Client Name: Scott Wilson

Document Title: Beckton Sewage Works, Precipitation Lanes and Re-Aeration Lanes

Document Type: Historic Building Recording

Issue Number: 2

National Grid Reference: TQ451 822

OA Job Number: 2267

Site Code: AFW04

Invoice Code: AFWBS

Prepared by: Jane Phimester
Position: Archaeologist
Date: October 2004

Checked by: Julian Munby
Position: Head of Buildings Archaeology
Date: October 2004

Approved by: Julian Munby Signed……………..…
Position: Head of Buildings Archaeology
Date: October 2004

Document File Location G:\Projects Ongoing\Beckton Sewage works\Report
Graphics File Location Server 10:/oaupubs1_AtoH*AFW04*Beckton Sewage Pipeline*jm*20.08.04
Illustrated by Julia Moxham
Building Name Beckton Sewage Works, Precipitation Lanes and Re-aeration Lanes
Building Location London Borough of Newham

Oxford Archaeology
Janus House
Osney Mead
Oxford OX2 0ES
t: (0044) 01865 263800 e: info@oxfordarch.co.uk
f: (0044) 01865 793496 w: www.oxfordarch.co.uk
Oxford Archaeological Unit Limited is a Registered Charity No: 285627

BECKTON SEWAGE WORKS

HISTORIC BUILDING INVESTIGATION AND RECORDING

TABLE OF CONTENTS

LIST OF FIGURES

PLATES

BECKTON SEWAGE WORKS, LB NEWHAM

HISTORIC BUILDING INVESTIGATION AND RECORDING

SUMMARY

Oxford Archaeology (OA) carried out archaeological and historical analysis at Beckton Sewage Works on behalf of Scott Wilson (consultants for Thames Water). The overall aim of the project was to investigate and record the structures of historical interest prior to their demolition. This site is of importance as it forms part of Joseph Bazalgette's London's sewage system. This was a grand scheme designed to clear the chronically polluted river and carry sewage out of the city. The original works at Beckton were constructed in the 1860s and form the end of the Northern Outfall. In 1887 precipitation lanes were constructed to treat the sewage chemically and the sludge was removed in ships and dumped at sea. These structures as well as the valve and pump rooms are the main focus of this study. In the 1960s the eastern section of these lanes were largely demolished to form re-aeration lanes and this later modification forms a secondary focus of the report. This work is required prior to the development of the new Thames Gateway Water Treatment Plant (TGWTP) at the site.

1 INTRODUCTION

1.1 LOCATION AND SCOPE OF WORK

1.1.1 Oxford Archaeology has been commissioned by Scott Wilson (consultants) to record and investigate Beckton Sewage Works in the London Borough of Newham. An Environmental Impact Assessment (EIA) had previously been undertaken and within this document it was recommended that those features of historical interest should be recorded prior to (and during) their demolition (OA 2003). The demolition is required to facilitate the construction of the new Thames Gateway Water Treatment Plant (TGWTP).

1.1.2 The structures covered by the current works (NGR TQ451 822) are located within the London Borough of Newham (Fig. 1). Beckton is located three kilometres (km) south-east of Barking and lies between East Ham to the west and Creekmouth to the east. It is bounded by Barking Creek to the east and the River Thames to the south. The sewage works at Beckton are the largest in Europe, and the Victorian structures remain surrounded by much later developments (Fig. 2).

1.1.3 The Sewage Works were constructed as part of Bazalgette's London sewage system in the 1860s. The sewage was initially discharged untreated into the Thames from the Northern Outfall Sewer. The Northern Outfall Sewer now only serves as surface water drainage although parts still exist forming the western wall of the sludge shipping tanks and precipitation lanes. The shipping tanks are of a similar date and lie to the south of the precipitation and re-aeration lanes. In 1887 the system was modified to precipitate the sewage chemically at Beckton (and Crossness). The precipitation lanes consist of thirteen brick lanes housing iron box weirs and penstocks used to control the flow of material in and out of the lanes. These lanes and associated buildings including the pump and valve houses are the main focus of this study. The lanes initially covered the entire area of the site until the eastern area of the lanes were demolished in the 1960s and replaced with 13 concrete re-aeration lanes (Fig. 3). This later modification forms a second focus. The valve house (located to the west of the site) is associated with the Victorian works and the pump house (located to the north of the site) is thought to date to the 20th century.

1.2 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

1.2.1 Beckton sewage works are part of the sewer network that helped relieve central London from the public hazard of the River Thames. The 'Great Stink' was the instigation for the works, as cholera and typhoid fever reached London from the east in the 1830s. The Thames was an important drinking water source for Londoners and the invention of the water closet meant that it became an open sewer (Trench & Hillman 1993). Sir Joseph Bazalgette in his capacity of engineer at the Metropolitan Board of Works solved this problem through his design and construction of brick-built sewers. Bazalgette believed that the drainage of the low-lying land in London was more important than cleansing the Thames (Halliday 2001).

1.2.2 The two halves of the main drainage system constructed north and south of the river are broadly similar. The main phase of construction was between 1859 and 1865 and the intercepting sewers were in total 82 miles in length. These were laid to a minimum of 2 feet per mile and involved the excavation of 3,500,000 cubic tons of earth (Rolt 1970). The principle on which they are based is to transport the sewage to east London; at Crossness on the south bank and Beckton on the north bank. The high level sewer on the north bank ran from Hampstead Heath, the middle level from Kensal Green and the low level from Pimlico. The northern outfall was designed around three main incepting sewers: the high, middle and low-level sewers. The construction was particularly complicated since it required massive embankments to be built to carry the outfall across low-lying marshy land as well as a network of roads, rivers and railway lines (Halliday 2001). Fig. 3 is Mudge's map of Kent (1801) showing the marshy land both north and south of the river. The sewage was stored at Beckton until high tide and then discharged into the river on the ebb tide. It was stored in sludge tanks that were constructed in c.1864 and used initially to store effluent during times of rising tide or when the tide was such would have taken the effluent back up the Thames to London (OA 2003). There was no attempt at this time to treat the sewage.

1.2.3 In 1887 it was decided to precipitate the sewage system chemically at Beckton (and Crossness) allowing only the effluent to run into the Thames with the sludge removed in ships and dumped at sea. The lanes at Beckton were built following the rising concern that it was not acceptable to discharge untreated sewage without first making it less offensive. Previously the sewage was held in large reservoirs located in the same area as the present shipping tanks before being released on the ebb tide. Bazalgette carried out a series of experiments in the early 1880s and found that the sewage could be disposed of by extracting the solid elements through the addition of lime and sulphate of iron. The solids could then be dumped at sea and the liquid discharged into the river. The lanes at Beckton were constructed by Furness contractors in January 1887 to a cost of £406,000 and this was followed in June with an order for six sludge vessels. The new system became necessary as between the 1860s and 1880s the population of London had grown by almost fifty percent. The previously sparsely inhabited community of Barking had become a substantial suburb (Halliday 2001).

2 AIMS AND OBJECTIVES

2.1.1 The general aim of the investigation was to create for posterity a record of the structures of historical interest at the sewage works prior to their demolition concentrating on their structure, construction, history and use. These include extant evidence relating to the Northern Outfall Sewer, the precipitation lanes, the valve and pump house, sludge tanks, and to a lesser extent the later re-aeration lanes .

2.1.2 More specifics objectives were to:

- Record the surviving features of the structures of historical interest to gain an understanding of their role within the sewage works;
- To determine the phasing of the structures to appreciate the development of the site within the historical context;
- To gain a overall understanding of the significance of the site within the history of London's sewage system and industrial archaeology; and
- To create an ordered archive of the work to be housed in the public depository.

3 METHODOLOGY

3.1 SCOPE OF ANALYSIS

3.1.1 The building recording was undertaken at Level II as defined in the Royal Commission on the Historical Monuments of England (RCHME 1996). The structures were recorded in their current form before the start of demolition works and this consisted of three principal methods: a drawn record, a photographic record and a written record. The site visits for the recording were completed on the 25th, 26th and 27th of May 2004 and a watching brief was undertaken during demolition work on the 19th July 2004.

3.2 FIELDWORK METHODS AND RECORDING

3.2.1 *The Drawn Record*

3.2.2 Thames Water undertook the base survey for the current works (Fig. 4). This is a plan of the site showing the precipitation and re-aeration lanes as well as the valve house, pumping station and shipping tanks. The plan (1:1000) was traced onto archivally stable permatrace and descriptive annotation added to indicate construction, structural breaks, evidence relating to the structure's use and other features of historical interest. The recording followed IFA Standards and Guidelines using conventions outlined in *Recording Historic Buildings: a Descriptive Specification* (RCHME 1996).

