at which the spokes and rings meet is secured by a cross-shaped metal joint (Plate 25). At the point where the diagonal lengths meet the spokes and rings, they are nailed together (Plate 26). Timber blocks are then nailed to the planks at these joints to further secure them (Plate 27). On the south-west of the frame is an area of repair between No 21 and No 23 standards made up of narrow steel lengths (Plate 28). This is the only area of the frame affected by the IRA bombing from 1979. The central four rings of the frame are more widely spaced than the outer eight, so the diagonals are arranged differently and some of the spokes disappear towards the centre of the structure (Figure 17). In the very centre of the crown support frame is an equilateral triangle with diagonal braces out from its corners and sides to meet the main spokes. Carved roman numerals on some of the timbers suggest that a numbering system relating to their position in the dome frame was used during construction (Plate 29).

5.7 The lattice dome is supported by timber uprights arranged in six rings (Figure 27 & 29). If counting the rings from the centre outwards:

- Rings 1, 3 and 5 are made up of timber uprights with various bracing timber posts reaching diagonally from the top of one upright to the bottom of another;
- Rings 2 and 4 are up made up of only timber uprights; and

- Ring 6, the largest and outermost ring, is comprised of timber uprights with metal diagonal tie-bars between every other one, secured centrally with a bolted tension ring (Plates 30 & 31).

5.8 Rings 1 - 4 and 6 are all set within a concrete block at their base attaching them to the tank floor (Plate 32). Ring 6 differs from the other four, however, as each concrete base supports three timber uprights: one set upright, one leaning diagonally outwards and one leaning diagonally into the tank (Figure 28). Ring 5 differs from all the rest as the base of these timber support posts is set within a concrete wall running in a ring around the tank base (Plate 33). At the top of each timber upright is a flat timber square used to support the joint sitting on it (Plate 34). Near the top of the uprights are two timber props nailed to the side of the uprights presumed to be scaffolding-style used by workers during the construction of the frame (Plate 34).

5.9 The top curb of the bell is supported by 56 steel, I-shaped, uprights attached to the interior (Figures 26 & 27). The top of the uprights extend into the tank forming a triangle shape which, along with a steep bar extending outwards from each side of the upright, help support the highly pressured joint. This area was not freely visible during the Phase II survey works but an archive drawing believed to be from 1919 shows the design clearly (Figure 20).

5.10 The base of the tank slopes up in the centre to form a dumpling (Figure 28). An archive drawing from 1919 shows the dumpling is comprised of alluvial deposit, loam, peat and ballast with clay and sand deposits below the tank walls (Figure 9). The dumpling is covered with a layer of concrete 12” thick. The dumpling has a platform halfway up on which the bases of the outermost ring of uprights sit (Plate 35). Access is possible up the dumpling via a set of steps situated on the south-west side of the dumpling, and a ladder on the north-west (Plates 36 & 37; Figure 27; Features V & W). The two features are connected via a handrail at the platform level halfway up the dumpling. Also visible within the tank is a pipe that enters from the NNW and encircles the top of the ringed wall (Plate 38; Figure 27; Feature X). It is not clear what the pipe operation was, but it is noted that it aligns with some control valves at ground level situated on the east side of No 1 standard (Figure 26: Feature Y).

5.11 In the centre of the tank is a triangular support structure comprised of timber planks (Plates 39 & 40; Figures 26 - 28). An archive drawing from 1919 shows the corner posts of the triangular structure are set into the dumpling (Figure 9).

5.12 The inlet and outlet pipes were visible in the south-west and NNW of the structure (Plate 41; Figure 27; Features Z and AA), each capped with Livesey man-lids, named after their inventor Sir George Livesay (Meade 1921, 671).

5.13 Archive drawings of the cup-and-grips show their design in the lifts (Figures 20 & 22). As demolition was on-going during the Phase II survey, one of the bases of a lift was observed, not *in-situ* (Plate 42). The flat base of the cup was also visible along with the roller wheel beneath to guide the telescopic lift up and down within the tank.

5.14 There are additional buildings and structures located within the complex (annotated in Figure 2), including:

A: Steel shed (Plate 43)
B: Large steel shed (Plate 44)
Ci & Cii: Two sets of three manholes to the north side of Shed A (Plate 45)
D: Entrainment valve and associated pipework (Plate 46)
E: Jet Booster valve and associated pipework (Plate 46)
F: Jet Booster valve and associated pipework (Plate 46)
G: Modern shed (Plate 47)
Hi: Holder outlet valve (Plate 48)

Hii: Volumetric Governor Overflow valve (Plate 48)
I: Unknown valve to the immediate north-east of valves Hi & ii
J: Unknown valve to the west of the gasholder
K: Steel tank and pipework in a concrete compound (Plate 49)
L: Cover for underground pipework (Plate 49)
M: Small concrete enclosure with pipe fitting (Plate 49)
N: Unknown valve
O: Small steel shed to the north-west side of the gasholder opposite L & M (Plate 50)
P: Large section of pipework (Plate 51)

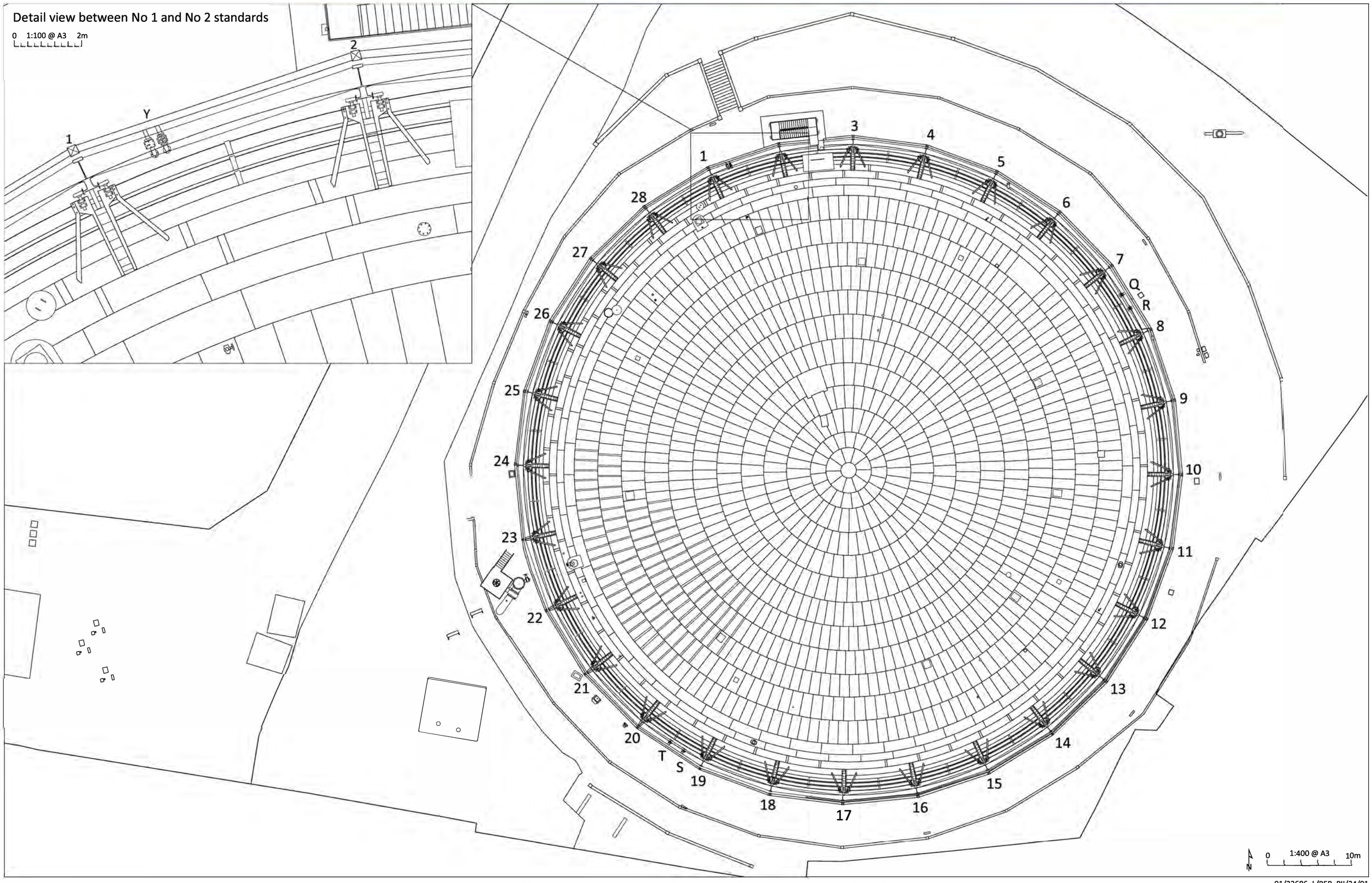


Figure 24: Blackwall Lane, Greenwich, Gasholder No 1, detailed site plan

01/23686_L/REP_PII/24/01

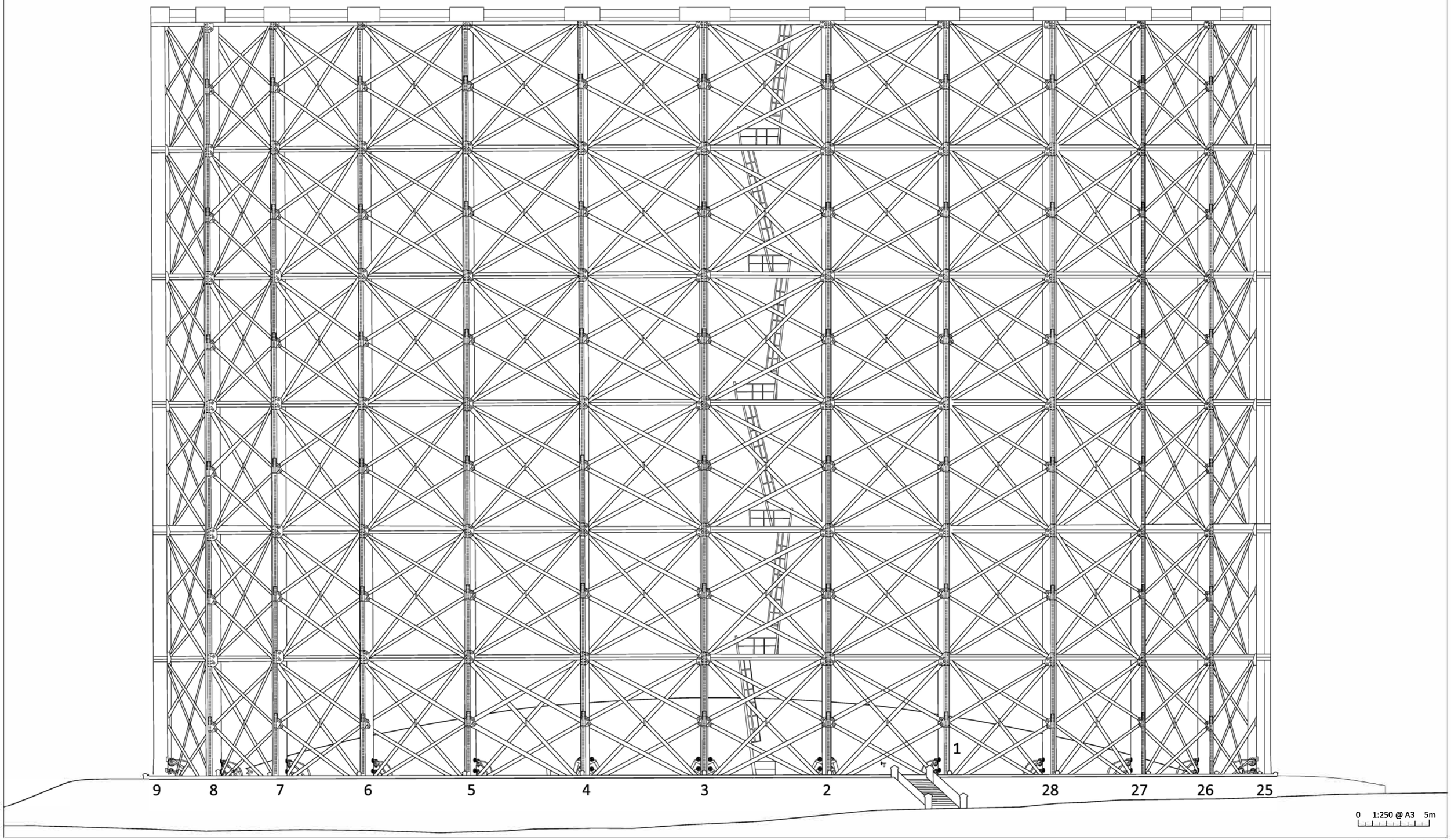


Figure 25: Blackwall Lane, Greenwich, Gasholder No 1, north-facing elevation

01/23686_L/REP_PII/25/01

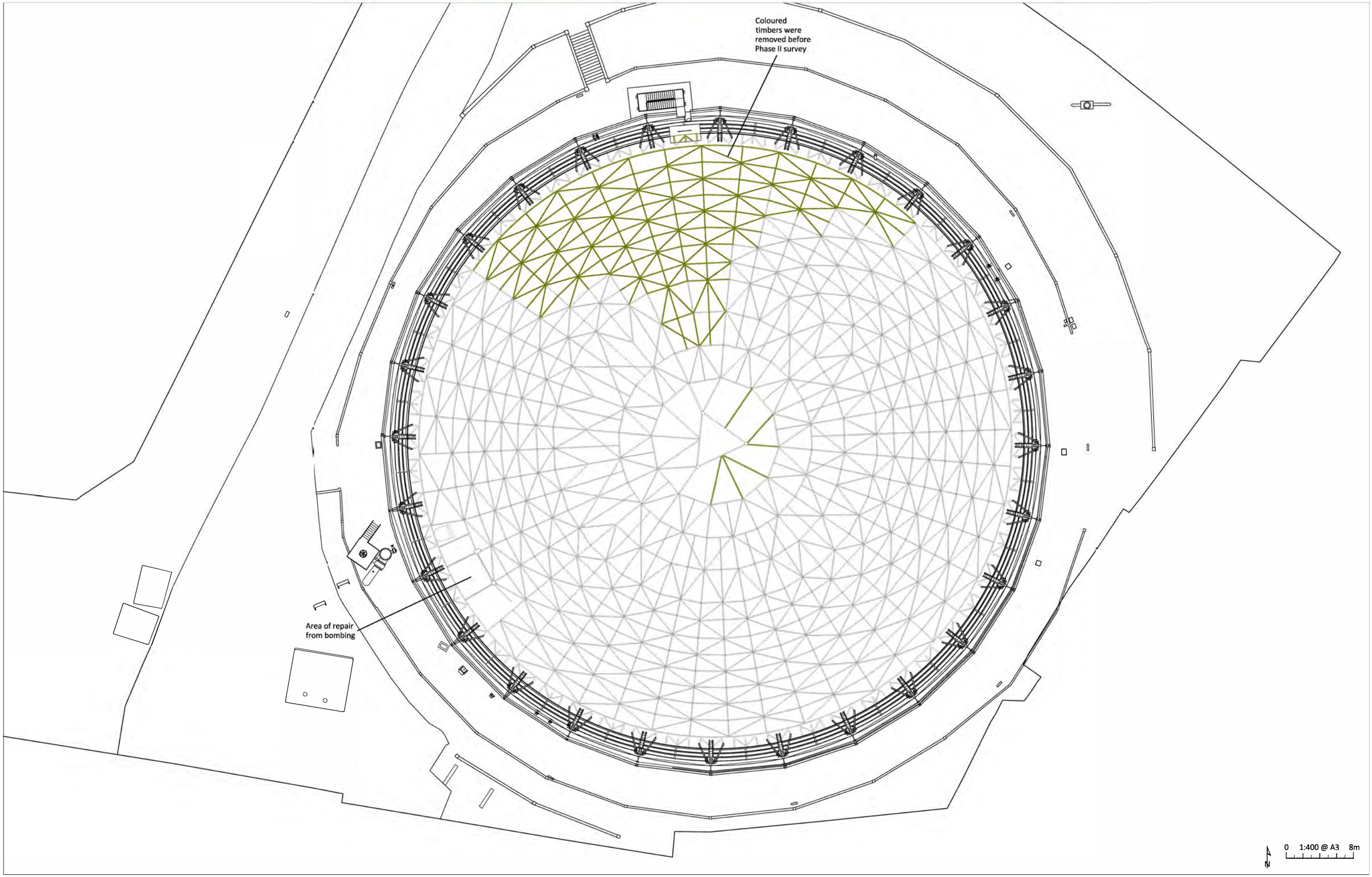
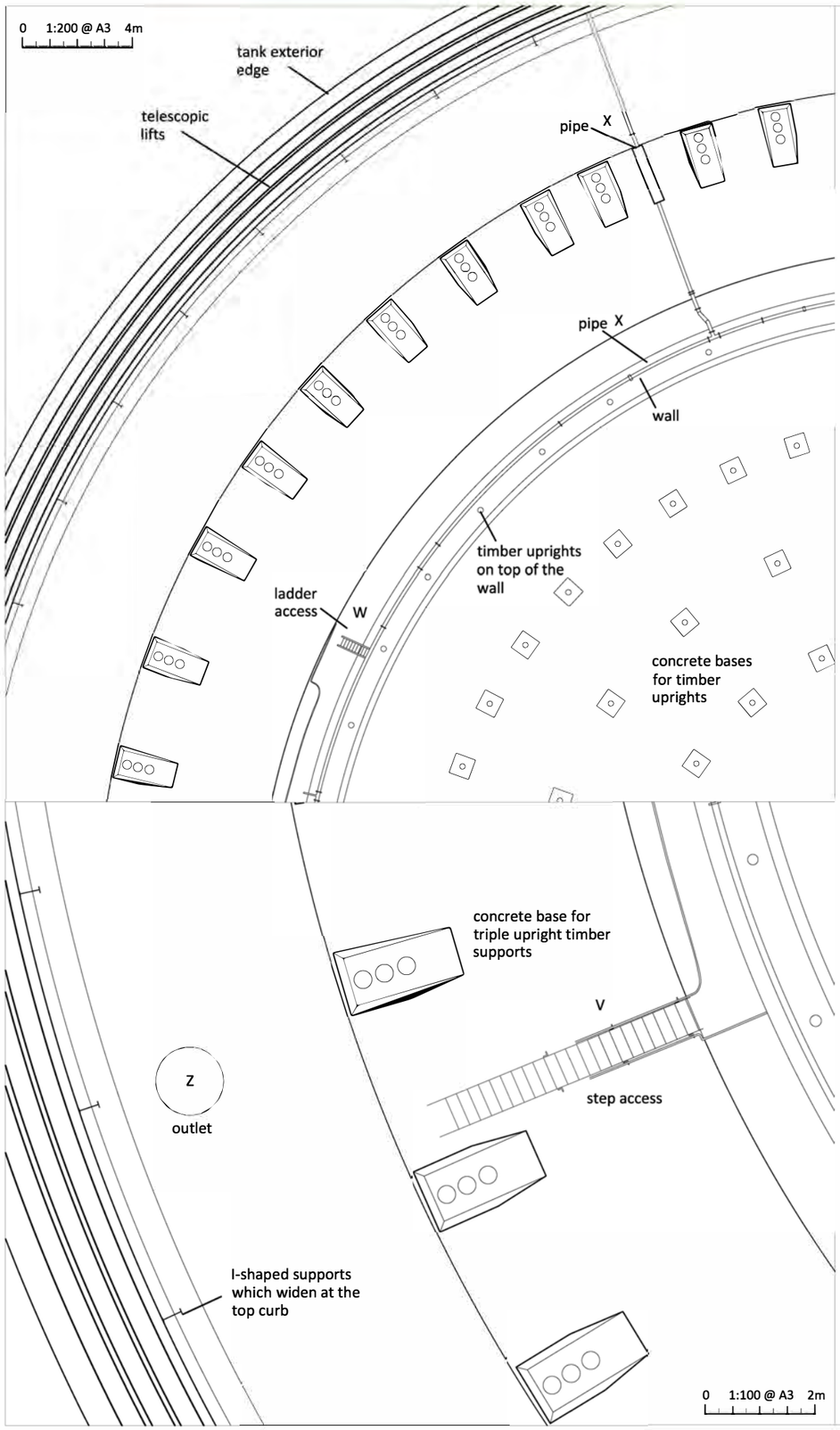


Figure 26: Blackwall Lane, Greenwich, Gasholder No 1, Crown Rest Frame Plan

01/23686_L/REP_PII/26/01



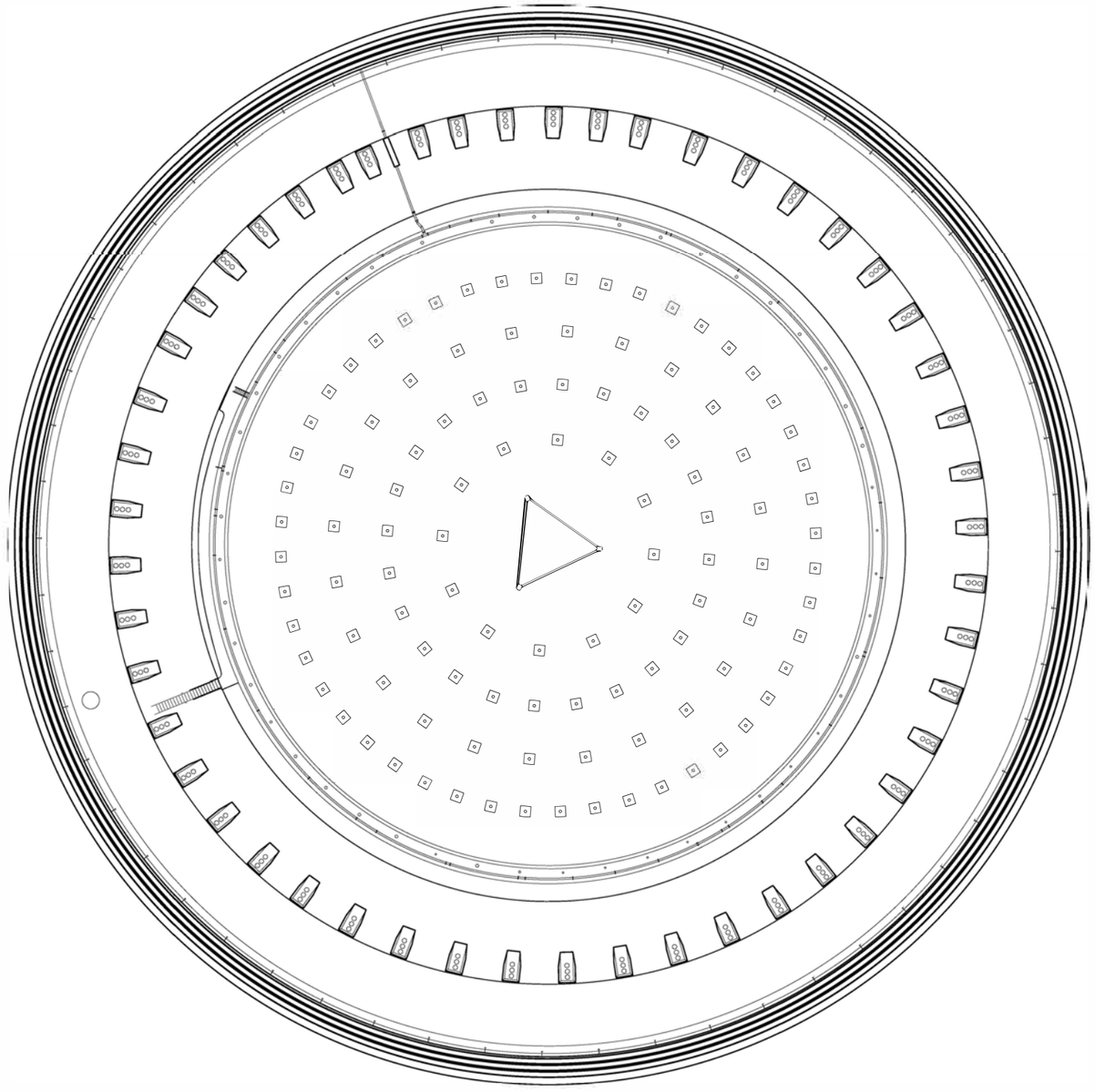
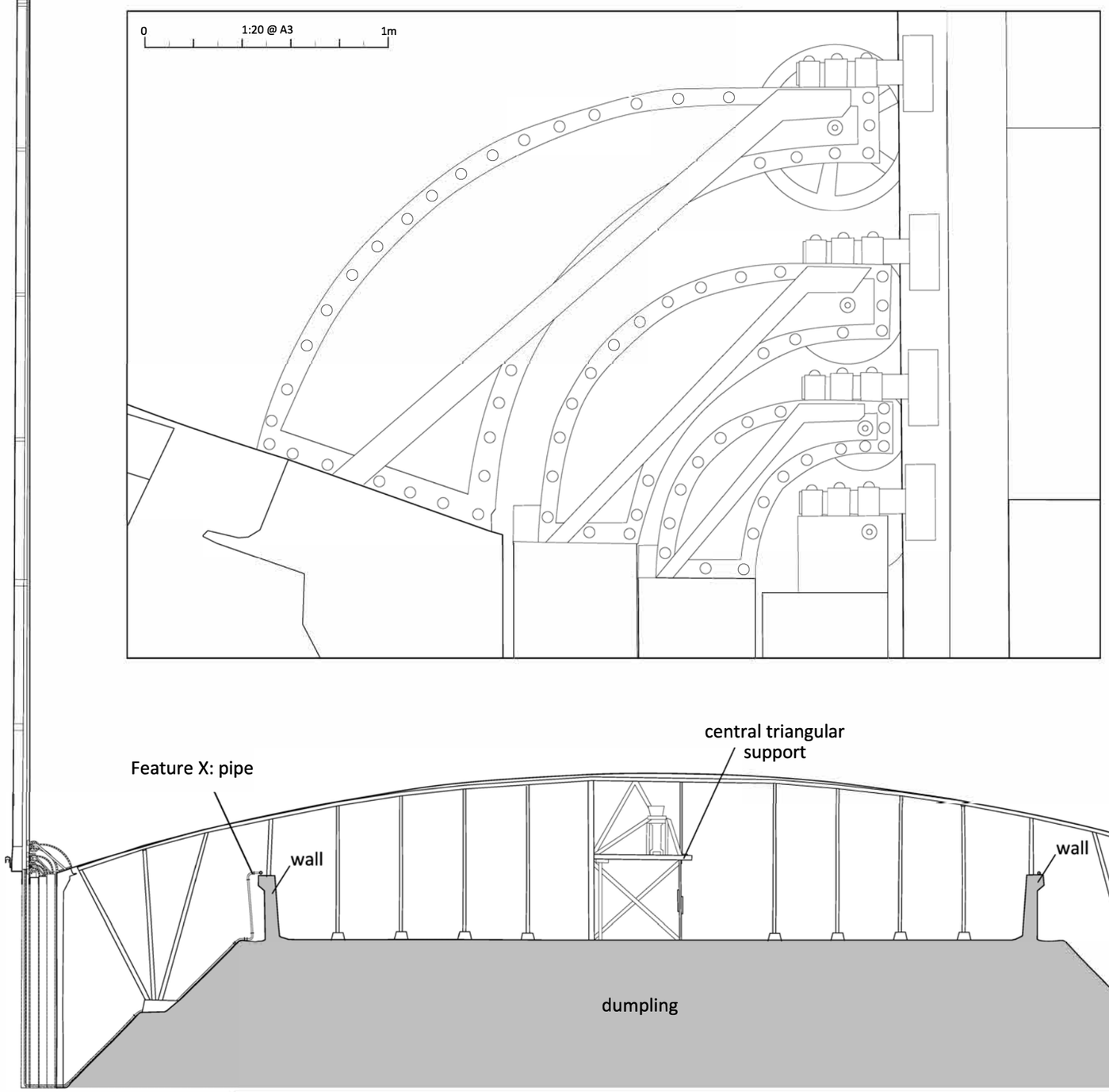
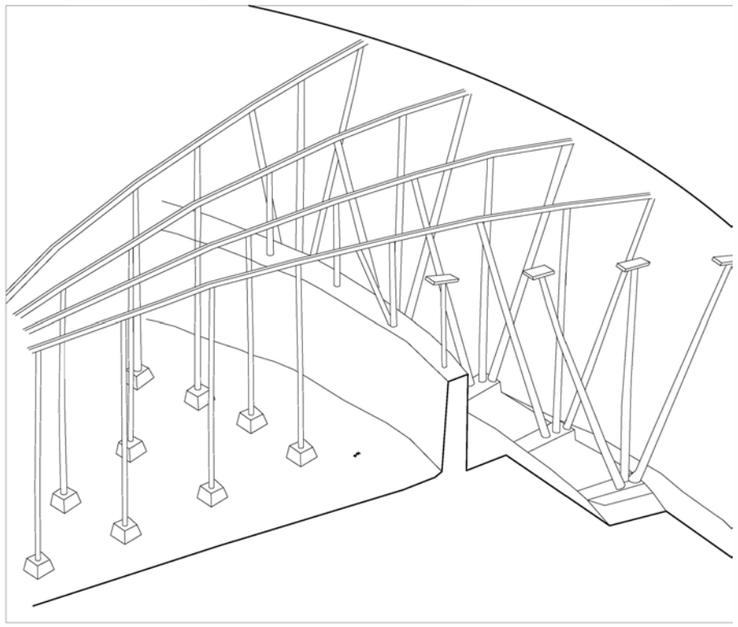


Figure 27: Gasholder No 1, plan of tank base

01/23686L/REP_PII/27/01





Simplified Isometric sketch of wall and uprights alignment on dumpling

0 1:300 @ A3 5m

Figure 28: Gasholder No 1, west-facing section

01/23686_L/REP_PII/28/01

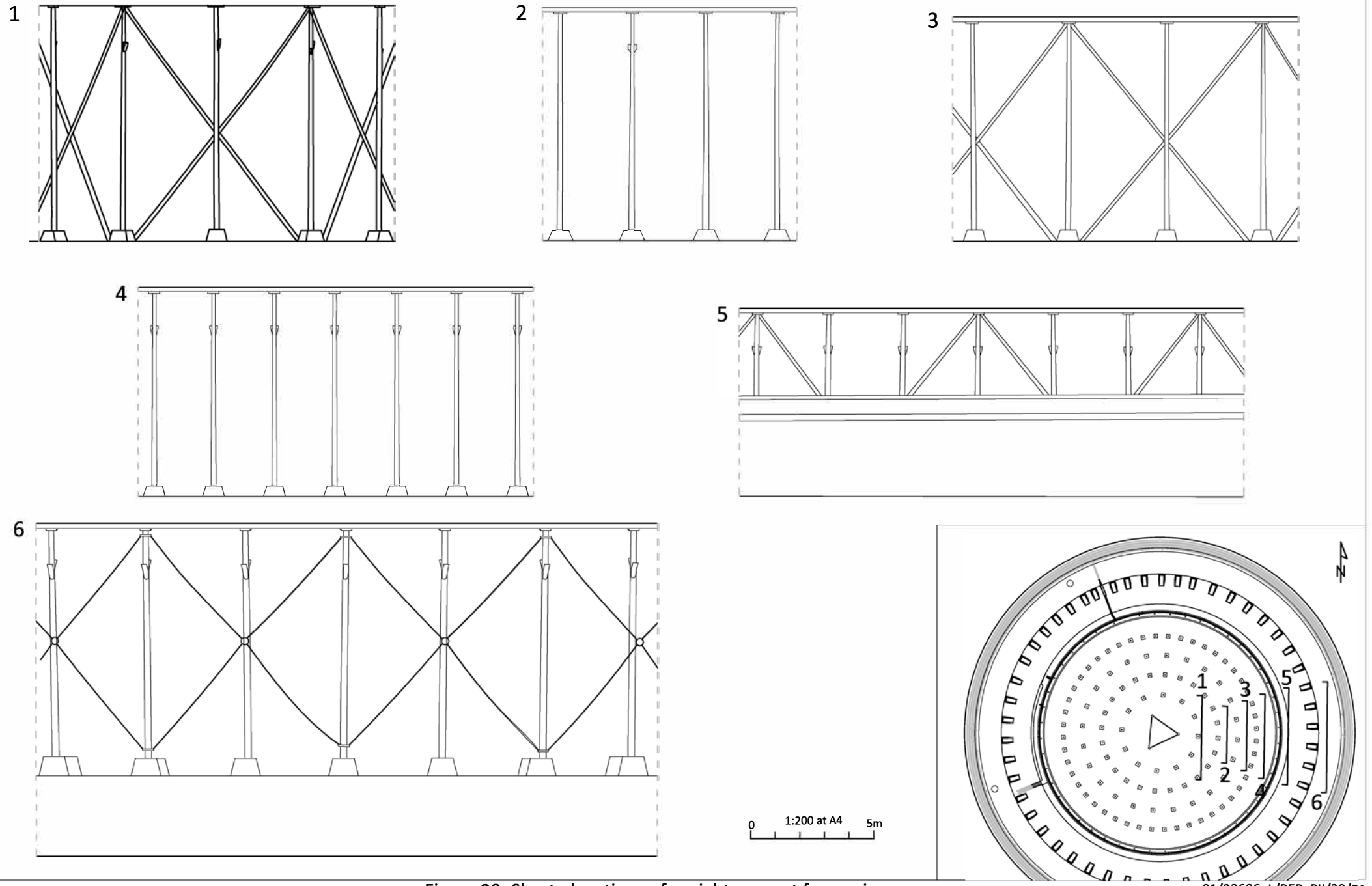


Figure 29: Short elevations of upright support frame rings

01/23686_L/REP_PII/29/01

Plate 1: Gasholder No 1, general view from the north-east

Plate 2: Gasholder No 1, general view from the north-west

Plate 3: Gasholder No 1, general view from the south-west

Plate 4: Gasholder No 1, detail of the frame from the NNE

Plate 5: Gasholder No 1, close detail of the diagonal bracing from the NNE

Plate 6: Gasholder No 1, detail of steps to the north side, from the NNW

Plate 7: Gasholder No 1, detail of No 1 standard from the north

Plate 8: Gasholder No 1, close detail of the inner section of No 1 standard from the east