3.2.3 Further drawings were produced as appropriate to record and interpret structures of particular interest. As structures were of standard repeated designs, sample sections were drawn rather than entire structures. Additionally, due to health and safety restrictions it was not possible to access many areas. A section drawing was completed of the precipitation lanes (Fig. 5) and Interserve (structural engineers) provided sections of the re-aeration lanes (Fig. 6) and the penstock located at the west end of the precipitation lanes (Fig. 7).

3.2.4 Historic drawings are held at the site office of Beckton Sewage Works relating to the construction of the precipitation lanes and re-aeration lanes. A number of these have been included in the figures within this report (Figs. 6, 8 & 9). Unfortunately, the date and exact source of these is unknown.

3.2.5 *The Photographic Record*

3.2.6 Photographs were taken using 35mm film (black and white prints, colour slides) and include general shots of structures (external and internal) and specific details. Flash lighting was used to illuminate dark interiors and a scale used where appropriate. All films included a chalk-board indicating the film number and site code. Photographic record sheets where used to indicate the location and direction of each shot and any further detail.

3.2.7 *The Written Record*

3.2.8 Written descriptions of the structures were made as part of the annotated drawings. Additional analytical and descriptive notes were taken as appropriate to compliment elements of the record.

3.2.9 In addition to the main site recording a short programme of historical research was undertaken. This research was based on principal secondary sources as listed in the bibliography.

3.3 LIMITATIONS OF STUDY

3.3.1 Health and safety restrictions at the sewage works meant that many areas could not be fully investigated. It was only possible to enter one pair of precipitation lanes located on the most southern parameters of the site. The remainder of the site was assessed at ground level only, as access was not permitted down into areas such as the base of the re-aeration lanes. Additionally, it was not possible to record the sludge shipping tanks and the Northern Outfall Sewer as entrance to this area was prohibited.

4 DESCRIPTION

4.1 GENERAL SITE LAYOUT

4.1.1 The site is bounded by the Barking Creek to the east and the River Thames to the south (Fig. 2). Within this, the thirteen precipitation lanes (1887) extend in a south-west/north-east alignment. The Northern Outfall Sewer provides the western edge of the lanes and shipping tanks and extends south to the outlet on the River Thames. The eastern edge of the precipitation lanes is met by the weir chamber that follows a roughly north-south alignment. The re-aeration lanes (1960s) extend from this junction in an east-west orientation and are met by the Barking Creek also following a roughly north-south alignment. The precipitation lanes originally covered the area now occupied by the re-aeration lanes and it is still possible to see the arches of these earlier lanes at the eastern edge (Fig. 4).

4.1.2 Lying to the south of the two sets of lanes are the sludge shipping tanks (c.1864) and the western wall of these is formed by the Northern Outfall Sewer (also of a similar date). The valve house lies towards the western end of the site and roughly at the centre of the precipitation lanes. Drainage pumping station no.2 lies to the north of the site on the outside parameters of the precipitation lanes.

4.2 PRECIPITATION LANES

4.2.1 Precipitation is the process of separating a substance from a solution as a solid. There are a total of 13 precipitation lanes that run in a south-west/ north-east orientation. The lanes have a kink in their alignment at the eastern end so that they subsequent run in a west-east direction as they meet the later re-aeration lanes. The precipitation lanes are accessible through six rectangular openings where it is possible to see the construction of the brick arches (Plate 1). The south-western length of the lanes is covered with earth and there are small rectangular brick vents located on this surface spaced at c.26 m intervals (Plate 2). The lanes also extend further to the east and this section is covered by a concrete walkway. The lanes terminate at the east end as they meet the weir chamber (Plate 3).

4.2.2 Six rectangular open areas each provide access to four precipitation lanes, although the most southern area houses six lanes. These open areas reach to the base of the lanes and show the arched construction of the tunnels to the east and west (Plate 4). The five areas to the north measure c.20 m in length and 7 m in width and the most southern area measures 28 m in length. The east termination of the channel lies just to the east of the east brick arch. The west-facing arch is the opening to the lanes extending to the south-west. At the time of the site visit, due to health and safety restrictions, it was only possible to gain access to the most southern area. The building recording of these lanes is therefore based upon observations within these parameters. The precipitation lanes are all of a similar construction and although measurements may differ to a small extent, the lanes appear all to be of a similar size and construction.

4.2.3 The six openings were modified in the 1960s with the construction of the re-aeration lanes. The later concrete lies on top of the original brick arches and this platform provides the concrete walkway (Plate 5). Concrete posts surround the open area that support iron rails. The original brick walls of this area were reinforced at a later date. This is most evident on the north wall, where the concrete extends from the 19th century brickwork.

4.2.4 The construction of the brick arches dating to the late 19th century is illustrated in Fig 5. This is a section of an east arch showing that the yellow brick arches measure c. 4.3 m in height and c. 4.6 in width. As described above a concrete render now sits directly on the brick height of the arches that support the concrete walkway. During the demolition of the precipitation lanes, this concrete was clearly visible running the length of the lanes. The arches have four headers and the roof of the lanes has two courses of brick (Plate 6). The west facing arches are of the same construction.

4.2.5 Two iron braces (0.60 m by 0.08 m) are bolted to the brick arches at a height of 2.30 m. These are also evident on the inside face of the arches at the same height. These would have once held horizontal wooden boards extending across the lanes. In some areas the wooden boards are bolted directly onto the brick arches and remain extant. The exact purpose of these is uncertain although they may have acted as scum separators (Plate 7). Similarly, horizontal wooden timbers lie on the floor of the channel at the east end of the arch. These are dislodged in some places but there is evidence of these in each of the lanes. The purpose of these is uncertain but again may be related to ensuring the scum was taken from the material.

4.2.6 The foundations of the arches are thought to have been similar to the sludge shipping tanks with concrete piers taken down into the gravel and brick arches supporting the stone floor (OA 2003). Fig. 6 is a longitude section through the Northern Outfall Sewer showing the penstock gallery and arched brick foundations sitting on a concrete base. During demolition of the lanes a borehole was dug to a depth of 0.82 m at the base of the tunnels. It was found that the clay foundations lay beneath the concrete. The foundations of the brick arches were also investigated and it was found that these were greater than the depth of the boreholes (again 0.82 m). It is thought that in some areas the foundations to these arches measure 8 m.

4.2.7 The floor surface is concrete and undulates, rising between the arches and sloping down at the centre of the arches to form lanes. There is a gully at the base of the channel that is c.0.30 m in width and runs the full length of the channel. Sitting on the concrete floor between alternate arches are small brick piers (0.80 m by 0.60 m). It is possible that small brick dividing walls once existed running between the east and west facing arches. Scarring is evident on the concrete floor between the arches and such walls exist internally within the lanes. These would have aided in ensuring the material was channelled effectively.

4.2.8 Internally, the lanes are divided into pairs with a central division of open arches extending the full length (Plate 8). The two outer walls are solid brick elevations although there is one infilled arch on each of the outer walls at the opening of the channel (Plate 9). There are small brick partition walls running between the central open arches at a height of 0.50 m. These sit on the concrete floor surface and are in places intercepted by small rectangular wooden gates that can be lifted up by handles. These would have permitted flow between the lanes during cleaning (Plate 10).

4.2.9 Penstocks (sluice gates for controlling the flow of sewage) are evident at the south-west end of each of the lanes. The alignment is entitled 'Penstock Platform' on the sewage work plans. Fig 7 is a plan of such a typical penstock within the penstock gallery. These were used to control the flow in of material from the Northern Outfall Sewers (Plate 11). Initially five sewers entered into the lanes although at a later date two of these were cut off. Fig. 8 is a plan of the lanes illustrating this later modification. The penstocks are constructed from iron and were operated from the valve house to the west of the site.

4.2.10 The eastern end of each precipitation lane is blocked by a concrete wall that is thought to be contemporary with the construction of the re-aeration lanes (see Plate 3). This has been built to a height of 2.43 m and has a circular hole (diameter 0.40 m) located near its base. A penstock is evident on the east elevation of the wall that was used to control the flow of material into the weir chamber. These are considerably smaller in size than those located at the south-west termination of the channel. Due to health and safety restrictions it was not possible to gain these measurements. The penstocks are iron and operated by small hand wheels located at ground level. The weir chamber is part of the 1960s re-aeration lanes and the penstocks were added at a later date in conjunction with this construction (Plate 12).

4.2.11 Iron box weirs are housed with the channel and used to control the flow of material from the precipitation lanes. At the east end of the tunnel, these are positioned beneath the internal arch of lanes 1 & 2, 3 & 4 and 5& 6 (Plate 13). These measure 2 m by 1.62 m and 0.60 m in depth. They are bolted onto an iron base, which sits on a brick platform that is 0.30 m in height and 1.40 m in length. There is also a large counterweight (1.59 m by 0.73 m) directly to the west of the penstocks. Large chains extend down through the brick arch from above to the top of the box weirs. These box weirs are hollow and once full of material would have been lowered by the chain into north/south running culverts. It is thought that they would have been suspended at different levels according to the type of material. For example, sludge is heavier and therefore the box weirs would be lowered further to allow this material to enter the culvert. The chains are operated by a hydraulic cable, leading from the valve house.

The counter weight is also suspended from two chains that are incorporated into the arch brickwork.

4.2.12 The south-western stretch of the lanes houses two box weirs under the central arches. These are of a construction as described in §4.2.11 (Plate 14). There is further box weir located at the south-west termination of the tunnel. This is considerably larger and sits on a brick platform in front of the penstock and to the north of the central division (Plate 15).

4.2.13 Iron cables operate the box weirs from the valve house (see §4.5.1) and these are evident running from the valve house and following the same alignment as the lanes. This area was stripped prior to demolition, and it was possible to see the cables running just below the ground surface in brick troughs that are 0.70 m in width and c. 0.50 in height (Plate 16). The cables run across the open rectangular areas on iron bars and are incorporated into the cement work above the brick arches (see Plate 7).

4.2.14 Culverts were used to carry the material from the box weirs into the shipping tanks. The shipping tanks lie to the south of the site and were used to hold the material before it could be transported and dumped into the sea. The box weirs would be lowered to allow the material to enter the culverts. Fig 8 is a general plan of the precipitation lanes prior to the construction of the re-aeration lanes. This shows that each alignment of box weirs fed into a number of culverts running in a north-west / south-east direction. Areas A & B have two sets of culverts; one running to shipping tank four and one to shipping tank two. Area C has three culverts: one runs into the 'specials culvert' and the remaining two run into shipping tanks four and two. The 'specials culvert' is located at the south-west end of the precipitation lanes and is thought to follow the same alignment as the Northern Outfall Sewers. This is identified in Fig 9. The larger box weirs (see §4.2.11?) also fed into this culvert. A further set of culverts once existed to the east (area D) that also fed into shipping tanks four and two. These are no longer extant and were destroyed with the construction of the 1960s re-aeration lanes.

4.2.15 Ventilators are located at ground level in order for light and air to enter into the precipitation lanes through the roof (Plate 17). These are brick rectangular constructions that sit on an outer brick plinth. The top of the vent measures 1.20 m by 2 m and there are two stepped courses of brick 0.80 m in depth. The total internal depth of the vents is 1.22 m. They are spaced at c.26 m alternating between each pair of lanes. These vents were covered with boards and presumably they originally had some covering, although no hinges are evident.

4.2.16 The original outer brick wall of the precipitation lanes is also evident running roughly east-west along the 1960s re-aeration lanes. The precipitation lanes in this area have largely been destroyed, and this evidence shows the original alignment of them. The brick wall is also extant at the north end of the site and provides the outer wall to the weir chamber. At the east termination of the re-aeration lanes it is possible to see the brick arches of the precipitation lanes. These would have formed the east termination of the lanes prior to their demolition in this area in the 1960s (Plate 18).

4.3 THE SHIPPING TANKS

4.3.1 The evidence relating to the sludge shipping tanks is primarily based on secondary sources, as it was not possible to assess the structures, due to health and safety restrictions. Evidence shows that Bazalgette's 1860s Northern Outfall Sewer forms the western wall of the shipping tank although it was not possible to confirm this at the time of the site visit (OA 2003). Further evidence shows that six sludge vessels were ordered in June 1887 at a cost of £16,353 following the construction of the precipitation lanes (Halliday 2001). The disposal of sludge at sea continued until 1998 when the practice was replaced with incineration.

4.3.2 The shipping tanks were constructed in c.1864 and were initially used for storing effluent during times of rising tide, or when the tide would have taken the effluent back up the Thames into London (Plate 19). Bazalgette describes the shipping tanks as being four compartments, 16.75 ft (5.10m) deep, covering an area of c.9.5 acres (3.8 ha). The external and partition walls were brick with the York stone floor being supported by brick arches on brick piers. The shipping tanks were built almost entirely above the natural ground surface. They were originally roofed and covered by an embankment of earth, rising c.0.6 m above the crown of the arches and built on foundation carried down to c.6 m. They appear to have survived largely in the original form but with some internal modifications (OA 2003).

4.3.3 In 1948-9 the two southerly compartments (1 and 2) were modified to form digestion compartments leading to changes and loss of their internal structure and roof. Compartments 3 and 4 appear not to have been modified although aerial photographs dating from 1941 show what appear to be two bomb craters, possibly in compartments 1 and either 2 or 3. During the 1960s the remaining roof covering the compartments was removed and ramps constructed into all four compartments at the Barking Creek end (OA 2003).

4.4 RE-AERATION LANES

4.4.1 The re-aeration lanes, built in the 1960s, are not part of Bazalgette's sewage works and are therefore of less archaeological interest. This report is primarily concerned with the earlier sewage works and therefore this area has been subject to less archaeological investigation and recording.

4.4.2 The layout of the thirteen lanes is roughly in an east-west alignment (Plate 20). At their western parameters they meet the weir chamber and earlier precipitation lanes, and to the east the Barking Creek. Fig 10 shows the section of the re-aeration lanes that were constructed from reinforced concrete. The purpose is to introduce oxygen into the treatment process to sustain the beneficial bacteria that consume the pollutants. Each channel houses three streams that dip in the centre to make a pointed triangular base (Plate 21). Circular iron discs run along this base through which, it is thought, air is ejected. The lanes measure 4.15 m in length, 4.65 m in width and each individual stream measures 1.55 m in width. The ten southernmost lanes are of a different construction, with an additional higher level of lanes at the west end (also detailed on Fig. 8). It is thought that the re-aeration lanesutilised the foundation of the earlier precipitation lanes and were constructed above this (OA 2003).

4.4.3 There is a criss-cross of walkways and supports that run between and over the re-aeration lanes (see Plate 20). The width of the walkways between the lanes is 0.98 m and those run over the lanes are 0.75 m. There are also horizontal structural supports between the lanes (0.31 in width) that are at the same level as the walkways. A number of these carry pipes thought to transport the material below to the streams. The walkways and supports cross the lanes alternatively, and at the beginning of the south end of the lanes the distance between the two is 1.77 m. Following this, the distance increases to between 4 and 4.5 m. There is iron fencing running along and across the lanes, with green upright supports and two sets of white rails.

4.4.4 Pipes (with valves) that would have carried material for the streams, run across and along the walkways and platforms (Plate 21). Each lane has three pipes running vertically into the streams and overhead these measure 0.25 m in diameter and 0.16 m as they extend into the streams. A horizontal pipe extends across the three streams at the bottom of the channel attaching onto the circular discs. The pipes run from a pumping house that is thought to be located to the west of the site. The pipes were visible during the watching brief following the stripping of the ground in the area of the precipitation lanes. The pipes run overland in a north-east/ south-west alignment and then turn at right angles to run in a south-east direction and then underground in a south-west/ north-east alignment. Five pipes run into the re-aeration lanes. During the demolition of the precipitation lanes it was possible to see the pipes running along the top. The 1960s concrete was laid on top of the precipitation brick arches and the pipes housed within this.

4.4.5 Penstocks are extant at both ends of the re-aeration lanes, these are of iron and are hand-operated by small wheels. At the west end there are two lines of penstocks that allow material to enter into two separate lanes that run in a roughly north-south alignment. At the east end are a further set of penstocks that would allow material to flow to a further north-south channel (Plate 22). There are also penstocks that are accessed by overhead walkways extending down to the base of the streams. It is thought that a north-south culvert runs beneath the streams into which the material is channelled. These penstocks are operated by a wheel that sits on an upright pole at a height of 0.96 m.

4.4.6 The weir chamber has two large penstocks located at the north end that appear to have been operated by hydraulics. These are large green galvanised iron mechanisms that house a gauge indicating the level, in inches, to which the penstock has been raised (Plate 23). It is possible these were operated from a small shelter located at the north end of the streams. This is a brick and concrete structure measuring 1.71 m by 2.08 m at a depth of 0.99 m. At the south end the penstocks are no longer *in situ* and have been bricked up.