Plate 9: Gasholder No 1, detail looking up at No 1 standard from the north-west

Plate 10: Gasholder No 1, detail looking up at No 17 standard from the south

Plate 11: Gasholder No 1, detail of the stairs between No 2 and No 3 standards from the west

Plate 12: Gasholder No 1, general view of the crown of the gasholder from the NNW

Plate 13: Gasholder No 1, general view of the crown of the gasholder from the north-east

Plate 14: Gasholder No 1, detail of the guided rollers behind No 1 standard from the ENE

Plate 15: Gasholder No 1, detail of the guided rollers behind No 1 standard, from the WNW

Plate 16: Gasholder No 1, detail of the guided rollers behind No 1 standard, from the NNW

Plate 17: Gasholder No 1, detail of the knock-off switches (Q & R) between No 7 and No 8 standards from the north

Plate 18: Gasholder No 1, detail of the northernmost knock-off switch (Q) between No 7 and No 8 standards from the north-east

Plate 19: Gasholder No 1, detail of the knock-off switch (S) between No 19 and No 20 standards from the SSW

Plate 20: Gas Main, general view from the north-west

Plate 21: Gas Main, detail of the wheel from the west

Plate 22: Gas Main, detail of the gauge from the north-west

Plate 23: Gasholder No 1, general view of the timber support frame visible due to the crown removal, from the south-west

Plate 24: Gasholder No 1, general view of the timber support frame comprised of many short lengths of timber, from the WSW

Plate 25: Gasholder No 1, detail of metal joint between spoke and ring timbers, from the WSW

Plate 26: Gasholder No 1, detail of nailed joint, from the WSW

Plate 27: Gasholder No 1, detail of blocks nailed at the joints to increase stability, from the WSW

Plate 28: Gasholder No 1, detail of metal repair to the crown support frame between standards 21 and 22, from the south-west

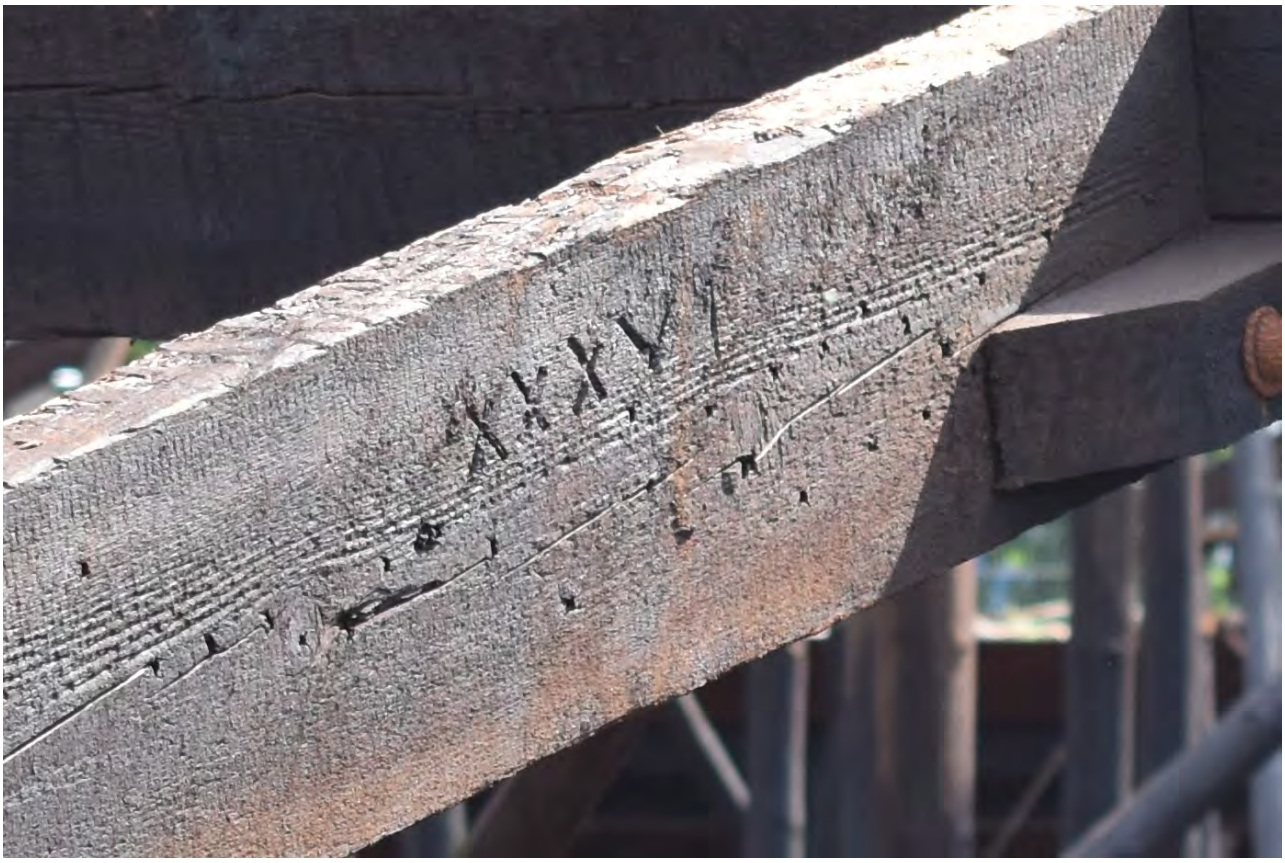


Plate 29: Gasholder No 1, detail of carved roman numeral (XXXVI) on spoke timber suggesting a numbering system was used during construction, from the WSW

Plate 30: Gasholder No 1, general view of diagonal tie-bars secured with tension rings between the timber uprights of the outermost support ring, from the east

Plate 31: Gasholder No 1, general view of concrete block bases for uprights, from the north-east

Plate 32: Gasholder No 1, general view of concrete block bases for uprights, from the north-east

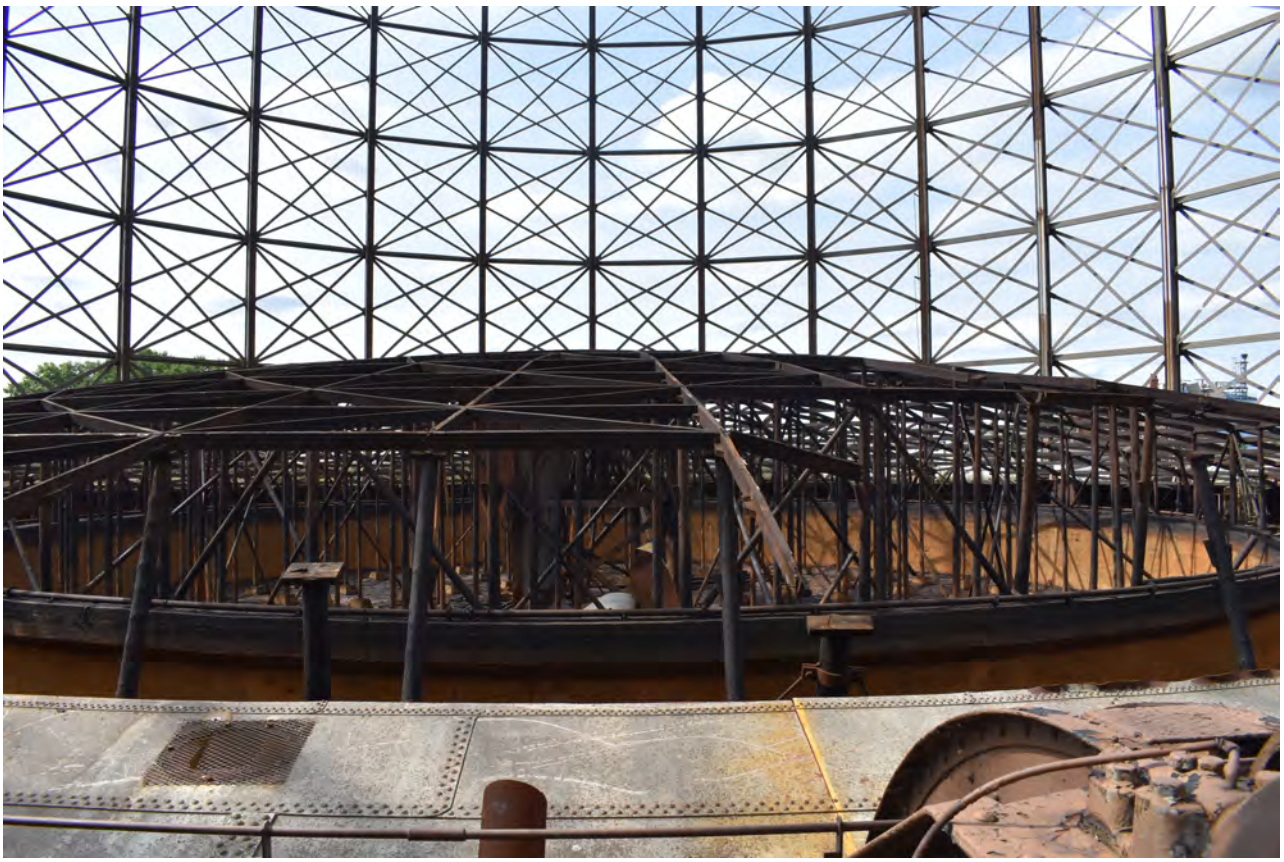


Plate 33: Gasholder No 1, general view of the central wall with uprights set on top, from the NNE

Plate 34: Gasholder No 1, detail view of a square block set on top of each upright to support the timber joint above, and blocks nailed to the side of the uprights for standing on during constructions, from the north

Plate 35: Gasholder No 1, general view of the platform halfway up the dumpling which supports the outermost ring of uprights with three set in each concrete base at this level, from the north-east

Plate 36: Gasholder No 1, general view of the steps leading up the west side of the dumpling, from the WNW

Plate 37: Gasholder No 1, general view of the ladder leading up the dumpling wall, from the ENE

Plate 38: Gasholder No 1, general view of a pipe entering the tank from the north and running up and around the top of the wall in the tank, from the ENE

Plate 39: Gasholder No 1, detail of central triangular support framework, from the NNE

Plate 40: Gasholder No 1, detail of central triangular support framework, from the north

Plate 41: Gasholder No 1, general view of the outlet pipe with Livesey man-lid on the WSW of the gasholder, from the SSW

Plate 42: Gasholder No 1, detail of the cup-and-grip and roller wheel on the base of one of the lifts, not *in situ*

Plate 43: Building A, general view from the west

Plate 44: Building B, general view from the SSW

Plate 45: Manholes Ci, general view from the south

Plate 46: Features D, E & F and their associated pipework to the east of Building B, from the SSE

Plate 47: Building G, general view from the NNE

Plate 48: Hi (Holder Outlet Valve) and Hii (Volumetric Governor Overflow),general view from t he NNW

Plate 49: Features K, L, M & N, general view from the north-east

Plate 50: Building O, general view from the north-west

Plate 51: Pipework P, general view from the north

6 DISCUSSION

6.1 Background to Guide Framed Gasholders in the UK

6.1.1 The industry of creating gas from burning coal was first realised in the 1790s, with the gas initially stored below ground and then in iron tanks immersed in water (HE 2017a). Gasholders first emerged in the UK in the early 19th century associated with mills and (later) factories, a small gasworks providing light and heat for industry. However, as early as the 1810s, German Friedrich Winzer saw the potential of having more centralised gasworks which then disseminated supply to a wider area. He subsequently started the Gas Light and Coke Company in 1812 (Thomas 2014). Soon, larger gasworks appeared in industrial towns and the need for more inventive engineering to store the gas was required, although did not take off substantially until the middle of the 19th century. The first gasholders were rectangular, although the advantages of a circular holder were soon realised, which led to the invention of telescopic gasholders with guide towers in 1824. Innovations in ironwork and structural engineering throughout the early 19th century was a catalyst for developing more efficient and well-engineered gasholders which began with the column-guided gasholders, columns supporting the gasholder tank as it rose and fell. Eventually, guide-framed gasholders became more popular. This involved an extensive framework erected around the gasholder to form an external skeleton either in steel or iron (Thomas 2010; 2014). The superstructure was formed by several upright radial standards, braced with (mostly) diagonal bracing. Throughout the late 19th and early 20th century, the style and type of bracing changed and varied. Gasholder No 1 at Greenwich had relatively complicated bracing, with two systems of diagonal bracing as opposed to single diagonal bracing together with a stiff upper girder to provide robust structural integrity to the outer frame.

6.1.2 The insertion of 'flying lifts' was also fairly common as demand for gas increased with the general increase in the local London population. In 1897, a flying lift was added to Gasholder No 1 due to the poor condition of the bell (Tucker 200b, 157). Two were originally planned, although only one was eventually added by S Cutler & Sons (*ibid*).

6.2 Gasholder No 1 at Greenwich in the Wider Context

6.2.1 After the completion of one of its largest gasholders (No 13) at the nearby Old Kent Road site, the company concentrated new production at the East Greenwich gasworks at Blackwall Lane rather than expand at Old Kent Road as the site due to lack of space with four large gasholders already in place there (Sproat *et al* 2018). Gasholder No 1 was made with four lifts and was the first ever built at the time with six tiers in total, the largest gasholder in the world before it was soon superseded by Gasholder No 2 on the same site in 1892.

6.2.2 The gargantuan size of Gasholder No 1 for the time was due not only to fulfil the needs of the increasing population, but also because of the geology of the site. The 2000 Heritage England study identifies the main issues:

> '*Alluvium and gravel overlie a band of London Clay, below which there are water-bearing strata of the Woolwich and Reading beds. Originally, two tanks, 250 feet across and 60 feet deep were proposed … But during excavation in 1884, the clay was found to be only a thin seam, and the depth of the tank had to be reduced to 45 feet, 13 feet of which was raised in an embankment, to keep clear of the lower qualifier. The second tank was cancelled*.' (Tucker 2000, 155).

Had this not been the case, then the gasholder here at Greenwich would have most likely been similar in technical build to Gasholder No 13 at Old Kent Road. There was still difficulty with the site at East Greenwich as there was a need to cement a ballast beneath the dumpling in the 1920s (Figure 21).

6.2.3 The double diagonal bracing was a necessity given the size of the gasholder in terms of the engineering capabilities of the time, which meant that single diagonal bracing – a common feature of large gasholders of the late 19th century - would not be up for the job (HE 2017b). It was a vast improvement in the structural

integrity of the holder and was an innovative solution to the problem, the bracing weaving in and out of the outer faces of the standards. The guide frame was a cylindrical shell design, something which had been pioneered by George Livesey, Frank Livesey's elder brother at Gasholder No 13 at the Old Kent Road works. Hence it was not unique or a 'first' in this type of construction, but a development of the type.

6.2.4 The gasholder also contains a four-lift telescopic bell, the largest in the world when it was built, although was eclipsed by the now demolished adjacent Gasholder No 2 in 1892 (HE 2017b). It has an untrussed timber crown support frame within its tank with uprights set in concrete blocks situated on a flat-topped, steep-sided dumpling with a circular wall set on the top. There is nothing specifically innovative about the bell, however, other than its size.

6.2.5 Finally, there have been some repairs to the holder in the 20th century after damage in 1917, which caused refurbishments in the 1920s, and repair after damage from the IRA bombing in 1979 (HE 2017b). Whilst the first repairs appear to be minimal, three standards, the bracing between them, the lifts between them and sections of the crown rest frame, were replaced to the west side of the holder after the 1979 attack. This consisted '… *largely* [of] *steel I-beams welded at the joints, which do not closely replicate the original design*.' (*ibid*, 3). The sheeting over the bell was also repaired at the same time. The most recent alterations to the structure include the replacement of the hand rails at the top of the holder (*ibid*).

7 CONCLUSIONS & ADDITIONAL WORKS

7.1 Gasholder No 1 is a typical example of its type, a development of George Livesey's cylindrical shell design, first used at the Old Kent Road gasworks site including his namesake Livesey man-lids situated over the inlet and outlet pipes. However, this holder was plainer in styling and execution in its construction. It was one of the many large gasholders built by the South Metropolitan Gas Company in the late 19th century and, for a brief period of 5 years, was the largest gasholder in the world.

8 REFERENCES

8.1 Bibliographical references

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Montagu Evans 2017b Montagu Evans 2017 *Historic Building Recording Brief for Sites at Park Lane, Worthing; Marsh Lane, Salisbury; St James Road, Carshalton; Bell Green, Sydenham; Old Kent Road, Southwark; Blackwall Lane, Greenwich.* Unpublished Method Statement for SGN.