4.4.7 Two larger penstocks are located at the west end of the venturi channel (Plate 24). A further two stand at right angles to these, as the venturi channel curves to the north. This means that the two most southerly re-aeration lanesare shorter in length. At the base of the channel and located just to the south of the penstocks are two circular brick walls that surround drainage lanes. A penstock once located at the south end of the tunnel has been cemented shut at a later date and it is no longer in situ. The extant penstocks are operated by hydraulics and a gauge of the same construction to the weir chamber penstocks is extant.

4.4.8 The venturi channel was used to monitor the flow of material and runs in a south-east/north-west alignment (Plate 25). It is constructed from reinforced concrete (width 6.9 m) and extends from the weir chamber to the Barking Creek. Directly to the north are the huge sludge tanks and there is a concrete walkway (width of 2.80 m) with rails separating these two areas. Two large culverts run beneath the venturi channel to the effluent channel. It is thought that this latter channel follows the same alignment as Barking Creek and runs out to sea.

4.4.9 The weir chamber is located between the re-aeration lanes and the precipitation lanes running in a roughly north-south alignment (Plate 26). It is constructed from reinforced concrete and is 12.2 m in length and c.4 m in width. The penstocks at the north and south ends and those located at the east end of the precipitation lanes would have permitted the flow of material within this channel.

4.5 ASSOCIATED BUILDINGS

4.5.1 The valve house is a rectangular yellow brick structure in a north-west/ south-east alignment measuring 15.2 m by 6.7 m (Plate 27). It is a single phase building thought to be contemporary with the construction of the precipitation lanes (1880-1890s). The structure is located to the south-west of the site close to the west end of the precipitation lanes and the Northern Outfall Sewer. The purpose of the building was to control the box weirs through a series of internal levers.

4.5.2 The building is single storey with a half basement. The roof is grey welsh slate with brick gables. There is a lean-to at the north-west elevation and one at the south-west elevation (Plate 28). The building has two wood panelled doors at the north-west and south-east ends. The doors and windows have finely rubbed gauged brick rounded heads over the doors and windows (Plate 29). There are concrete steps with an iron baluster leading up to the doors. Windows are extant on each of the elevations with two located at the south-east end and north-west ends. These are eight light windows with top hinges. The five located on the longer elevations have twelve lights with four outer side openings. There is a large concrete slab footing at the north-west end.

4.5.3 Internally, the upper room is brick painted with a plank boarded ceiling and a later rubber floor. There are levers along the north-east elevation housed in thirteen wooden boxes with gauges and each box has corresponding three levers that are labelled ‘C1 - B1 - A1- C2 - B2 - A2’, etc. (Plate 30). The mechanisms for these levers are housed within the basement that leads out of the building along the alignment of the precipitation lanes (Plate 31). Undergrowth cover at the time of the site visit made it difficult to ascertain the exact orientation as they leave the building.

4.5.4 Drainage pumping station no.2 is located directly to the north of the east end of the precipitation lanes (Plate 32). This building is thought to date from the early 20th century thus being later in date than the valve house and precipitation lanes. Its purpose was to pump material throughout the re-aeration lanes for treatment. This is a brick-built structure with a rectangular footprint measuring 14.6 m by 7.2 m in an east-west alignment. The building is single storey with a brick foundation and a flat concrete roof. There are six windows located on the north and south elevations and a further two windows at the west end of the building. The windows are uniform measuring 1.8 m by 0.89 m, with an iron frame and six lights (Plate 33). These have a brick surround with a concrete lintel across the window. There are two entrances to the building with the main entrance located at the east end of the building. This has a wood panelled double door and the wooden sign ‘Drainage Pumping Station No.2’ located above the door. The door has a brick surround with a concrete lintel above the door (Plate 34). The single secondary door is located on the west elevation that is also wood panelled measuring 2.05 m by 0.82 m.

4.5.5 Internally, the floor is concrete and the west end of the building once housed six pumps. The walls are plastered and painted with tiling at the lower elevation and there are electric light switches located on these elevations (Plate 35). It is thought that six pumps were housed within the building although these are no longer extant and the foundations for the structures are the only surviving evidence. There is concrete *in situ* (in particular to the east) overlying the concrete floor, which would have been the foundations for the pumps. There are six square platforms measuring 0.55m² (organised into three sets of two) from which pumping pipes were thought to have once extended vertically. These are no longer extant although the circular footprints are clearly visible on the surface of the platform (Plate 36). There are three iron uprights to a height of 0.6 m extant at the south-west edge of the pairs of platforms. These lie within two recesses to the north and south at a depth of 0.56 m. These house iron pipes that extend externally beneath the walls of the building (Plate 37). The north pipe (7.25 m in length) extends out of the pump house beneath the north elevation and the west pipe (7.25 m in length) extends beneath the west elevation. The pipes are 0.42 m in width.

4.5.6 At the east end of the building are two control boxes for the pumps measuring 1.62 m by 0.52 m and at a height of 0.93 m (Plate 38). These are cast iron with an on/ off lever and a gauge with 1-10 specifications. It is thought these were used to control the pumps and alter the level of material being pumped into the lanes. There are two iron rails running the length of the building above the windows. A further two iron cross rail run along these rails on two wheels extending across the width of the building. Two chains and hooks on a pulley wheels hang from these cross rails that were thought to have been used to hoist machinery needed during the operation of the pumps.

4.5.7 The penstock controller house is located at the south end of the re-aeration lanes (Plate 39). The building is of the same construction as the pumping house and thought to be of a similar date. This is a single-storey brick and concrete structure (3.95 m by 5.55 m) that is divided into two equal sections. The south section contains sample pots for testing the material and the north section houses the machinery for operating the large penstocks located at the west termination of the venturi channel. This machinery has a gauge and three push buttons labelled: Raise, Master Stop, Lower. There are four sets of these buttons, presumably to operate the four penstocks associated with the venturi channel. There is also a telephone within the structure and the plastic sign 'Telephone' is extant on the exterior of the building.

4.5.8 An administration building is located directly to the south of the pumping house (Plate 40). This is single storey in elaborate 1960s concrete structure with an asbestos roof. It has small buttresses and crittal-type windows. There are four windows and two doors and the building is internally partitioned. The building contains an administration room and a toilet and is thought to have been used as an office/ staff room during the operation of the sewage works.

5 DISCUSSION AND INTERPRETATION

5.1.1 The sewage works at Beckton are of importance in housing the Northern Outfall Sewer that is part of Bazalgette's original 1860s sewage system. This is now only extant along the western wall of the precipitation and sludge tanks although it is not possible to assess this area fully due to health and safety restrictions. The precipitation lanes and valve house relate to Bazalgette's second phase of construction following the need to properly treat the sewage prior to its disposal at sea. The pump house and telephone room relate to a later phase of construction (possibly early 20th century). The re-aeration lanes are part of the later 1960s modifications and are of less archaeological importance.

5.1.2 The sewage works represent an amalgamation of centuries of development in structural engineering. The precipitation lanes remained in use until recently and worked alongside the 1960s re-aeration lanes. This is testimony to Balzalgette's excellence and ingenuity in design and engineering. At the time of construction, the Northern Outfall

Sewer was described in an architectural magazine, The Builder, as: 'Medieval with Byzantine and Norman features' (1865, 238). It is the simplicity of the accomplishment however that is of most significance, and this in part has attributed to their continued use. The Northern Outfall Sewer and precipitation lanes are designed on a basic concept and moreover were easy to maintain. They were constructed in such a way that blockages and overflows were easy to identify and solve. The vents, for example, meant that they were easily visible and the penstocks and box weirs enabled problems to be quickly remedied. The beauty of the construction was not only in the expanse of the project or the architectural design, but the fact that a handful of trained workers were able to resolve issues.

5.1.3 Bazalgette's sewage works also represented a huge engineering advancement and the Northern Outfall Sewer in particular required the construction of a temporary cement works and railway for its use. Such was the demand that the sewage works created, the price of bricks in the second year of works increased by forty to fifty per cent. Such huge works were important in the late 18th and early 19th centuries in creating the emergence of the concept of contract management. This made possible the development of open competitive tendering for large projects and replaced the earlier arrangement whereby the client made arrangement with each of the master craftsmen. Also, Bazalgette's use of Portland cement in the construction of the intercepting sewers mark him as a pioneer in the use of the material and as well as the development of effective quality control techniques. Most importantly the sewage works must be seen as important in a humanitarian framework as they prevented further cholera epidemics, and in this way they can be seen to have saved thousands of lives.

6 CONCLUSION

6.1.1 Beckton sewage works forms part of Bazalgette's London Sewage system and although it is not particularly widely known and lacks the visual appeal of the pumping stations at Crossness and Abbey Mills it is of historical interest nonetheless. This interest has been reflected in the current programme of historic building investigation and recording which has been undertaken prior to the redevelopment of part of the site. A record has been made of those structures affected by the development and this record will be deposited in an archive for future generations to consult. The precipitation lanes, shipping tanks, re-aeration lanes, valve house and other associated features have all been photographed and measured drawings made of particular features. Historical research has also been undertaken and the work has generated a greater understanding of these structures and of the development the sewage works generally.

Jane Phimester
September 2004

7 BIBLIOGRAPHY AND REFERENCES

Bartlett, R — *Pumping Stations & Water Sewage*, Applied Science Publishers Ltd., London, 1974

Bartlett, R — *Public Health Engineering, Design in Metric Sewerage*, Elsevier Publishing Co. Ltd., London, 1970

Bartlett, R & Mudill, W — *Hydraulics for Public Health Engineers*, Applied Science Publishers, London, 1982

Bazalgette, J W — 'On the main drainage of London, and the interception of the sewage from the River Thames', *Min. Proc. Inst. Civil Engineers* 24, 1865, 280-314, reprinted in Howie & Chrimes.

Halliday, S — *The Great Stink of London: Sir Joseph Bazalgette & The Cleaning of the Victorian Metropolis*, Sutton Publishers, 2001

Howie, W & Chrimes, M — *Thames Tunnel to Channel Tunnel*, Thomas Telford, London, 1978

Jones, W — *Dictionary of Industrial Archaeology*, Sutton Publishing, 1996

Oxford Archaeology — *Thames Gateway Water Treatment Plant Environmental Statement* - Chapter Eleven, Archaeology and Cultural Heritage, 2003

Rolt, L — *Victorian Engineering - A fascinating story of invention and achievement*. Penguin Books, Harmondsworth, 1970

The Builder — '*Completion of the Southern Metropolitan Sewerage'* 8th April 1865

Trench, R & Hillman, E — *London Under London: A subterranean guide*, John Murray, 1993

8 SUMMARY OF SITE DETAILS

Site name: Aeration Lanes, Beckton Sewage Works
Site code: AFW04
Type of evaluation: Building Analysis and Recording
Date and duration of project: Site work undertaken 25-27 May 2004
Location of archive: The archive is currently held at OA,
Janus House, Osney Mead, Oxford, OX2 0ES.

List of Archived Items:

Six films of 35mm photographic negatives (black and white prints)
Six sets of black and white photographic prints (contact sheets)
Six films of 35mm colour slides
A copy of the current report
Original site drawings to permatrace
Descriptive notes

Beckton Sewage Works
Precipitation lanes and re-aeration lanes
London Borough of Newham

Historic Building Investigation and Recording

Oxford Archaeology

October 2004

Client: Scott Wilson

Issue N^{O}: 2
OA Job N^{O}: 2267
NGR: TQ 451 822

Figure 1: Site location

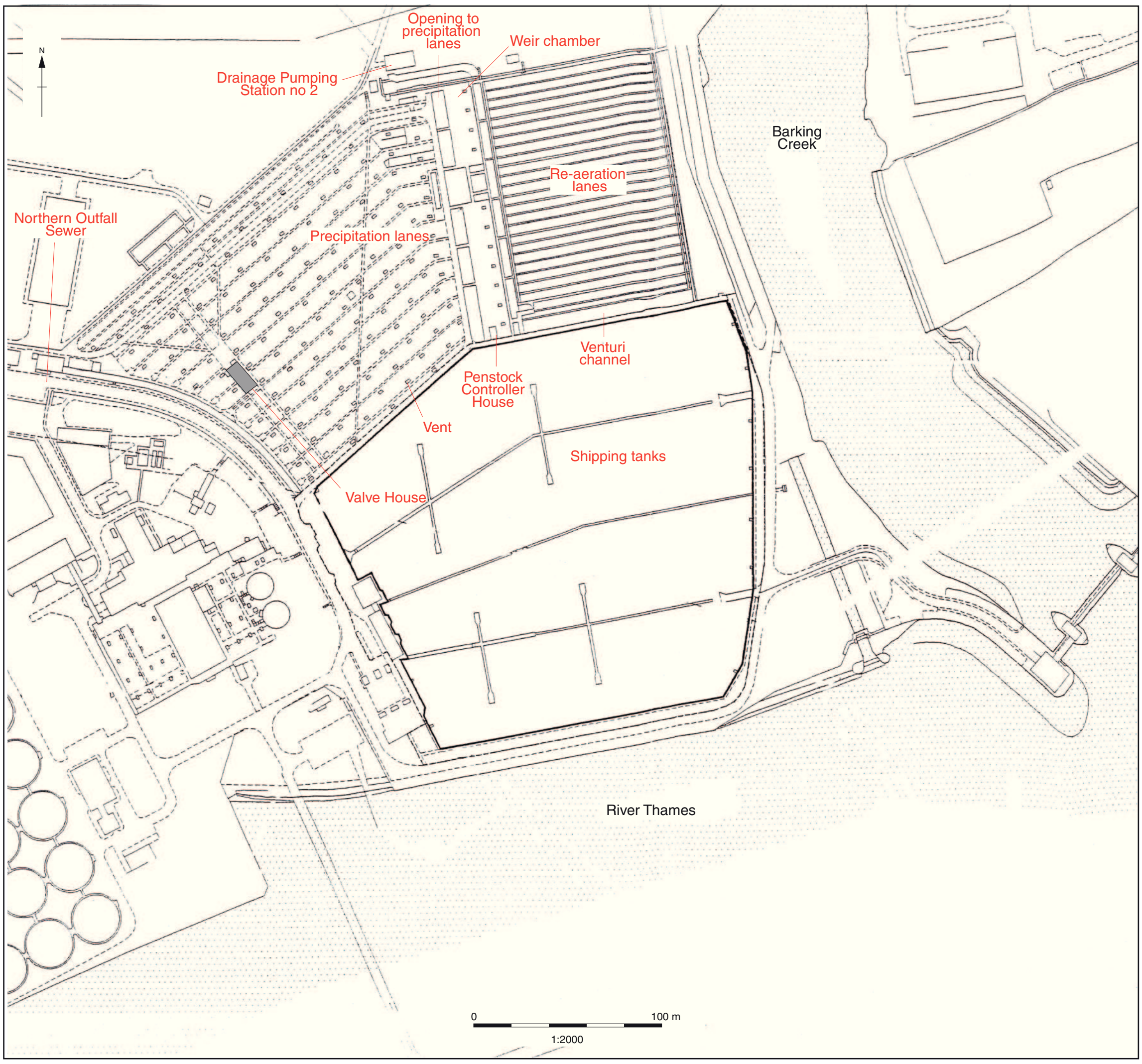


Figure 2: Site plan

Not to scale

Figure 3: Mudge's map of Kent (1801)