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http://www.eugris.info/newsdownloads/Gasholders%20and%20their%20tanks.pdf, Accessed 8th March 2018

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Tucker, M 2000b *London Gasholders Survey: Part B* (Section 10). Unpublished gasholder research survey for English Heritage.

8.2 Cartographic references

1873 Ordnance Survey Essex Sheet LXXXI

1899 Ordnance Survey Essex LXXXI.NW

1920 Ordnance Survey London Sheet L

1946 Ordnance Survey London Sheet

APPENDIX 1a: DIGITAL PHOTOGRAPHIC REGISTER

Gasholder No 1

Frame	*Description*	*Taken From*	*Date*
GRE_001	General view of gasholder	N	05/02/2018
GRE_002	General view of gasholder	N	05/02/2018
GRE_003	General view of gasholder	N	05/02/2018
GRE_004	General view of gasholder	N	05/02/2018
GRE_005	General view of gasholder	N	05/02/2018
GRE_006	General view of gasholder	N	05/02/2018
GRE_007	General view of gasholder	N	05/02/2018
GRE_008	General view of gasholder	N	05/02/2018
GRE_009	General view of gasholder	N	05/02/2018
GRE_010	General view of gasholder	N	05/02/2018
GRE_011	General view of gasholder	N	05/02/2018
GRE_012	General view of gasholder	N	05/02/2018
GRE_013	General view of gasholder	N	05/02/2018
GRE_014	General view of gasholder	N	05/02/2018
GRE_015	General view of mall monitoring area to the NW side of the gasholder	NE	05/02/2018
GRE_016	General view of mall monitoring area to the NW side of the gasholder	NE	05/02/2018
GRE_017	General view of mall monitoring area to the NW side of the gasholder	ESE	05/02/2018
GRE_018	General view of mall monitoring area to the NW side of the gasholder	ESE	05/02/2018
GRE_019	General view of mall monitoring area to the NW side of the gasholder	ESE	05/02/2018
GRE_020	Detail of station outlet pressure valves	SE	05/02/2018
GRE_021	Detail of S-most station outlet pressure valve	SE	05/02/2018
GRE_022	Detail of S-most station outlet pressure valve	SE	05/02/2018
GRE_023	Detail of valve in S-most station outlet pressure valve	S	05/02/2018
GRE_024	Detail of valve in S-most station outlet pressure valve	SE	05/02/2018
GRE_025	Detail of fixing tying together the valves	SE	05/02/2018
GRE_026	Detail of station outlet pressure valves	NW	05/02/2018
GRE_027	Detail of low concrete enclosure (b)	SE	05/02/2018
GRE_028	Detail of low concrete enclosure (b)	S	05/02/2018
GRE_029	Detail of cover over underground feature	SE	05/02/2018
GRE_030	Detail of cover over underground feature (c)	NW	05/02/2018
GRE_031	General view of concrete tank and pipework (d)	NNE	05/02/2018
GRE_032	General view of concrete tank and pipework (d)	SE	05/02/2018
GRE_033	Detail of pipework to the SW side of the concrete tank (d)	SE	05/02/2018
GRE_034	Detail of pipework to the SW side of the concrete tank (d)	SE	05/02/2018
GRE_035	Detail of pipework to the SW side of the concrete tank (d)	SE	05/02/2018
GRE_036	Detail of pipework to the SW side of the concrete tank (d)	SE	05/02/2018
GRE_037	Detail of pipework to the SW side of the concrete tank (d)	SE	05/02/2018
GRE_038	Detail of pipework to the SW side of the concrete tank (d)	SW	05/02/2018
GRE_039	Detail of pipework to the SW side of the concrete tank (d)	NW	05/02/2018
GRE_040	Detail of pipework to the SW side of the concrete tank (d)	NW	05/02/2018
GRE_041	Close detail of plaque on the pipework to the SW side of the concrete tank (d)	NW	05/02/2018
GRE_042	General view of steps to the NW side of the gasholder	NW	05/02/2018
GRE_043	General view of steps to the NW side of the gasholder	NW	05/02/2018
GRE_044	General view of No 1 standard	NNW	05/02/2018
GRE_045	General view of No 1 standard	N	05/02/2018
GRE_046	General view of No 1 standard	NW	05/02/2018
GRE_047	Detail of guided rollers behind No 1 standard	ENE	05/02/2018
GRE_048	Head-on detail of the guided rollers (as they face outwards from the gasholder) behind No 1 standard (W side)	NNW	05/02/2018

GRE_049	Head-on detail of the guided rollers (as they face outwards from the gasholder) behind No 1 standard	NNW	05/02/2018
GRE_050	Detail of guided rollers behind No 1 standard	WNW	05/02/2018
GRE_051	Head-on detail of the guided rollers (as they face outwards from the gasholder) behind No 1 standard (E side)	NNW	05/02/2018
GRE_052	Detail to the base of No 1 standard	NNW	05/02/2018
GRE_053	Close detail of the rivets of No 1 standard	NNW	05/02/2018
GRE_054	Detail of the inner section of No 1 standard	E	05/02/2018
GRE_055	Detail looking up at the joints of No 1 standard	N	05/02/2018
GRE_056	Detail looking up at the joints of No 1 standard	NW	05/02/2018
GRE_057	Detail of pipework between No 1 and No 2 standards	NW	05/02/2018
GRE_058	Detail of pipework between No 1 and No 2 standards	NNW	05/02/2018
GRE_059	Detail of pipework between No 1 and No 2 standards	NE	05/02/2018
GRE_060	General view of the crown of the gasholder	NNW	05/02/2018
GRE_061	General view of stair between No 2 and No 3 standards	WNW	05/02/2018
GRE_062	General view of stair between No 2 and No 3 standards	WNW	05/02/2018
GRE_063	General view of stair between No 2 and No 3 standards	W	05/02/2018
GRE_064	General view of stair between No 2 and No 3 standards	NNW	05/02/2018
GRE_065	General view of stair between No 2 and No 3 standards	NNW	05/02/2018
GRE_066	General view of stair between No 2 and No 3 standards (looking up at frame)	NNW	05/02/2018
GRE_067	General view of stair between No 2 and No 3 standards (looking up at frame)	NNW	05/02/2018
GRE_068	General view of the crown of the gasholder	N	05/02/2018
GRE_069	Detail of guided rollers behind No 3 standard	NNE	05/02/2018
GRE_070	Detail of guided rollers behind No 3 standard	NNE	05/02/2018
GRE_071	Detail of small gantry to the immediate W side of No 3 standard	N	05/02/2018
GRE_072	Detail of small gantry to the immediate W side of No 3 standard	NNW	05/02/2018
GRE_073	Detail of guided rollers behind No 2 standard	NE	05/02/2018
GRE_074	Detail to the base of No 2 standard	N	05/02/2018
GRE_075	General view of the rear of the stairs between No 2 and No 3 standard	E	05/02/2018
GRE_076	Detail to the underside of the stairs between No 2 and No 3 standards	NE	05/02/2018
GRE_077	Detail to the underside of the stairs between No 2 and No 3 standards showing the small platform infront of the crown	N	05/02/2018
GRE_078	General view of No 4 standard	NNE	05/02/2018
GRE_079	General view of No 4 standard	NNE	05/02/2018
GRE_080	General view of No 4 standard (looking up)	NNE	05/02/2018
GRE_081	General view of No 4 standard (looking up)	NNE	05/02/2018
GRE_082	Close detail of framework between No 3 and No 4 standards	NNE	05/02/2018
GRE_083	Close detail of base of No 4 standard	NNE	05/02/2018
GRE_084	Close detail of base of No 4 standard	NNE	05/02/2018
GRE_085	Detail of frame and pipework between No 5 and No 6 standard	NW	05/02/2018
GRE_086	General view of No 4 standard and framing between No 4 and No 5 standards	NW	05/02/2018
GRE_087	Detail of lifts between No 4 and No 5 standards including detail of guided roller behind No 5 standard	WNW	05/02/2018
GRE_088	Detail of small pipe to the foot of the crown of the gasholder between No 4 and No 5 standard	NNE	05/02/2018
GRE_089	General view of the crown of the gasholder	NNE	05/02/2018
GRE_090	General view of the crown of the gasholder	N	05/02/2018
GRE_091	General view of the crown of the gasholder	N	05/02/2018
GRE_092	General view of the crown of the gasholder	N	05/02/2018
GRE_093	General view of the crown of the gasholder	N	05/02/2018
GRE_094	General view of the crown of the gasholder	NNE	05/02/2018
GRE_095	General view of the crown of the gasholder (at the foot including the pipe)	N	05/02/2018
GRE_096	General view of the crown of the gasholder	NE	05/02/2018
GRE_097	General view of the crown of the gasholder	NE	05/02/2018
GRE_098	General view of the frame of the gasholder	NNE	05/02/2018

GRE_099	General view of the frame of the gasholder	NNE	05/02/2018
GRE_100	General view of the frame of the gasholder	NNE	05/02/2018
GRE_101	General view of the frame of the gasholder	NNE	05/02/2018
GRE_102	General view of the frame of the gasholder	N	05/02/2018
GRE_103	General view of the frame of the gasholder	N	05/02/2018
GRE_104	General view of the crown of the gasholder	N	05/02/2018
GRE_105	General view of the crown of the gasholder (at the foot including the pipe)	N	05/02/2018
GRE_106	Detail of guided roller behind No 6 standard	E	05/02/2018
GRE_107	General view of the crown of the gasholder	NE	05/02/2018
GRE_108	Close detail of small pipe in the crow of the gasholder	NE	05/02/2018
GRE_109	Detail of pipework between No 5 and No 6 standard	NE	05/02/2018
GRE_110	General view of No 6 standard	E	05/02/2018
GRE_111	General view of No 6 standard	E	05/02/2018
GRE_112	General view of No 6 standard	E	05/02/2018
GRE_113	General view of No 6 standard (looking up at frame)	E	05/02/2018
GRE_114	General view of No 6 standard (looking up at frame)	E	05/02/2018
GRE_115	General view of No 6 standard (looking up at frame)	E	05/02/2018
GRE_116	General view of No 6 standard (top)	E	05/02/2018
GRE_117	General view of No 7 standard	N	05/02/2018
GRE_118	General view of No 7 and No 8 standards, including detail of knock-off switch between them	N	05/02/2018
GRE_119	Detail of knock-off switches between No 7 and No 8 standard	N	05/02/2018
GRE_120	Detail of knock off switch between No 7 and No 8 standard	NE	05/02/2018
GRE_121	Detail of knock off switches between No 7 and No 8 standard	SE	05/02/2018
GRE_122	Detail of knock off switches between No 7 and No 8 standard	NE	05/02/2018
GRE_123	Close detail of N-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_124	Close detail of N-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_125	Close detail of N-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_126	Close detail of N-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_127	Close detail of N-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_128	Close detail of S-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_129	Close detail of S-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_130	Close detail of S-most knock-off switch No 7 and No 8 standard	NE	05/02/2018
GRE_131	General view of No 8 standard	NNW	05/02/2018
GRE_132	General view of No 8 standard	N	05/02/2018
GRE_133	General view of No 8 standard	E	05/02/2018
GRE_134	General view of No 9 and No 10 standard	SSE	05/02/2018
GRE_135	General view of No 11 standard	SSE	05/02/2018
GRE_136	General view of No 12 standard	NE	05/02/2018
GRE_137	General view of No 13 standard	NE	05/02/2018
GRE_138	Detail of pipe between No 13 and No 14 standards	S	05/02/2018
GRE_139	General view of small box in front of No 14 standard	SE	05/02/2018
GRE_140	General view of small box in front of No 14 standard	SE	05/02/2018
GRE_141	Detail of small box in front of No 14 standard	SW	05/02/2018
GRE_142	Close detail of small box in front of No 14 standard	SW	05/02/2018
GRE_143	Detail of farm over the outside of the tank between No 14 and No 15 standard	SE	05/02/2018
GRE_144	Detail of farm over the outside of the tank between No 14 and No 15 standard	SW	05/02/2018
GRE_145	Close detail of breaker box opposite the frame over the outside of the tank between No 14 and No 15 standard	NW	05/02/2018
GRE_146	General view of No 15 standard	E	05/02/2018
GRE_147	Close detail of pipe between No 15 and No 16 standards	SSE	05/02/2018
GRE_148	General view of No 16 standard	SE	05/02/2018
GRE_149	General view between No 15 and No 16 standards	SSE	05/02/2018
GRE_150	Detail of wires and electric work between No 16 and No 17 standards	SW	05/02/2018
GRE_151	Detail of wires and electric work between No 16 and No 17 standards	SSE	05/02/2018

GRE_152	Detail of electrics between No 16 and No 17 standards	SSE	05/02/2018
GRE_153	Detail looking up at electric wire support between No 16 and No 17 standards	SSE	05/02/2018
GRE_154	Close detail of electrical fittings between No 16 and No 17 standards	SSE	05/02/2018
GRE_155	Detail of top of tank and railings between No 16 and No 17 standards	SW	05/02/2018
GRE_156	Detail of top of tank and railings between No 16 and No 17 standards	SW	05/02/2018
GRE_157	General view of No 17 standards and the framing between No 17 and No 18 standards	SSE	05/02/2018
GRE_158	General view looking up at No 17 standard	S	05/02/2018
GRE_159	Detail of base of framing to the immediate W side f No 17 standard showing riveting and concrete base	S	05/02/2018
GRE_160	Detail of base of framing to the immediate W side f No 17 standard showing riveting and concrete base	S	05/02/2018
GRE_161	General view of No 18 standard	SSE	05/02/2018
GRE_162	General view between No 19 and No 20 standards		05/02/2018
GRE_163	Detail of knock-off switch between No 19 and No 20 standards	SSW	05/02/2018
GRE_164	Detail of knock-off switch between No 19 and No 20 standards	SW	05/02/2018
GRE_165	Detail of knock-off switch between No 19 and No 20 standards	SSW	05/02/2018
GRE_166	Detail of knock-off switch between No 19 and No 20 standards	SSW	05/02/2018
GRE_167	Detail of knock-off switch between No 19 and No 20 standards	SSW	05/02/2018
GRE_168	Detail of knock-off switch between No 19 and No 20 standards	WSW	05/02/2018
GRE_169	General view between No 20 and No 21 standards	S	05/02/2018
GRE_170	Detail of small electric box in front of No 20 standard	SW	05/02/2018
GRE_171	Detail of small electric box in front of No 20 standard	ESE	05/02/2018
GRE_172	Detail of small electric box in front of No 20 standard	SW	05/02/2018
GRE_173	Detail of small electric box in front of No 20 standard	SW	05/02/2018
GRE_174	Detail of small electric box in front of No 20 standard	ESE	05/02/2018
GRE_175	Detail of small electric box in front of No 20 standard	ESE	05/02/2018
GRE_176	Detail of small electric box to the immediate SE side of No 21 standard	SW	05/02/2018
GRE_177	Detail of small electric box to the immediate SE side of No 21 standard	SE	05/02/2018
GRE_178	Detail of small electric box to the immediate SE side of No 21 standard	SW	05/02/2018
GRE_179	Detail of small electric box to the immediate SE side of No 21 standard	SW	05/02/2018
GRE_180	Detail of small electric box to the immediate SE side of No 21 standard	SW	05/02/2018
GRE_181	Detail of small electric box to the immediate SE side of No 21 standard	S	05/02/2018
GRE_182	General view of No 21 standard	SW	05/02/2018
GRE_183	General view looking up at No 21 standard	S	05/02/2018
GRE_184	Detail of pipework in front of No 21 standard	SW	05/02/2018
GRE_185	Detail of pipework in front of No 21 standard	SW	05/02/2018
GRE_186	Detail of pipework in front of No 21 standard	SW	05/02/2018
GRE_187	Detail of panel to electric box infront of No 21 standard	SW	05/02/2018
GRE_188	General view of pipework in front of No 21 standard	WSW	05/02/2018
GRE_189	Detail of pipework in front of No 21 standard	NW	05/02/2018
GRE_190	Detail of pipework in front of No 21 standard	W	05/02/2018
GRE_191	Detail of knock-off switch between No 21 and 22 standards	S	05/02/2018
GRE_192	Detail of knock-off switch between No 21 and 22 standards	SW	05/02/2018
GRE_193	Detail of knock-off switch between No 21 and 22 standards	SW	05/02/2018
GRE_194	Detail of knock-off switch between No 21 and 22 standards	SW	05/02/2018
GRE_195	Detail of knock-off switch between No 21 and 22 standards	SW	05/02/2018
GRE_196	General view of the crown of the gasholder	SW	05/02/2018
GRE_197	General view of the crown of the gasholder	SW	05/02/2018
GRE_198	Detail of knock-off switch to the immediate S of No 22 standard	SW	05/02/2018
GRE_199	Detail of knock-off switch to the immediate S of No 22 standard	SW	05/02/2018
GRE_200	Detail of knock-off switch to the immediate S of No 22 standard	SW	05/02/2018
GRE_201	Detail of knock-off switch to the immediate S of No 22 standard	SW	05/02/2018
GRE_202	General view of No 22 standard	SSW	05/02/2018
GRE_203	General view of No 22 standard	SSW	05/02/2018