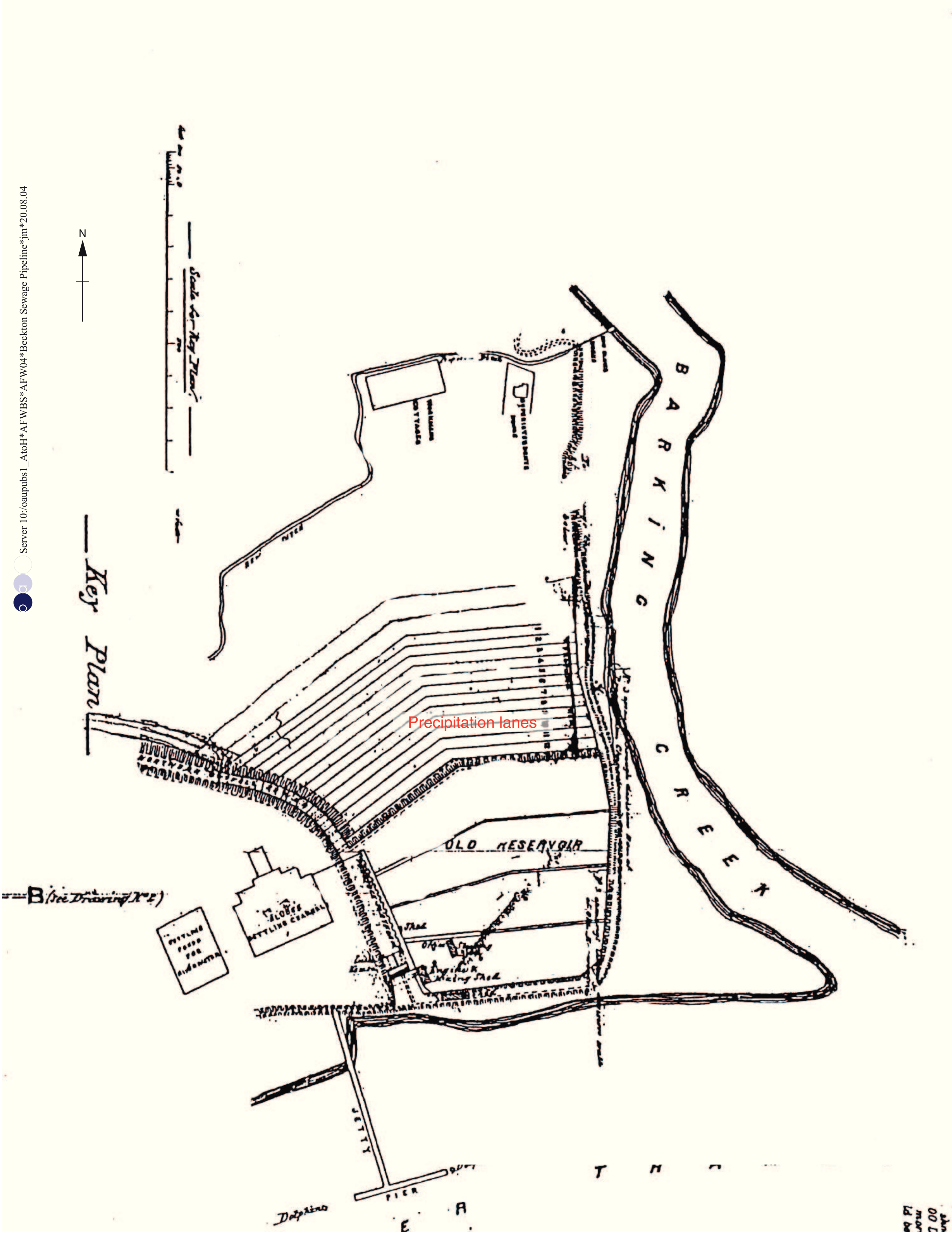


Figure 4: Plan showing orginal layout of precipitation lanes (date unknown, pre -1960)

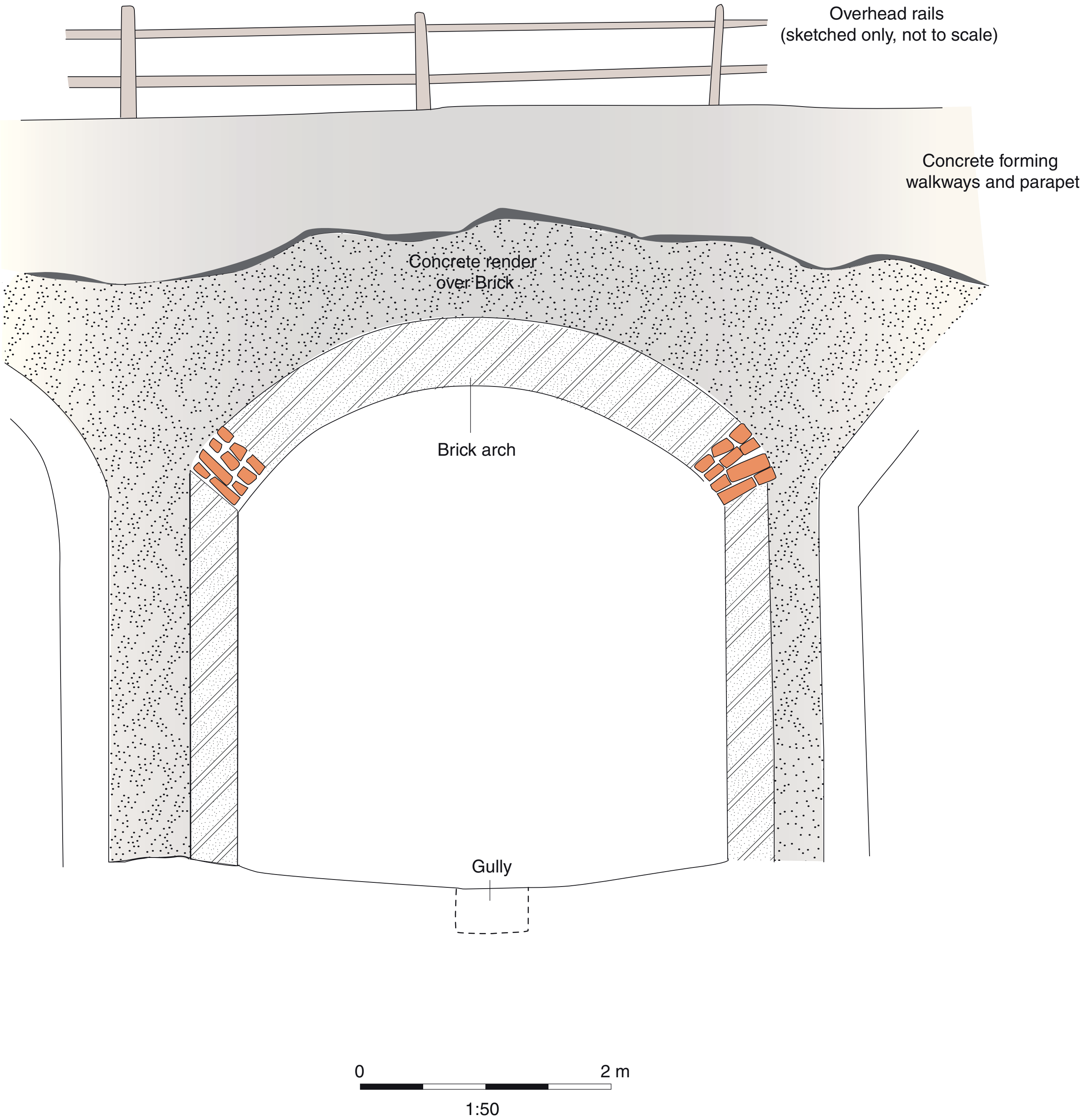
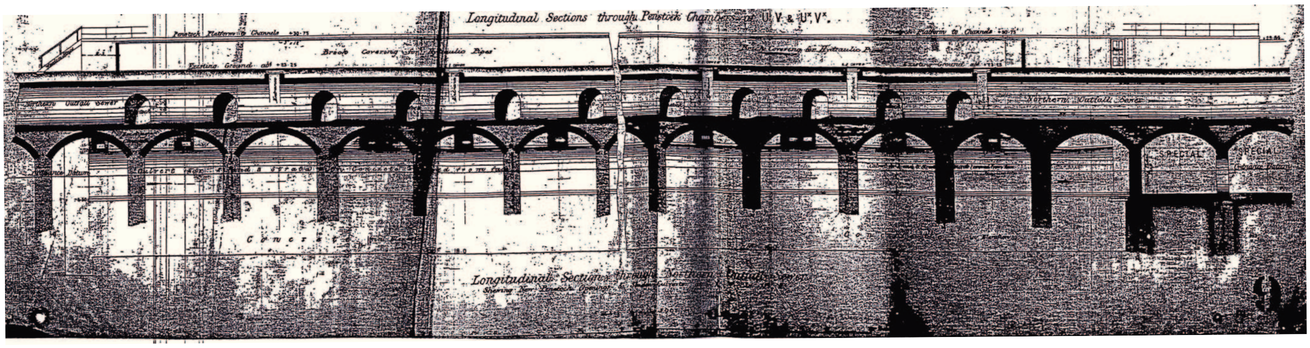
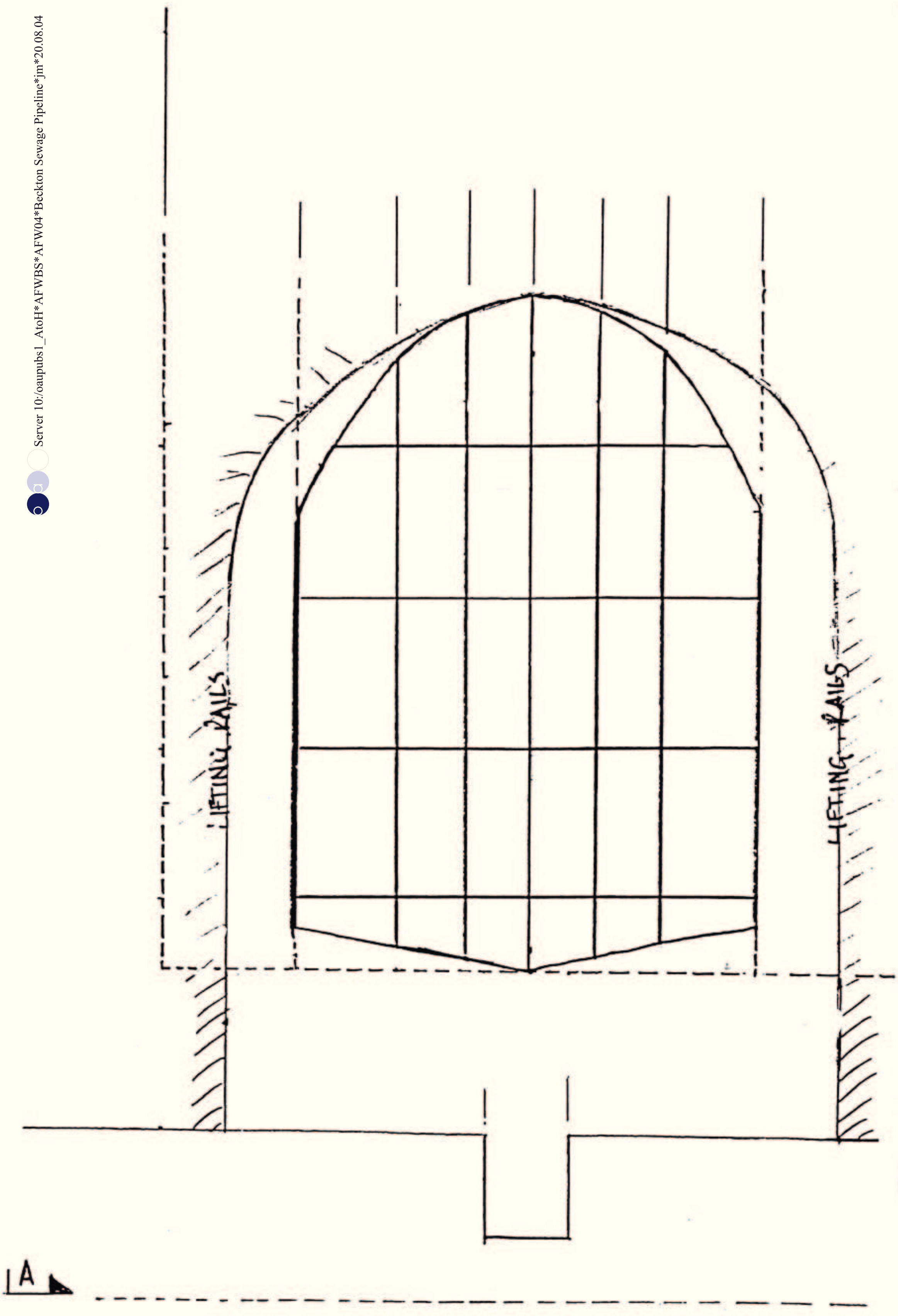