GRE_204	General view of No 22 standard (looking up at framework)	SSW	05/02/2018
GRE_205	General view of No 22 standard	SSW	05/02/2018
GRE_206	General view of No 22 standard (looking up at framework)	SSW	05/02/2018
GRE_207	General view of No 22 standard (looking up at framework)	SSW	05/02/2018
GRE_208	Detail of side of No 22 standard	SE	05/02/2018
GRE_209	Detail of side of No 22 standard	S	05/02/2018
GRE_210	Detail of base of No 22 standard	SE	05/02/2018
GRE_211	Detail of base of No 22 standard	NW	05/02/2018
GRE_212	General view of area of pipework to the SW side of the gasholder in front of No 22 standard	SE	05/02/2018
GRE_213	General view of area of pipework to the SW side of the gasholder in front of No 22 standard	SE	05/02/2018
GRE_214	General view of area of pipework to the SW side of the gasholder in front of No 22 standard	SE	05/02/2018
GRE_215	General view of area of pipework to the SW side of the gasholder in front of No 22 standard	SE	05/02/2018
GRE_216	General view of area of pipework to the SW side of the gasholder in front of No 22 standard	SE	05/02/2018
GRE_217	Detail of gauge to the NE side of the pipework to the SW side of the gasholder	SE	05/02/2018
GRE_218	Detail of gauge to the NE side of the pipework to the SW side of the gasholder	SE	05/02/2018
GRE_219	Detail of gauge to the NE side of the pipework to the SW side of the gasholder	SE	05/02/2018
GRE_220	Detail of gauge to the NE side of the pipework to the SW side of the gasholder	SE	05/02/2018
GRE_221	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	SE	05/02/2018
GRE_222	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_223	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	N	05/02/2018
GRE_224	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_225	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018
GRE_226	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018
GRE_227	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	W	05/02/2018
GRE_228	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	W	05/02/2018
GRE_229	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	W	05/02/2018
GRE_230	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	N	05/02/2018
GRE_231	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_232	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	W	05/02/2018
GRE_233	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	N	05/02/2018
GRE_234	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	WSW	05/02/2018
GRE_235	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_236	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_237	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018

GRE_238	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018
GRE_239	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018
GRE_240	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_241	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_242	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NW	05/02/2018
GRE_243	Detail of large area of pipework to the WSW side of the gasholder in front of No 23 standard	NE	05/02/2018
GRE_244	General view of outbuilding to the SW side of the gasholder and the gauges in front	N	05/02/2018
GRE_245	Detail of gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_246	Detail of gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	SSE	05/02/2018
GRE_247	Detail at the foot of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_248	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_249	Detail of '39' sign in front of the large area of pipework to the WSW side of the gasholder	NW	05/02/2018
GRE_250	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_251	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_252	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_253	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_254	Detail of the gauge nearest the gasholder in front of the outbuilding to the SW side of the gasholder	NNW	05/02/2018
GRE_255	General view of No 213 and No 24 standards and the framing between	W	05/02/2018
GRE_256	General view of the crown of the gasholder	W	05/02/2018
GRE_257	Detail at the foot of No 24 standard showing small brick feature	SW	05/02/2018
GRE_258	Detail to the S side of No 24 standard	SW	05/02/2018
GRE_259	Detail of small brick feature in front of No 24 standard	SW	05/02/2018
GRE_260	Detail of small brick feature in front of No 24 standard	SW	05/02/2018
GRE_261	General view of No 25 and No 26 standards and the framing between	WNW	05/02/2018
GRE_262	General view of No 25 and No 26 standards and the framing between	WNW	05/02/2018
GRE_263	General view of No 25 and No 26 standards and the framing between	WNW	05/02/2018
GRE_264	Detail of guide rollers behind No 26 standard	SW	05/02/2018
GRE_265	General view of the crown of the gasholder	WNW	05/02/2018
GRE_266	General view of No 26 and No 27 standard and the framing between	WNW	05/02/2018
GRE_267	Detail of Pipework P		05/02/2018
GRE_268	Detail of Pipework P		05/02/2018
GRE_269	Detail of Pipework P		05/02/2018
GRE_270	Detail of Pipework P		05/02/2018
GRE_271	Detail of Pipework P		05/02/2018
GRE_272	General view of No 28 and No 1 standards	NW	05/02/2018
GRE_273	General view of Building O	SW	05/02/2018
GRE_274	General view of Building O	SE	05/02/2018
GRE_275	General view of Building O	NW	05/02/2018
GRE_276	General view of Building O	NE	05/02/2018

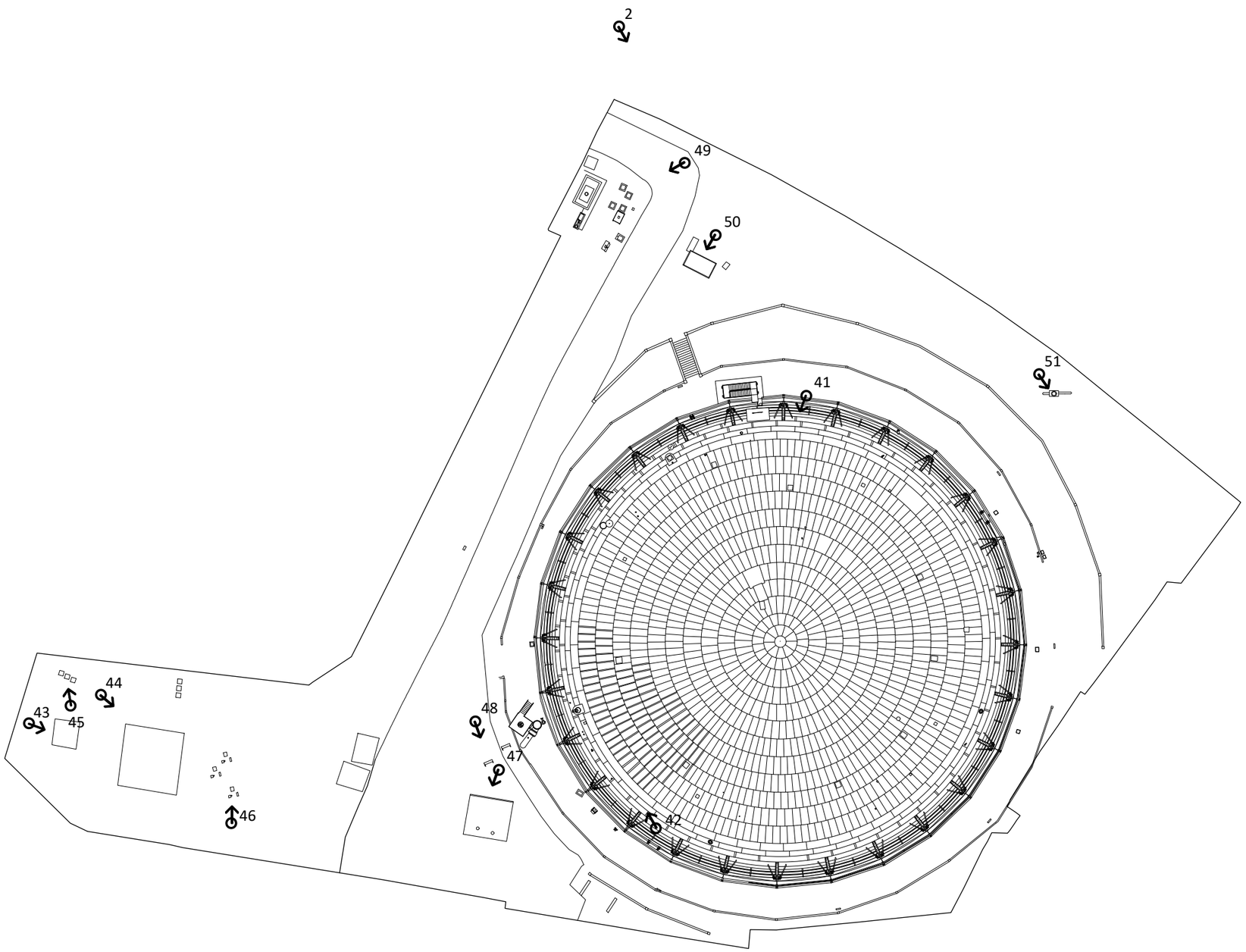
GRE_277	Detail of Jet Booster Flow Transmitter (J) to the W side of the gasholder	WSW	05/02/2018
GRE_278	Detail of Jet Booster Flow Transmitter (J) to the W side of the gasholder	NE	05/02/2018
GRE_279	Detail of Jet Booster Flow Transmitter (J) to the W side of the gasholder	NW	05/02/2018
GRE_280	Detail of Jet Booster Flow Transmitter (J) to the W side of the gasholder	SE	05/02/2018
GRE_281	Detail of Jet Booster Flow Transmitter (J) to the W side of the gasholder	NNE	05/02/2018
GRE_282	General view of Building B	SSW	05/02/2018
GRE_283	General view of Building B	NE	05/02/2018
GRE_284	General view of Building B	ESE	05/02/2018
GRE_285	General view of Building B	WNW	05/02/2018
GRE_286	General view of Building B	NW	05/02/2018
GRE_287	General view of Building A	SSW	05/02/2018
GRE_288	General view of Building A	WNW	05/02/2018
GRE_289	General view of Building A	NNE	05/02/2018
GRE_290	General view of Building A	WSW	05/02/2018
GRE_291	Detail of three manhole covers (Ci) to the far NW corner of the compound, to the N of Building A	SSW	05/02/2018
GRE_292	General view of pipework and booster valves D, E & F to the E side of Building B	S	05/02/2018
GRE_293	General view of pipework and booster valves D, E & F to the E side of Building B	SSW	05/02/2018
GRE_294	General view of pipework and booster valves D, E & F to the E side of Building B	SSE	05/02/2018
GRE_295	Detail of Jet Booster Valve (F) and associated pipework	W	05/02/2018
GRE_296	Detail of rear of Jet Booster Valve (F)	N	05/02/2018
GRE_297	Detail of rear of Jet Booster Valve (F)	N	05/02/2018
GRE_298	Detail of Entrainment Valve (Dii) and associated pipework (Di)	W	05/02/2018
GRE_299	Detail of pipework (Di)	SW	05/02/2018
GRE_300	Detail of pipework (Di)	S	05/02/2018
GRE_301	Detail of pipework (Di)	SW	05/02/2018
GRE_302	Detail of Entrainment Valve (Dii)	W	05/02/2018
GRE_303	Detail of Entrainment Valve (Dii) and associated pipework (Di)	E	05/02/2018
GRE_304	Detail of Entrainment Valve (Dii) and associated pipework (Di)	E	05/02/2018
GRE_305	General view of pipework and booster valves D, E & F to the E side of Building B	NNW	05/02/2018
GRE_306	Detail of Jet Booster Valve (E)	S	05/02/2018
GRE_307	Detail of Jet Booster Valve (E)	S	05/02/2018
GRE_308	Detail of Jet Booster Valve (E)	S	05/02/2018
GRE_309	Detail of Jet Booster Valve (E)	S	05/02/2018
GRE_310	Detail of Jet Booster Valve (E)	S	05/02/2018
GRE_311	Detail of rear of Jet Booster Valve (E) and associated pipework	N	05/02/2018
GRE_312	Detail of pipework associated with Jet Booster Valve (E)	SE	05/02/2018
GRE_313	Detail of pipework associated with Jet Booster Valve (E)	W	05/02/2018
GRE_314	Detail of pipework to the N side of the E elevation of Building G	E	05/02/2018
GRE_315	General view of the E elevation of Building G	E	05/02/2018
GRE_316	General view of the S elevation of Building G	SSW	05/02/2018
GRE_317	General view of Building G	SW	05/02/2018
GRE_318	Detail of door to the E side in small annexe to the S side of Building G	E	05/02/2018
GRE_319	General view of the E elevation of Building G	NNE	05/02/2018
GRE_320	General view of the W elevation of Building G	NNW	05/02/2018
GRE_321	General view of the E elevation of Building G	NNE	05/02/2018
GRE_322	General view of the E elevation of Building G	NNE	05/02/2018
GRE_323	Detail of pipework to the S side of the E elevation of Building G	E	05/02/2018
GRE_324	General view of Building G	W	05/02/2018
GRE_325	General view of Building G	WNW	05/02/2018
GRE_326	General view of the Holder Outlet Valve (Hi)	NNW	05/02/2018

GRE_327	Detail of the Holder Outlet Valve (Hi)	NNW	05/02/2018
GRE_328	Detail of the Volumetric Governor Flow Valve (Hii)	NNW	05/02/2018
GRE_329	General view of the rear of valves Hi and Hii	SSE	05/02/2018
GRE_330	General view of valves H and Building G	NNW	05/02/2018
GRE_331	Detail looking at pipework to the fence to the W side of Building G	E	05/02/2018
GRE_332	Detail looking at pipework to the fence to the W side of Building G	E	05/02/2018
GRE_333	General view of gasholder	WSW	05/02/2018
GRE_334	General view of gasholder	WSW	05/02/2018
GRE_335	General view of gasholder	W	05/02/2018
GRE_336	General view of gasholder	W	05/02/2018
GRE_337	General view of gasholder	W	05/02/2018
GRE_338	General view of gasholder	WSW	05/02/2018
GRE_339	General view of gasholder	WSW	05/02/2018
GRE_340	General view of gasholder	W	05/02/2018
GRE_341	General view of gasholder	WNW	05/02/2018
GRE_342	General view of gasholder	WNW	05/02/2018
GRE_343	General view of gasholder	W	05/02/2018
GRE_344	General view of gasholder	N	05/02/2018
GRE_345	General view of gasholder	N	05/02/2018
GRE_346	General view of gasholder	N	05/02/2018
GRE_347	General view of gasholder	N	05/02/2018
GRE_348	General view of gasholder	NNW	05/02/2018
GRE_349	General view of gasholder	NNW	05/02/2018
GRE_350	General view of gasholder	NNW	05/02/2018
GRE_351	General view of gasholder	NNW	05/02/2018
GRE_352	General view of gasholder	NNW	05/02/2018
GRE_353	General view of gasholder	NNW	05/02/2018
GRE_354	General view of gasholder	N	05/02/2018
GRE_355	General view of gasholder	N	05/02/2018
GRE_356	General view of gasholder	N	05/02/2018
GRE_357	General view of gasholder	N	05/02/2018
GRE_358	General view of gasholder	NNW	05/02/2018
GRE_359	General view of gasholder	NNW	05/02/2018
GRE_360	General view of gasholder	NNW	05/02/2018
GRE_361	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_362	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_363	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_364	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_365	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_366	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_367	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_368	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_369	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_370	General view of gasholder (looking up at the top of the frame)	NNW	05/02/2018
GRE_371	General view of the gasholder in its setting taken from the other side of the Millennium Way	E	05/02/2018
GRE_372	General view of the gasholder in its setting taken from the other side of the Millennium Way	E	05/02/2018
GRE_373	General view of the gasholder in its setting taken from the other side of the Millennium Way	E	05/02/2018
GRE_374	General view of the gasholder in its setting taken from the other side of the Millennium Way	N	05/02/2018
GRE_375	General view of the gasholder in its setting taken from the other side of the Millennium Way	N	05/02/2018
GRE_376	General view of the gasholder in its setting taken from the other side of the	N	05/02/2018

	Millennium Way		
GRE_377	General view of the gasholder in its setting taken from the other side of the Millennium Way	NNW	05/02/2018
GRE_378	General view of the gasholder in its setting taken from the other side of the Millennium Way	NNW	05/02/2018
GRE_379	General view of the gasholder in its setting taken from the other side of the Millennium Way	NNW	05/02/2018
GRE_380	General view of the gasholder in its setting taken from the other side of the Millennium Way	NNW	05/02/2018
GRE_381	General view of crown support structure from access platform between standards 23 and 24	W	08/07/2019
GRE_382	General view of crown support structure from access platform between standards 23 and 24	NW	08/07/2019
GRE_383	General view of crown support structure from access platform between standards 23 and 24	SW	08/07/2019
GRE_384	General view of crown support structure from access platform between standards 23 and 24	SW	08/07/2019
GRE_385	General view of crown support structure from access platform between standards 23 and 24	W	08/07/2019
GRE_386	General view of crown support structure from access platform between standards 23 and 24	NW	08/07/2019
GRE_387	General view of crown support structure from access platform between standards 23 and 24	NW	08/07/2019
GRE_388	General view of crown support structure from access platform between standards 23 and 24	SW	08/07/2019
GRE_389	General view of crown support structure from access platform between standards 23 and 24	NW	08/07/2019
GRE_390	Detail of iron tie and jointing above upright timber	SW	08/07/2019
GRE_391	General view of dumpling and inner wall from access platform between standards 23 and 24	SW	08/07/2019
GRE_392	Detail of jointing between rafter and diagonal and lateral purlins, from access platform between standards 23 and 24	W	08/07/2019
GRE_393	Detail of pipe on top of inner wall	W	08/07/2019
GRE_394	Detail of jointing between rafter and diagonal and lateral purlins, from access platform between standards 23 and 24	W	08/07/2019
GRE_395	General view of crown support structure from access platform between standards 23 and 24	W	08/07/2019
GRE_396	Detail of jointing between rafter and lateral purlins, from access platform between standards 23 and 24	W	08/07/2019
GRE_397	View of dumpling and internal access steps, from access platform between standards 23 and 24	NW	08/07/2019
GRE_398	Detail of timber 'wedges' on upright timber beam, from access platform between standards 23 and 24	W	08/07/2019
GRE_399	General view towards central support structure, from access platform between standards 23 and 24	W	08/07/2019
GRE_400	Detail of numbering (XXXVI) on rafter, from access platform between standards 23 and 24	SW	08/07/2019
GRE_401	Detail of jointing between rafter and lateral purlins, from access platform between standards 23 and 24	SW	08/07/2019
GRE_402	General view of from access platform between standards 23 and 24	SW	08/07/2019
GRE_403	General view of crown support structure from platform above gas main valve	W	08/07/2019
GRE_404	General view of crown support structure from platform above gas main valve	W	08/07/2019
GRE_405	General view of crown support structure from platform above gas main valve	NW	08/07/2019
GRE_406	General view of crown support structure from platform above gas main valve	NW	08/07/2019
GRE_407	General view of gas main valve	SE	08/07/2019