Figure 5: Section of typical precipitation lane



Not to scale

Figure 6: Section of Northern Outfall Sewer, showing foundations and penstock chambers (date unknown)



Reproduced from drawing no SK/83120/160/REV A, Interserve

0 1 m

1:20

Figure 7: Plan of typical penstock at south-west termination of precipitation lanes

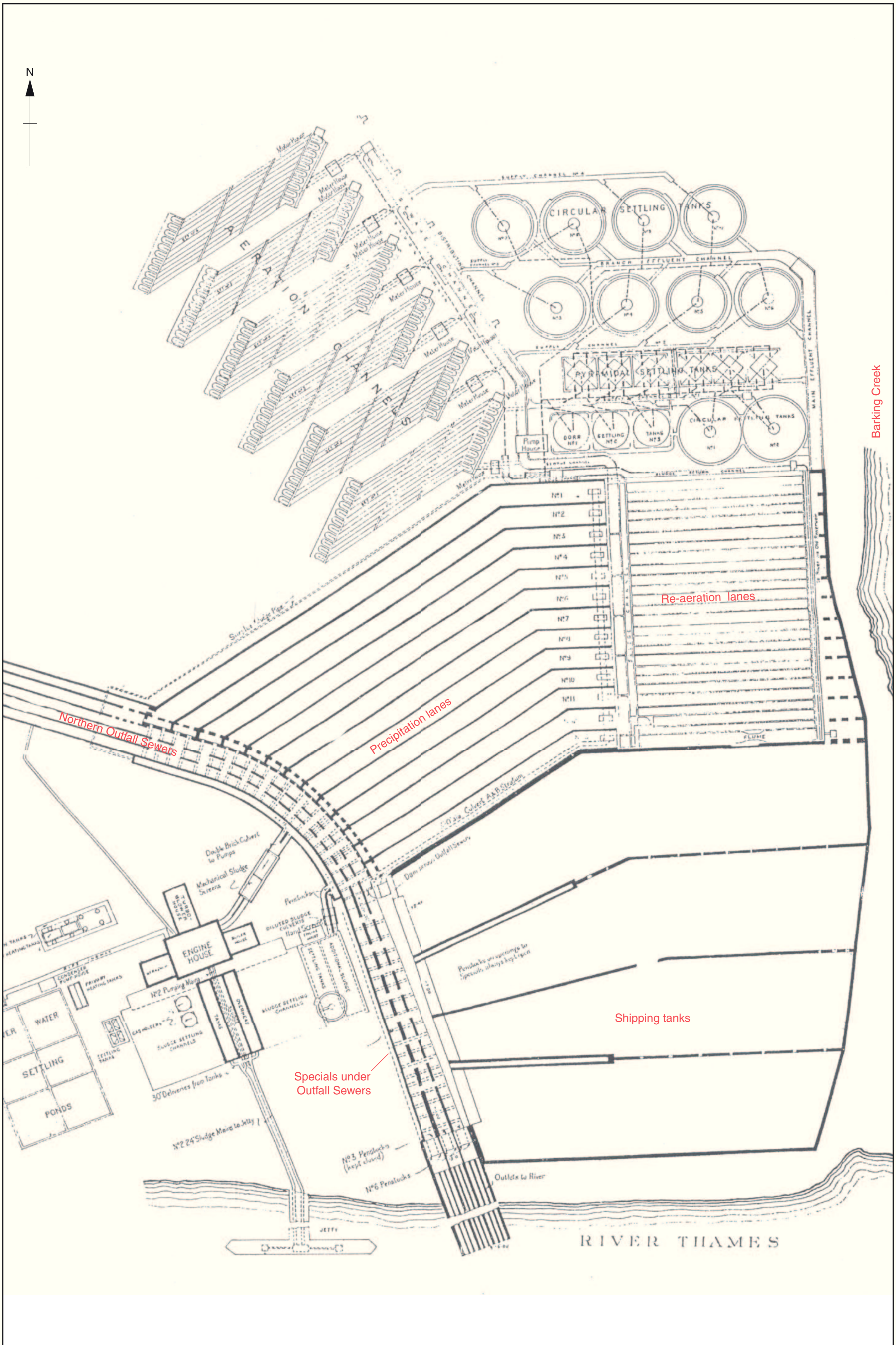


Figure 9: Plan showing Northern Outfall Sewer, (date unknown, post 1960)

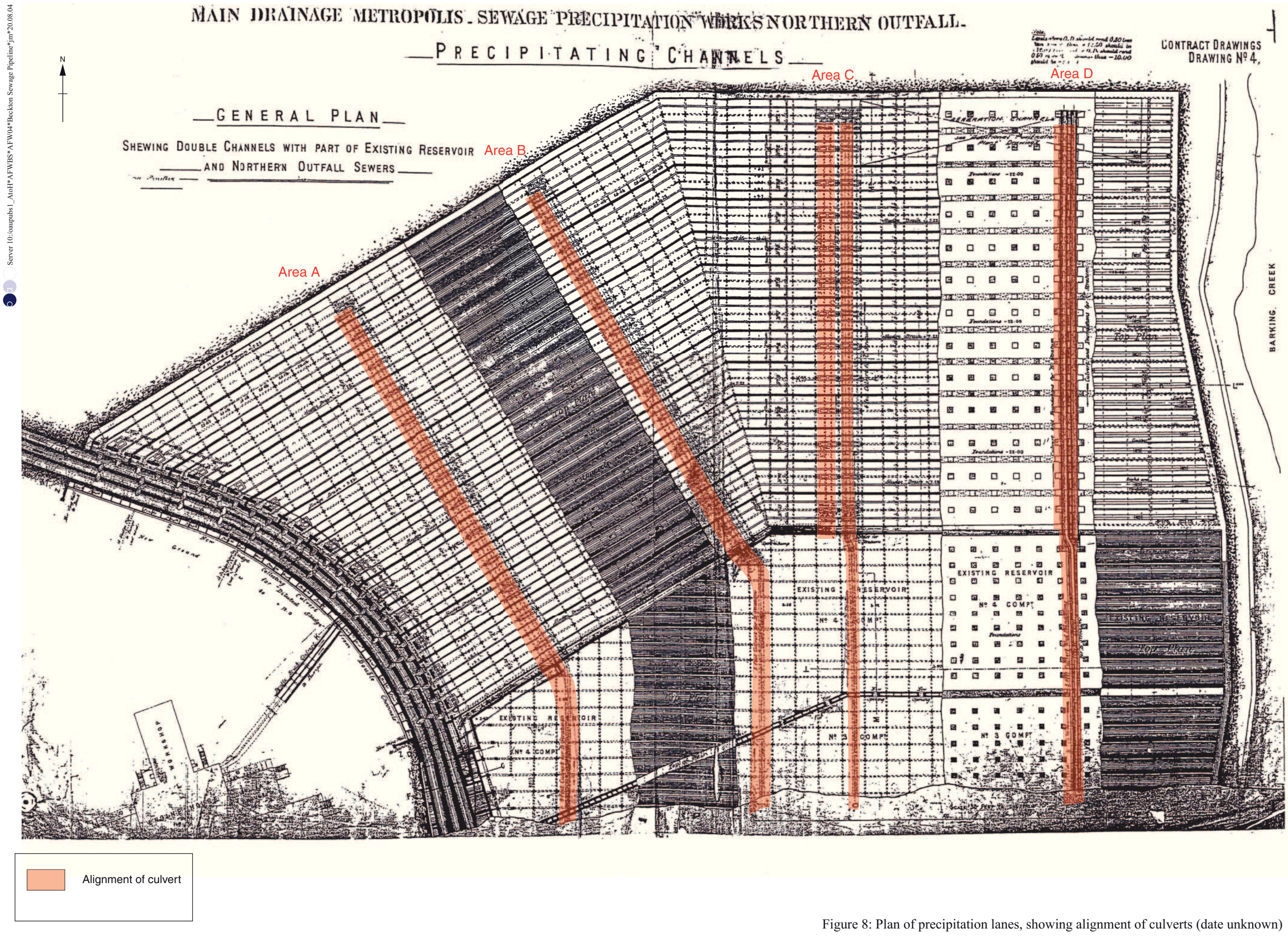


Figure 8: Plan of precipitation lanes, showing alignment of culverts (date unknown)

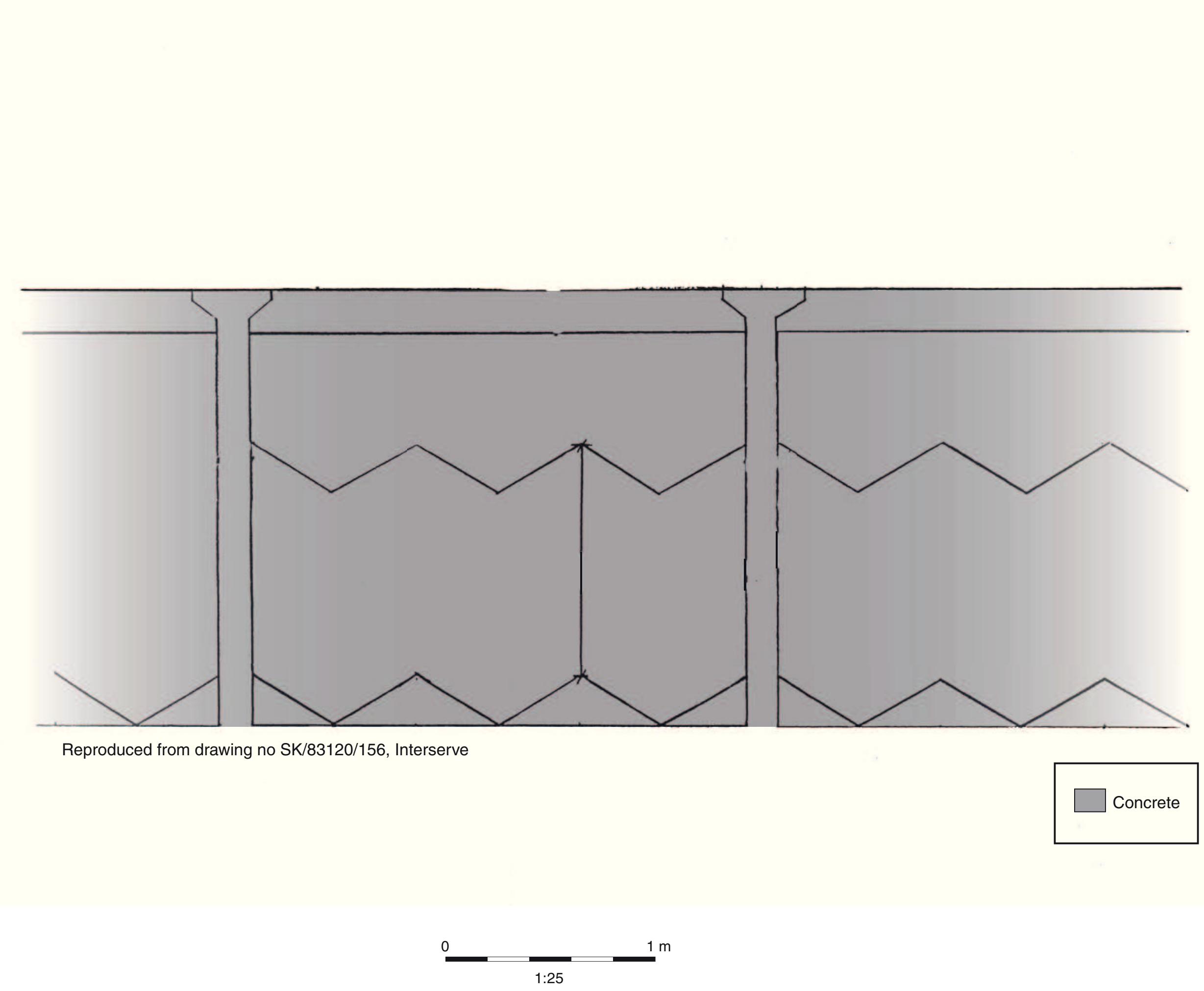


Figure 10: Section of re-aeration lanes

Plate 1: South view of precipitation lanes

Plate 2: North-west view of covered precipitation lanes showing vents

Plate 3: East termination of precipitation lanes

Plate 4: Southern precipitation lanes, east and west facing arches

Plate 5: East facing arch of precipitation lane

Plate 6: North view showing construction of precipitation lanes

Plate 7: Precipitation lanes west facing arches

Plate 8: Internal north view of open arches dividing precipitation lanes

Plate 9: Internal west view of precipitation lanes

Plate 10: Internal north view of precipitation lanes showing partition walls and wooden gates

Plate 11: Penstock at south-west termination of precipitation lane

Plate 12: South-west view of weir chamber penstock

Plate 13: North-east view of box weirs at east termination of precipitation lanes

Plate 14: North view of weir located in south-west length of precipitation lanes

Plate 15: Box weir located at south-west termination of precipitation lanes

Plate 16: East view depicting brick troughs above precipitation lanes (taken during demolition works)

Plate 17: West view of vent above precipitation lanes

Plate 18: North-east view of blocked precipitation lane arch at east termination of re-aeration lanes

Plate 19: East view of shipping tanks

Plate 20: East view of re-aeration lanes

Plate 21: East view showing base of re-aeration lanes

Plate 22: South view of penstocks at east

Plate 23 North view showing weir chamber penstocks

Plate 24: West view of venturi channel penstocks

Plate 25: East view of venturi channel

Plate 26: South view of weir chamber

Plate 27: North view of valve house


Plate 28: Valve House, south-west elevation


Plate 29: Valve House windows, south-west elevation


Plate 30: Internal north-east view showing upper room of Valve House


Plate 31: Internal north-east view showing the Valve House basement

Plate 32: South-east view of Drainage Pumping Station no.2

Plate 33: South elevation of Drainage Pumping Station no.2

Plate 34: East view showing entrance of Drainage Pumping Station no. 2

Plate 35: Internal west view of Drainage Pumping Station no.2

Plate 36: Internal east view of square platforms within Drainage Pumping Station no. 2

Plate 37: Internal east view of iron pipes within Drainage Pumping Station no. 2

Plate 38: Internal east view of controls boxes within Drainage Pumping Station no. 2

Plate 39: South-west view of Penstock Controller House

Plate 40: North-east view of administration building