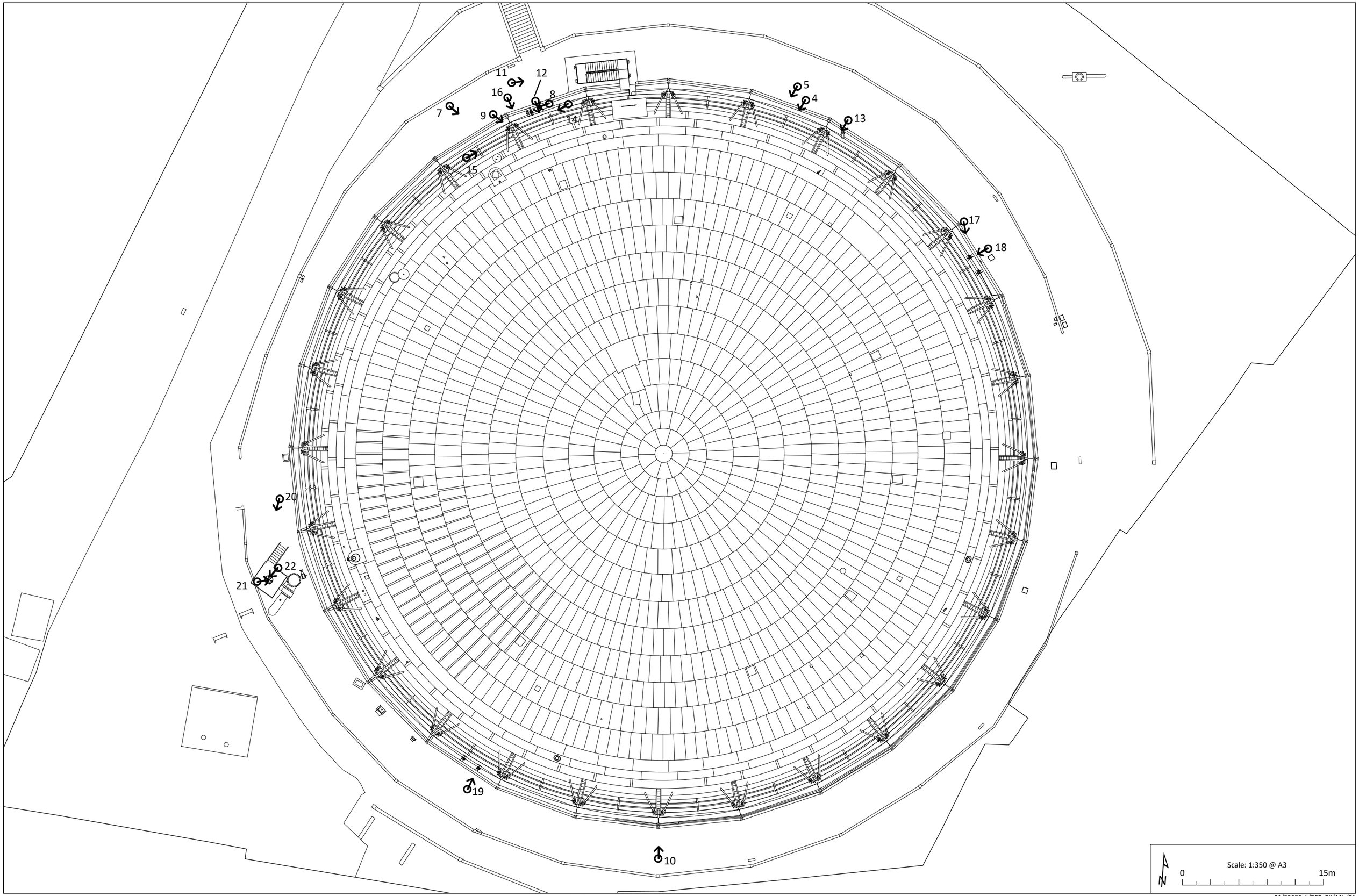
GRE_408	View of repair to crown support structure after 1979 fire damage, between standards 21 and 22	SW	08/07/2019
GRE_409	Detail of steel angle bar used to repair to crown support structure after 1979 fire damage, between standards 21 and 22	SW	08/07/2019
GRE_410	Detail of steel angle bar used to repair to crown support structure after 1979 fire damage, between standards 21 and 22	W	08/07/2019
GRE_411	General view of crown support structure from standard 20	S	08/07/2019
GRE_412	Detail of tank below valve on top of crown near to gas main	SE	08/07/2019
GRE_413	Detail of tank below valve on top of crown near to gas main	SE	08/07/2019
GRE_414	General view of crown support structure, between standards 19 and 20	SW	08/07/2019
GRE_415	General view of crown support structure from standard 18	S	08/07/2019
GRE_416	General view of crown support structure, between standards 17 and 18	S	08/07/2019
GRE_417	General view of crown support structure from standard 17	SE	08/07/2019
GRE_418	General view of crown support structure, between standards 16 and 17	S	08/07/2019
GRE_419	General view of crown support structure from standard 15	S	08/07/2019
GRE_420	General view of crown support structure, with city in background	E	08/07/2019
GRE_421	General view of crown support structure, between standards 14 and 15	SE	08/07/2019
GRE_422	Detail of jointing between rafter and lateral and diagonal purlins on top of beam supported with iron tie	SE	08/07/2019
GRE_423	Detail of jointing between rafter and lateral and diagonal purlins	SE	08/07/2019
GRE_424	Detail of iron pipe on top of inner wall	SE	08/07/2019
GRE_425	General view of crown support structure from standard 13	SE	08/07/2019
GRE_426	General view of crown support structure, between standards 12 and 13	SE	08/07/2019
GRE_427	Detail of jointing between rafter and lateral and diagonal purlins on top of beam supported with iron tie, between standards 12 and 13	SE	08/07/2019
GRE_428	General view of crown support structure from standard 11	SE	08/07/2019
GRE_429	General view of crown support structure, between standards 10 and 11	E	08/07/2019
GRE_430	General view of crown support structure, between standards 10 and 11	E	08/07/2019
GRE_431	General view of crown support structure from standard 11	E	08/07/2019
GRE_432	General view of crown support structure between standards 10 and 11, showing area collapsed during removal of crown	E	08/07/2019
GRE_433	General view of crown support structure, between standards 10 and 11	S	08/07/2019
GRE_434	Detail of upright timbers and concrete bases on top of dumpling	E	08/07/2019
GRE_435	General view of crown support structure from standard 8	E	08/07/2019
GRE_436	General view of crown support structure, between standards 7 and 8	NE	08/07/2019
GRE_437	General view of crown support structure, between standards 5 and 6 (guide frame cross-members removed)	E	08/07/2019
GRE_438	General view of crown support structure, between standards 5 and 6	NE	08/07/2019
GRE_439	Detail of exposed iron tie at end of rafter	NE	08/07/2019
GRE_440	Detail of large outlet(?) pipe at the northern edge of the chamber (near standard 3)	E	08/07/2019
GRE_441	Detail of pipe up to and surrounding the top of inner wall	E	08/07/2019
GRE_442	Detail of large outlet(?) pipe at the northern edge of the chamber (near standard 3)	E	08/07/2019
GRE_443	Detail of upright timber, between standards 5 and 6	NE	08/07/2019
GRE_444	General view of crown support structure from standard 4	N	08/07/2019
GRE_445	General view of crown support structure, between standards 4 and 5	N	08/07/2019
GRE_446	Detail of central crown support truss	N	08/07/2019
GRE_447	Detail of central crown support truss	N	08/07/2019
GRE_448	General view of crown support structure from standard 4	N	08/07/2019
GRE_449	General view of crown support structure, between standards 3 and 4	N	08/07/2019
GRE_450	Detail of iron tie support	N	08/07/2019

GRE_451	Detail of rafter and purlin base nailed to the top of upright member in crown support structure	N	08/07/2019
GRE_452	Detail of dumpling and internal access steps	E	08/07/2019
GRE_453	Detail of central crown support truss	N	08/07/2019
GRE_454	General view of crown support structure from standard 20	N	08/07/2019
GRE_455	Detail of central crown support truss	N	08/07/2019
GRE_456	Detail of dumpling and internal pipework	N	08/07/2019
GRE_457	General view of dumpling and internal wall	E	08/07/2019
GRE_458	General view of crown support structure and top of dumpling	NE	08/07/2019
GRE_459	Detail of central crown support truss	N	08/07/2019
GRE_460	General view of dumpling and internal wall	E	08/07/2019
GRE_461	General view of crown support structure from standard 1	NW	08/07/2019
GRE_462	General view of collapsed area	NW	08/07/2019
GRE_463	General view of collapsed area	NW	08/07/2019
GRE_464	General view of crown support structure from standard 1	NW	08/07/2019
GRE_465	General view of crown support structure, between standards 2 and 3	N	08/07/2019
GRE_466	View of removed crown support timbers	N	08/07/2019
GRE_467	Detail of jointing at ends of crown support structure timbers	N/A	08/07/2019
GRE_468	Detail of jointing at ends of crown support structure timbers	N/A	08/07/2019
GRE_469	Detail of jointing at ends of crown support structure timbers	N/A	08/07/2019
GRE_470	General view of crown support structure from standard 27	NW	08/07/2019
GRE_471	Detail of jointing between rafter and diagonal and lateral purlins	NW	08/07/2019
GRE_472	General view of crown support structure from standard 22	SW	08/07/2019
GRE_473	General view of crown support structure from standard 22	SW	08/07/2019
GRE_474	General view of crown support structure from platform above gas main valve	W	08/07/2019
GRE_475	General view of crown support structure from platform above gas main valve	SW	08/07/2019
GRE_476	General view of crown support structure from platform above gas main valve	W	08/07/2019
GRE_477	General view of crown support structure from platform above gas main valve	W	08/07/2019
GRE_478	Gasholder No 1, General view of the platform halfway up the dumpling which supports the outermost ring of uprights with three set in each concrete base at this level	NE	28/08/19
GRE_479	Gasholder No 1, General view of the steps leading up the west side of the dumpling	WNW	28/08/19
GRE_480	Gasholder No 1, General view of the ladder leading up the dumpling wall	ENE	28/08/19



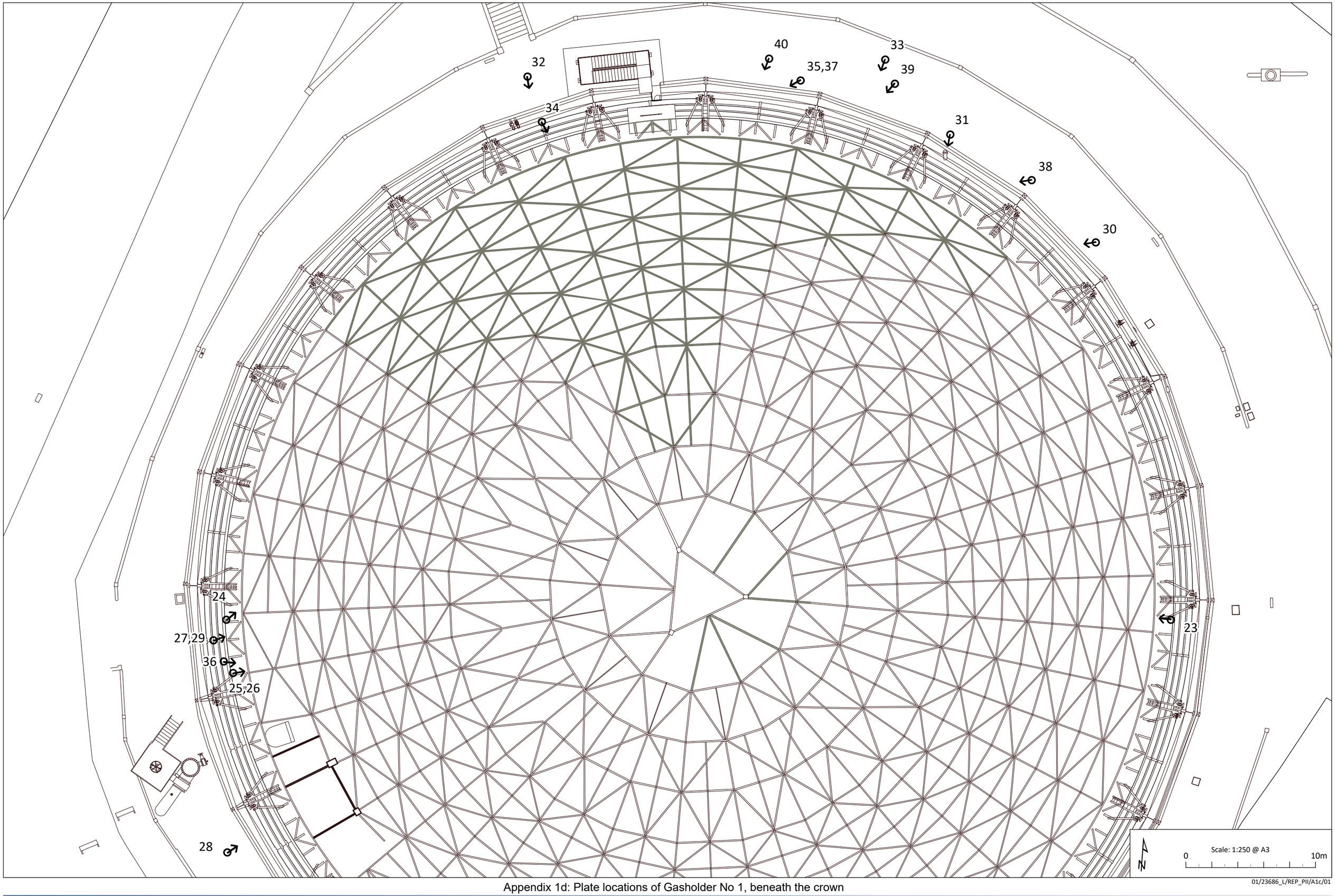
Appendix 1b: Plate locations of Gasholder No 1, wider area and surrounding structures

01/23686_L/REP_PII/A1a/01



Appendix 1c: Plate locations of Gasholder No 1, before any demolition works

01/23686_L/REP_PII/A1b/01



Appendix 1d: Plate locations of Gasholder No 1, beneath the crown

01/23686_L/REP_PII/A1c/01

APPENDIX 2a: RECORDS HELD BY THE NATIONAL GAS ARCHIVE

Ref	*Record*	*Date*	*Description*
5326	South Metropolitan Gas Company - general description of the East Greenwich works of the company,12th November 1925. Grey pamphlet	1925	Unknown
5333	Visit of the Institution of Gas Engineers to East Greenwich Works, Wed May 30th and Thu May 31st, 1956	1956	Unknown
G11_EGW_5327	South Metropolitan Gas Company - visit of members of the Society of the Chemical Industry to the East Greenwich works, 15 July 1931	1931	None
G11_EGW_5328	Description of the Metro-Coalite Works of the South Metropolitan Gas Company at East Greenwich note: produced for the visit of the Institution of Gas Engineers for the 69th Annual General Meeting, 7-9 June 1932	1932	None
G11_EGW_5330	Inauguration by HRH the Duke of Gloucester of the Coke Oven Plant, East Greenwich Gas Works on Thursday 7th December 1950	1950	None
G11_EGW_5334	Visit of the London and Southern Junior Gas Association to the East Greenwich Works of the South Eastern Gas Board, Wednesday 7th April 1965	1965	None
G11_EGW_5335	The New Works of the South Metropolitan Gas Company at East Greenwich note: photocopy taken from the Journal of Gas Lighting, 5 Jan 1886	1886	None
G11_EGW_5336	Description of the East Greenwich Works note: small dark blue pamphlet	n.d.	None
G11_EGW_5337	Description of the East Greenwich Gas Works note: A5 beige pamphlet	n.d.	None
G11_EGW_5338	South Metropolitan Gas Company Description of the East Greenwich Works note: A5 pale blue pamphlet	n.d.	None
G11_EGW_5339	South Metropolitan Gas Company Description of the Metro-Coalite Works at East	1933	None

	Greenwich		
G11_EGW_5340	East Greenwich Works note: South Eastern Gas Board pamphlet. Turquoise cover	n.d.	None
G11_EGW_5341	South Eastern Gas Board Description of the Extensions to Plant Under Construction at East Greenwich Works	n.d.	None
G11_EGW_5342	East Greenwich Works South Eastern Gas Board	n.d.	None
G11_EGW_5343	Town Gas Plant for the South Eastern Gas Board at East Greenwich note: contains site specifications	n.d.	None
G11_EGW_5344	East Greenwich, Phoenix Wharf Chemical Works - new sulphate of ammonia and sulphuric acid plants of the South Eastern Gas Board	n.d.	None
GJ/1903_82/891	East Greenwich, South Metropolitan GC - history, description	1903	East Greenwich, South Metropolitan GC - history, description
GJ/1910_112/104	East Greenwich, South Metropolitan GC - description, photographs	1910	East Greenwich, South Metropolitan GC - description, photographs
GJ/1910_112/204	East Greenwich, South Metropolitan GC - description, photographs	1910	East Greenwich, South Metropolitan GC - description, photographs
GJ/1926_176/301	HM Fuel Research Station, adjacent to Greenwich gasworks - description of visit to station, photographs	1926	HM Fuel Research Station, adjacent to Greenwich gasworks - description of visit to station, photographs
GJ/1927_177/203	East Greenwich gasworks, South Metropolitan GC - correction note re article p 146, vol 177	1927	East Greenwich gasworks, South Metropolitan GC - correction note re article p 146, vol 177
GJ/1931_193/104	East Greenwich gasworks - description of visit	1931	East Greenwich gasworks - description of visit
NT/NTG/AAQ/E/F/21/72	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
NT/NTG/AAQ/E/F/21/73	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
NT/NTG/AAQ/E/F/21/74	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
NT/NTG/AAQ/E/F/21/75	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
NT/NTG/AAQ/E/F/21/76	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
NT/NTG/AAQ/E/F/21/77	Miscellaneous North Thames - East Greenwich - Aerial View	n.d.	None
SE/SEG/AAQ/DA/E/E/3/26	Plan Of East Greenwich Works	1940	detailed plan showing holders, circular structures and buildings

SE/SEG/ME/AQ/E/B/6	Report On East Greenwich Works For The Metropolitan Division	1949	Inc area map, site plans, flow diagram and description of site
SE/SEG/ME/EGR/E/B/1	Report On East Greenwich Works For Met. Division	1950	Includes map of area, site plan, gas flow diagram, full description of works and plant, photographs etc.
SE/SEG/ME/EGR/E/E/1A	East Greenwich- Plan Of Works	1953	East Greenwich Works-Blackwall Lane -plan showing holders, booster house, governor house,mains,detailed paln of valves.
SE/SEG/ME/EGR/E/E/1B	East Greenwich- Site Plan Of Works	1956	Site plan of East Greenwich works showing drainage, holders with capacities, treatment plant, retort house, coal store, storage tanks, tar storage tanks,prifiers,tar well, outbuildings,
SE/SEG/ME/EGR/E/E/2A	East Greenwich- Plan Of Works	1965	East Greenwich Works- plan showing holders with capacities, booster houses, mains, coke holders, pressure controlling valves.
SE/SEG/ME/EGR/E/E/2B	East Greenwich- Site Plan Of Works	1961	Site plan of part of East Greenwich works for planning application for new boiler plant, showing holders, water tower.
SE/SEG/ME/EGR/E/E/3	East Greenwich- Plan Of Works	1955	East Greenwich Works - plan showing holder, governor house,substation,mains,boosters,general arrangement of fans and station governors.
SE/SEG/ME/EGR/E/E/4	East Greenwich- Plan Of Works	1963	East Greenwich Works-plan showing general arrangement of fans and station governors,holders,condensate collecting pit.
SE/SEG/ME/EGR/E/E/5	East Greenwich- Plan Of Works	1963	East Greenwich Works - plan showing holders ,outlet pit, water cooler, governor house,main,sub station.
SE/SEG/ME/EGR/E/E/6	East Greenwich- Plan Of Works	1964	East Greenwich Works - plan showing holders with capacities, coke ovens, reforming plant,mains,butane plant,boosters,proposed service.
SE/SEG/ME/EGR/E/E/7	East Greenwich- Plan Of Works	n.d.	East Greenwich Works - plan showing main, orifice plate carrier.
SE/SEG/ME/EGR/E/F/3/1	East Greenwich: Coalite Bunker: Fitting roof elements	Jul-1954	Crane lifting curved RH RC roof beam into position
SE/SEG/ME/EGR/E/F/3/2	East Greenwich: Coalite Bunker: Fitting roof elements	Jul-1954	Crane lifting curved LH RC roof beam into position
SE/SEG/ME/EGR/E/F/3/3	East Greenwich: Coalite Bunker: Fitting roof elements	Jul-1954	Crane lifting crown plate linking beams into position
SE/SEG/ME/EGR/E/F/3/4	East Greenwich: Coalite Bunker: Interior view of bunker	Jul-1954	Interior view of roof beams of partially completed bunker
SE/SEG/ME/EGR/E/F/3/5	East Greenwich: Coalite Bunker: Hoist	Jul-1954	Ground level view of hoist carrying RC roof 'tiles'
SE/SEG/ME/EGR/E/F/3/6	East Greenwich: Coalite Bunker: Hoist	Jul-1954	Roof level view of hoist carrying RC roof 'tiles'
SE/SEG/ME/EGR/E/F/3/7	East Greenwich: Coalite Bunker: Roof covering	Jul-1954	Roof level view of trolley/hoist fitting roofing felt over complete 'tile' section
SE/SEG/ME/EGR/E/F/3/8	East Greenwich: Coalite Bunker: Base of roof beam	Jul-1954	Detail of base end of roof beam
SE/SEG/ME/EGR/E/F/3/9	East Greenwich: Coalite Bunker: Jack/roller	Jul-1954	detail: mechanical jack/roller
SE/SEG/ME/EGR/E/F/3/10	East Greenwich: Coalite Bunker: Hydraulic machine	Jul-1954	Device with hydraulic cylinder (possibly tensioning reinforcement)

SE/SEG/ME/EGR/E/F/4/1	East Greenwich: Ovens 1-44 and 45-88 from ram side	n.d.	Coke Ovens 1-44 and 45-88; Ram side; '4 men on each machine on ovens 1-44 doors had to be sealed. 3 men on each machine on ovens 45-88 self-sealing doors.'
SE/SEG/ME/EGR/E/F/4/2	East Greenwich: Charging machine on top of battery of ovens	n.d.	Top of the Coke Ovens. The charging machine is being loaded with coal from the service bunker.
SE/SEG/ME/EGR/E/F/5/1	East Greenwich: Aerial Photograph	circa 1965	Aerial view of Greenwich peninsula from slightly east of north
SE/SEG/ME/EGR/E/F/5/2	East Greenwich: Aerial Photograph	circa 1965	Aerial view of East Greenwich works from slightly east of north
SE/SEG/ME/EGR/E/F/5/3	East Greenwich: Aerial Photograph	circa 1965	Aerial view across East Greenwich works from north east
SE/SEG/ME/EGR/E/F/5/4	East Greenwich: Aerial Photograph	circa 1965	Close up aerial view of Stage 3 with bunker in background; plus London Electricity Board at LH side of stage 3
SE/SEG/ME/EGR/E/F/5/5	East Greenwich: Aerial Photograph	circa 1965	Close up aerial view of Stages 4 / 2 / 6 in Coalite
SE/SOM/E/B/18	Specification For Retort House At East Greenwich	1883, 1893	Also specification for steam pumping engine.
SE/SOM/E/E/2	East Greenwich- Plan Of Works	1881	East Greenwich Works, Blackwall Lane. Plan showing holders with capacity, plant and buildings.
SE/SOM/E/F/1	One Volume Of B/W Photographs Of Plant And Buildings At East Greenwich	1924 - 1926	Including Wharf Wall, Hydraulic Condensers, Coke grading plant, riveting shop (1924 - 1926).
SE/SOM/E/F/3	Photograph Album	1927 -1929	Retort settings, dry dock, new reservoir, purifiers, washers etc at East Greenwich. [Loose leaves from volume - covers missing].
SE/SOM/E/F/4	Photograph Album	1930 -1936	Retort settings, plant and buildings inc tar tank, wharf etc.at East Greenwich. [Loose leaves from volume - covers missing].
SE/SOM/E/F/5	Large Volume Of Photographs	1927 - 1940	Retort settings, coke plant, exhauster house, holders etc. at East Greenwich and Old Kent Road; also bomb damage c.1940, ARP shelters etc.
SE/SOM/E/F/9	East Greenwich Photograph Album	1929 - 1931	Detailing the construction of a Coalite plant from initial site clearance to installation of plant, delivery of a coal dryer and general site views (b/w; 88 items). Covers missing.
SE/SOM/E/F/13	Photograph Of Holder Tank Foundations At East Greenwich	n.d.	(b/w). [g02042]
SE/SOM/E/F/15	Photograph Album Of East Greenwich Coke Ovens	1947 - 1949	Including excavation, construction etc.
SE/SOM/E/F/16	Photograph Album Of Plant And Buildings At Old Kent Rd And East Greenwich	n.d.	Includes barges and locomotives, railway sidings, condensers, holders, boilers, women workers in laboratory, workshops and showrooms.
SE/SOM/SMI/E/B/7A	East Greenwich- Plan Of Works	1902	East Greenwich, plan shows numerous streets, holders ,greenwich marshes.
SE/SOM/SMI/E/B/7B	East Greenwich- Plan Of Works	1902	East Greenwich, plan shows numerous streets, holders, greenwich marshes.
SE/SOM/SMI/E/B/12	East Greenwich- Plan Of Works	1913	East Greenwich Works-plan showing oil tank, boundary fence at Angersteins Wharf.
SE/SOM/SMI/E/B/13	East Greenwich- Plan Of Works	n.d.	East Greenwich Works-Horn Lane, boundary of land Angerstein.

SE/SOM/SMI/E/B/15	East Greenwich- Plan Of Works	1918	East Greenwich Works-Tunnel Avenue, plan shows holders with capacities, coal store, retort houses, oil plant, tar well, proposed extensions and out buildings.
SE/SOM/SMI/E/B/16	East Greenwich- Plan Of Works	1918	East Greenwich Works-Tunnel Avenue, plan shows holders with capacities, coal store, retort houses, oil plant, tar well, proposed extensions and out buildings.
SE/SOM/SMI/E/B/25	East Greenwich- Plan Of Works	1937	East Greenwich Works - plan showing holders, fuel research station, coal ground, retort house, coal store, sulphate store, acid plant.
SE/SOM/SMI/E/B/26	East Greenwich- Plan Of Works	1937	East Greenwich Works - Tunnel Avenue, plan showing holder, tar well, coal store, retort house, oxide shed.
TIGE/1955_105/1073	The post-war development of East Greenwich works.	01/06/1956	None
TIGE/1955_105/1136	Presentation, Discussion and Reply; The post-war development of East Greenwich works.	01/06/1956	None
TJGA/1912_3/L31	Report of Visit To The East Greenwich Works of the South Metropolitan Gas Company.	1912	Bound in Transactions of the London & Southern District Junior Gas Association-Tenth Session - 1912-13 Page 31. Visit hosted by F J Bywater, Engineer East Greenwich gas-works, SMGC. Patron, L&SDJGA. ; Description of works.

APPENDIX 2b: RECORDS FROM SGN SITES

(SOURCED BY MARTIN BAILEY OF SGN, NOT FORMALLY STORED)

Ref	*Record*	*Date*	*Description*
043-253-258__GASHOLDER MAINTENANCE 2-6	Cups & Grips No 1 Gas Holder, East Greenwich Station	1936	East Greenwich Station: Detail of cup-and-grips between all four lifts. Dwg No. 80 EG
043-253-258__GASHOLDER MAINTENANCE 3-6	No 1 Gasholder	1917	East Greenwich Station: Elevation of gasholder and section through tank
043-253-258__GASHOLDER MAINTENANCE 4-6	No 1 Gasholder	1917	East Greenwich Station: Elevation of gasholder and section through tank
043-253-258__GASHOLDER MAINTENANCE 5-6	No 1 Gasholder	1917	East Greenwich Station: Elevation of gasholder and section through tank
043-253-258__GASHOLDER MAINTENANCE 6-6	Cups & Grips No 1 Gas Holder, East Greenwich Station	1936	East Greenwich Station: Detail of cup-and-grips between all four lifts. Dwg No. 80 EG
049-289-294__GASHOLDER MAINTENANCE 1-6	Concrete Gasholder Tank	1919	South Metropolitan Gas Company survey of the East Greenwich No 1 concrete tank
051-301-306__GASHOLDER MAINTENANCE 1-6	Proposed cementation of ballast under gas holder	1923	South Metropolitan Gas Company plans of the proposed cementation of the East Greenwich No 1 tank. Traced from the Francois Cementation DRG G44 DRW 1/6 (not viewed)
110-655-660__GASHOLDER MAINTENANCE 3-6	Holder Tanks	1925	South Metropolitan Gas Company sections of various holder tanks
136-811-816__GASHOLDER MAINTENANCE 3-5	Untitled	1941	Unknown surveys of gasholder features including top curb, bottom curb, cup-and-grips, standard sections for various gasholders. Presumed by South Metropolitan Gas Company
137-817-822__GASHOLDER MAINTENANCE 2-5	Details of Gasholder Tanks	1941	Unknown surveys of gasholder tanks. Presumed by South Metropolitan Gas Company
139-829-834__GASHOLDER MAINTENANCE 5-6	Concrete Gasholder Tank	1919	South Metropolitan Gas Company survey of the East Greenwich No 1 concrete tank
139-829-834__GASHOLDER MAINTENANCE 6-6	Concrete Gasholder Tank	1919	South Metropolitan Gas Company survey of the East Greenwich No 1 concrete tank
140-835-840__GASHOLDER MAINTENANCE 1-6	Concrete Gasholder Tank	1919	South Metropolitan Gas Company survey of the East Greenwich No 1 concrete tank

166-966-970__GASHOLDER MAINTENANCE 6-6	Gas Holder Tank for Four Lift Holder 254'-0in x 45	1919	South Metropolitan Gas Company, East Greenwich. Design for four-lift remodel of holder No 1.
199-1156-1161__GASHOLDER MAINTENANCE 1-6	Repairs to No 1 Holder: Part Re Sheet Second Lift	1980	Design of repairs to Greenwich Gasholder No 1: second lift Clayton, Son & Co. Ltd. from Moor End Works in Hunslet, Leeds
199-1156-1161__GASHOLDER MAINTENANCE 1-6	Repairs to No 1 Holder: Part Re Sheet Third Lift	1980	Design of repairs to Greenwich Gasholder No 1: Third lift Clayton, Son & Co. Ltd. from Moor End Works in Hunslet, Leeds
199-1156-1161__GASHOLDER MAINTENANCE 1-6	Repairs to No 1 Holder: Part Re Sheet Inner Lift	1980	Design of repairs to Greenwich Gasholder No 1: Inner lift Clayton, Son & Co. Ltd. from Moor End Works in Hunslet, Leeds
199-1156-1161__GASHOLDER MAINTENANCE 1-6	Repairs to No 1 Holder: Part Re Sheet Outer Lift	1980	Design of repairs to Greenwich Gasholder No 1: Outer lift Clayton, Son & Co. Ltd. from Moor End Works in Hunslet, Leeds
0527_1960_01_00_RPR_GHNo1Sheet	Report of Examination of Gasholder	Unknown. Assumed early 20th century	Inspection of Gasholder No 1 by British Engine, Boiler & Electrical Insurance Company LTD
642028830_GAa	East Greenwich: General Arrangement	2011	Site Plan of Greenwich Gasholder No 1 site
Greenwich 1 No1sheet	Report of Examination of Gasholder – Water Sealed Type Inspection Record and Summary Sheet	2001	Inspection of Gasholder No 1 by SGS United Kingdom Ltd.
SE/EGHS/N/001	Southern Gas Networks: Greenwich, Drainage Survey	2006	Drainage Survey Plan of Greenwich Gasholder No 1

APPENDIX 3: MEASURED SURVEY DATA

Phase I

The measured survey of Greenwich Gasholder No 1 was undertaken using a Trimble TX-5 laser scanner. The TX-5 scanner is a phase comparison system, capable of full dome scanning at ranges of ca. 0.5m to 50m and at resolutions of up to 92 lines per degree. Scanning was undertaken on site using resolutions as recorded below yielding a typical point-cloud resolution of between 6.136mm and 12.272mm at 10m from the instrument. Overlapping stations mean that some of the site is scanned at a greater resolution. The survey was controlled using spherical targets, located using a Trimble S6 total station with site control provided by a Trimble R8s GPS using the "vrs now" service.

The laser scan data was registered in Trimble Realworks v.10.0. The site drawings were produced using Rhino 4.0, AutoCAD LT 2009 and Arcmap 10.5.1. Orthoimages were produced using Pointools View Pro 1.8.

STN	*Number of points*	*Resolution*	*Quality*	*Gasholder*
GRW001	79,413,615	1/3	4x	1
GRW002	23,681,677	1/4	4x	1
GRW003	22,205,773	1/4	4x	1
GRW004	23,329,288	1/4	4x	1
GRW005	22,320,141	1/4	4x	1
GRW006	15,414,464	1/5	4x	1
GRW007	23,301,031	1/4	4x	1
GRW008	21,814,545	1/4	4x	1
GRW009	23,083,479	1/4	4x	1
GRW010	21,863,002	1/4	4x	1
GRW011	23,540,205	1/4	4x	1
GRW012	22,779,511	1/4	4x	1
GRW013	22,244,095	1/4	4x	1
GRW014	24,271,078	1/4	4x	1
GRW015	24,699,540	1/4	4x	1
GRW016	119,321,474	1/1	3x	1
GRW017	26,237,478	1/4	4x	1
GRW018	24,223,146	1/4	4x	1
GRW019	24,458,831	1/4	4x	1
GRW020	25,578,460	1/4	4x	1
GRW021	23,798,975	1/4	4x	1
GRW022	24,478,907	1/4	4x	1
GRW023	24,928,438	1/4	4x	1
GRW024	24,487,781	1/4	4x	1
GRW025	24,136,901	1/4	4x	1
GRW026	24,781,351	1/4	4x	1
GRW027	22,961,311	1/4	4x	1
GRW028	24,121,451	1/4	4x	1
GRW029	24,286,153	1/4	4x	1
GRW030	24,882,374	1/4	4x	1
GRW031	23,249,310	1/4	4x	1
GRW032	14,659,709	1/5	4x	1
GRW033	20,742,070	1/4	4x	1
GRW034	20,027,418	1/4	4x	1

GRW035	21,134,545	1/4	4x	1
GRW036	22,549,343	1/4	4x	1
GRW037	21,094,235	1/4	4x	1
GRW038	22,279,504	1/4	4x	1
GRW039	20,234,036	1/4	4x	1
GRW040	14,754,867	1/5	4x	1
GRW041	24,454,902	1/4	4x	1
GRW042	15,254,428	1/5	4x	1
GRW043	24,096,200	1/4	4x	1
GRW044	14,989,251	1/5	4x	1
GRW045	21,265,459	1/4	4x	1
GRW046	15,133,308	1/5	4x	1
GRW047	21,122,206	1/4	4x	1
GRW048	15,115,556	1/5	4x	1
GRW049	22,141,322	1/4	4x	1
GRW050	14,805,122	1/5	4x	1
GRW051	15,173,737	1/5	4x	1
GRW052	23,054,186	1/4	4x	1
GRW053	15,306,954	1/5	4x	1
GRW054	21,459,028	1/4	4x	1
GRW055	14,969,834	1/5	4x	1
GRW056	21,744,419	1/4	4x	1
GRW057	14,795,428	1/5	4x	1
GRW058	20,789,302	1/4	4x	1
GRW059	15,190,610	1/5	4x	1
GRW060	21,308,367	1/4	4x	1
GRW061	23,701,978	1/4	4x	1
GRW062	22,605,320	1/4	4x	1
GRW063	23,721,364	1/4	4x	1
GRW064	20,871,682	1/4	4x	1
GRW065	15,184,736	1/5	4x	1
GRW066	18,803,772	1/5	4x	1

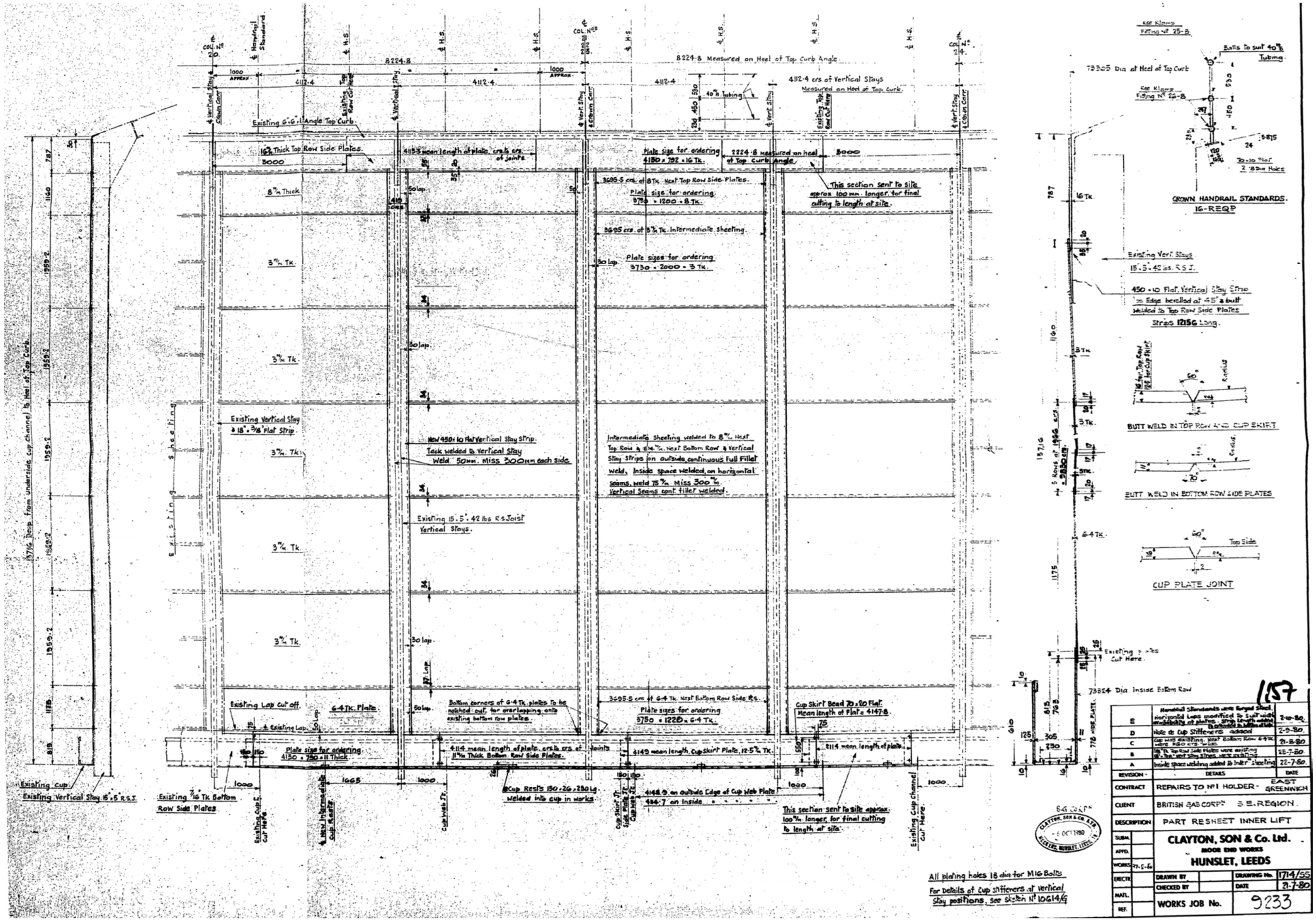
Phase II

The measured survey of Greenwich Gasholder No 1 was undertaken using a Trimble TX-8 laser scanner. The TX-8 scanner is a phase comparison system, capable of full dome scanning at ranges of ca. 0.5m to 240m and at resolutions of up to 92 lines per degree. Scanning was undertaken on site using resolutions as recorded below yielding a typical point-cloud resolution of between 6.136mm and 12.272mm at 10m from the instrument. Overlapping stations mean that some of the site is scanned at a greater resolution.

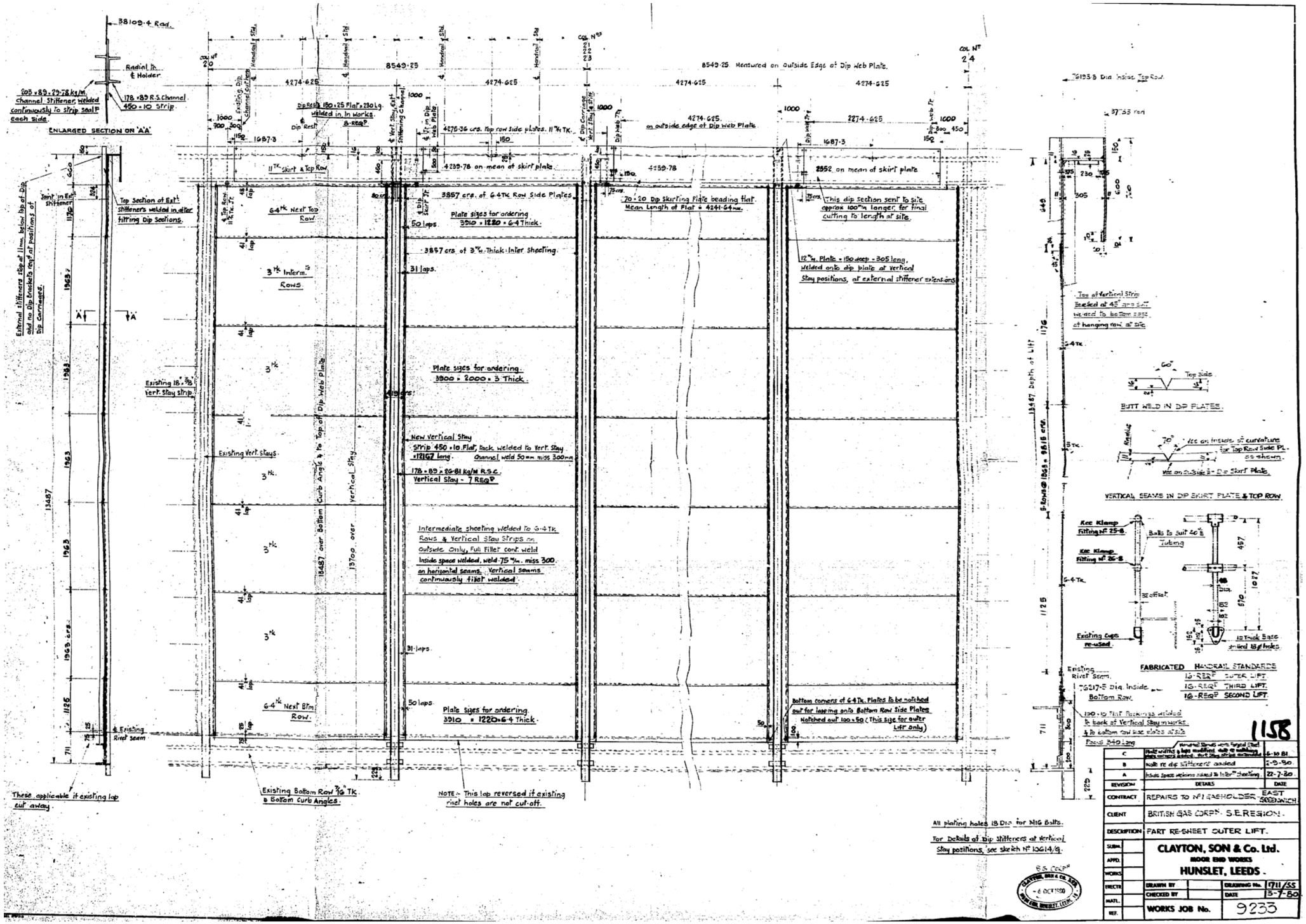
The laser scan data was registered in Trimble Realworks v.10.0 and v.11.0 with a cloud-to-cloud matching method to the Phase I scan. The site drawings were produced using Rhino 4.0, AutoCAD LT 2020 and ArcGIS Pro v.2.4.2.

STN	*Number of points*	*Resolution*	*Quality*	*Gasholder*
23686_L_Station001	75,130,322	Level 2	N/A	1
23686_L_Station002	75,551,310	Level 2	N/A	1
23686_L_Station003	75,089,943	Level 2	N/A	1
23686_L_Station004	292,858,069	Level 3	N/A	1
23686_L_Station005	293,719,309	Level 3	N/A	1
23686_L_Station006	72,948,692	Level 2	N/A	1
23686_L_Station007	250,889,983	Level 3	N/A	1
23686_L_Station008	230,059,038	Level 3	N/A	1
23686_L_Station009	73,461,807	Level 2	N/A	1
23686_L_Station010	73,429,810	Level 2	N/A	1
23686_L_Station011	244,368,299	Level 3	N/A	1

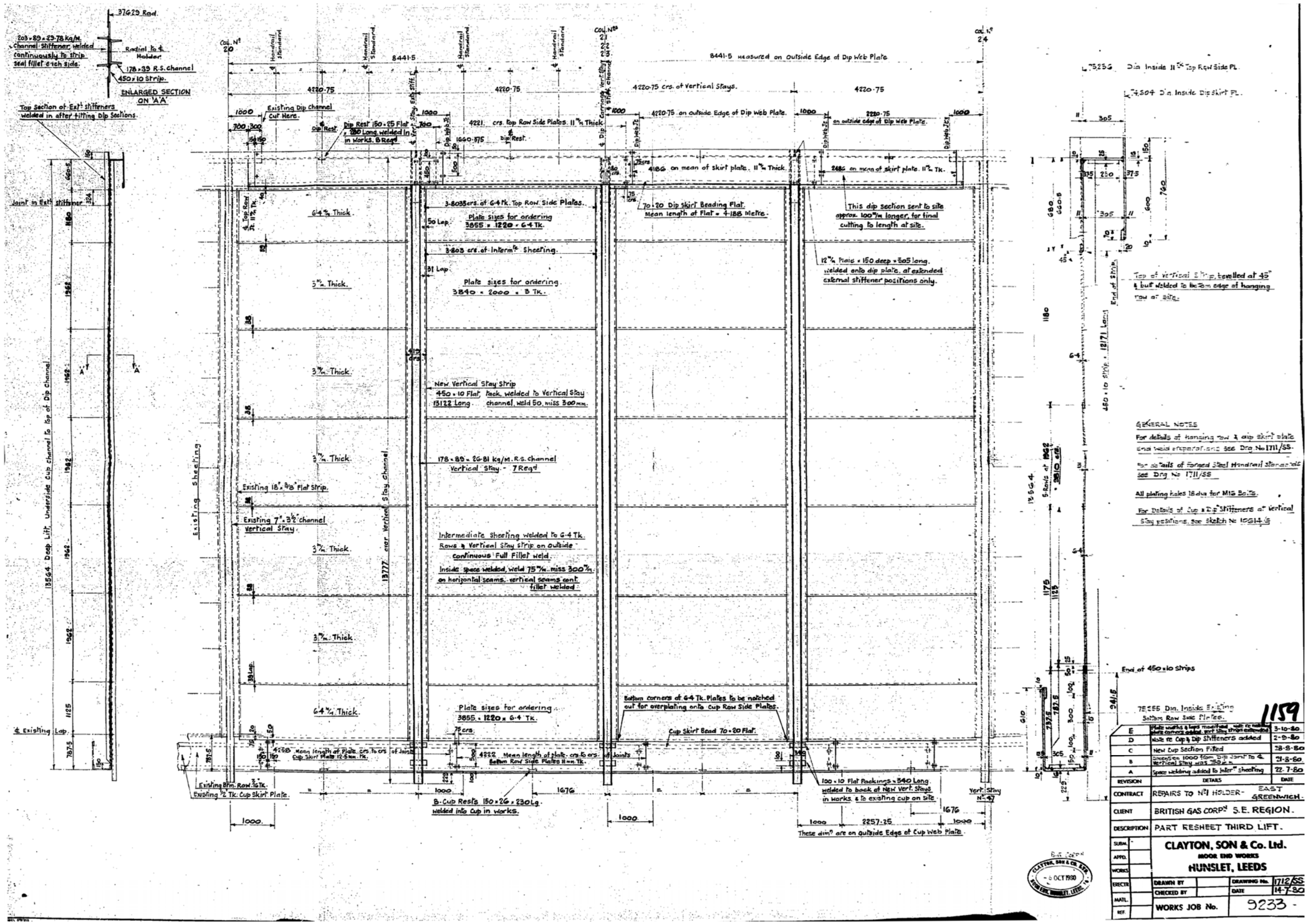
APPENDIX 4: ADDITIONAL SGN ARCHIVE DRAWINGS



Appendix 4a: Drawn record of proposed repairs to the inner lift by Clayton, Son & Co. Ltd. (SGN Archive 199-1156-1161, 1980)



Appendix 4b: Drawn record of proposed repairs to the outer lift by Clayton, Son & Co. Ltd. (SGN Archive 199-1156-1161, 1980)



Appendix 4c: Drawn record of proposed repairs to the third lift by Clayton, Son & Co. Ltd. (SGN Archive 199-1156-1161, 1980)

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