University of Salford MANCHESTER

Archaeological Excavation

Site D, Trinity Islands, Regent Road, Manchester

Client:
Trinity Developments (Manchester) Ltd

Planning Ref:
132429/FO/2021 and 134039/FO/2022

Technical Report:
Katie Fletcher

Report No:
SA/2022/99

The Centre for Applied Archaeology

REGISTERED ORGANISATION CIfA

Location:	The site is bounded by Water Street, Trinity Way and the River Irwell in Manchester city centre		
NGR:	SJ 82700 97750		
Project:	Site D, Trinity Islands, Regent Road, Manchester		
Planning reference:	132429/FO/2021 and 134039/FO/2022		
Internal reference:	SECL2216 / SECL 2266		
Report number:	SA/2022/99		
Prepared for:	Trinity Developments (Manchester) Ltd		
Document:	Archaeological Excavation Report		
Version:	1		
Author:	Katie Fletcher		
Position:	Supervising Archaeologist		
Date:	October 2022		
Approved by:	Joe Brooks	**Signed:**	[redacted]
Position:	Post-excavation Manager		
Date:	October 2022		
Copyright:	Copyright for this document remains with the Centre for Applied Archaeology, University of Salford		
Contact:	Salford Archaeology, Centre for Applied Archaeology, LG 19 – 26 Peel Building, University of Salford, the Crescent, Salford, M5 4WT		
Email:	[redacted]		

Disclaimer:

This document has been prepared by the Centre for Applied Archaeology, University of Salford for the titled project or named part thereof and should not be used or relied upon for any other project without an independent check being undertaken to assess its suitability and the prior written consent and authority obtained from the Centre for Applied Archaeology. The University of Salford accepts no responsibility or liability for the consequences of this document being used for a purpose other than those for which it was commissioned. Other persons/parties using or relying on this document for other such purposes agrees and will by such use or reliance be taken to confirm their agreement to indemnify the University of Salford for all loss or damage resulting therefrom. The University of Salford accepts no liability or responsibility for this document to any other party/persons than by whom it was commissioned.

CONTENTS

SUMMARY 3

1. INTRODUCTION 5

2. AIMS AND OBJECTIVES 7

3. LOCATION, TOPOGRAPHY AND GEOLOGY 9

4. HISTORICAL BACKGROUND 10

5. METHODOLOGY 19

6. EVALUATION RESULTS 21

7. DISCUSSION 46

8. CONCLUSIONS 65

9. ARCHIVE 68

10. ACKNOWLEDGEMENTS 69

BIBLIOGRAPHY 70

APPENDIX 1: CONTEXT INDEX 72

APPENDIX 2: FINDS REPORT 74

APPENDIX 3: FIGURES 88

SUMMARY

This report details the results of an archaeological excavation at Trinity Islands – site D, Regent Road, Manchester, Greater Manchester (centred on NGR SJ 82700 97750). The work was undertaken by Salford Archaeology and was commissioned by Trinity Island Developments (Manchester) Ltd who have submitted a planning application (132429/FO/2021 and 134039/FO/2022) to Manchester City Council for the redevelopment of land in the southernmost extent of the St John's Strategic Masterplan area. The proposed scheme involves the erection of two residential apartment blocks, with commercial premises, public realm, car and cycle parking and highways works. As such, the construction works will necessitate considerable earth-moving works, with a potential to remove any buried archaeological remains that may exist within the development site.

A desk-based assessment highlighted the archaeological interest in the site, which included the potential site of a late 18th-century dye works, an early 19th-century warehouse, and mid-19th-century chemical works, a boat house and a row of workers' houses. In light of the potential surviving archaeological remains on the site, the Greater Manchester Archaeological Advisory Service (GMAAS), in their role as advisors to the Local Planning Authority, recommended that an archaeological evaluation should be undertaken in advance of development.

In June 2022, six trial trenches were excavated across the sites of archaeological interest, partially revealing the reasonably well-preserved remains of flue systems in Trench 1. An open-area excavation was recommended by GMAAS to further investigate the remains revealed in Trench 1 and the area to the southeast. The excavation uncovered the remains of a large octagonal chimney base, cruciform engine bed, the partially exposed remains of a boiler house, flue systems and working floor surfaces, which were associated with a late 19th-century refuse destructor site at Manchester Corporation Cleansing Yard. The cleansing yard was established to undertake municipal waste collection and disposal.

Historical sources imply that Manchester Corporation built an early furnace at the Water Street depot in 1873. The incinerator was a crude furnace that would have had limited success. In 1876, Water Street was the first waste disposal centre to be fitted with the first operational incinerator, designed and patented by Alfred Fryer and engineered by Manlove, Alliott & Co. Ltd of Nottingham. The destructor had to reach extremely high temperatures to reduce the refuse and eliminate noxious gases produced during incineration. The heat produced from the incinerators could be used to raise steam and thus power engines without burning coal. Waste disposal centres became profitable works, using waste as fuel to power sewage pumping works, mortar mills and generated electricity. Manchester Corporation installed several onsite

mortar mills and may have generated electricity for onsite consumption. The mortar mills made use of clinker, a by-product of incineration.

Throughout the late 19th and early 20th centuries, incinerators were continuously improved, but were all based on Fryer's design. Henry Whiley, the superintendent at the Water Street depot, patented his own design in 1891, which was built at the corporation yard. He had also reportedly altered the Fryer destructor that had been installed. By 1898, the site had 28 destructor cells, with at least four different design types.

The remains exposed within the open area excavation trench were built between 1891 and 1896. Remains associated with this phase included the lower courses of the chimney base, an engine bed, boiler housing, flues and a possible partially exposed furnace. Several phases were identified within the archaeological remains, which were likely associated with improvements (possibly to increase furnace temperatures, improve draught and potential prevent unburnt refuse from falling into the flue to the chimney) and potentially with the installation of new machinery in 1929.

Most of the excavated remains, including the chimney, engine house and boiler house may have been associated with the '*12 modern-type destructor cells, two Galloway boilers that powered driving engines of 300-horsepower and a 200 ft. high chimney shaft'* described by Maxwell in 1898. The flues were most likely connected to a Whiley-type destructor as these were the most common kind of destructor at the Water Street depot (Goodrich reported that Water Street had 28 destructors of this type in 1901).

The archaeological remains recorded were deemed to be of regional importance. No further onsite work was merited however, to fulfil the demands of the planning condition an article will also be sent for inclusion in the journal *Industrial Archaeology Review*.

1. INTRODUCTION

1.1.1 A full planning application (132429/FO/2021 with variations 134039/FO/2022) has been submitted to Manchester City Council for the redevelopment of site D, Trinity Islands, Regent Road, Manchester, situated in the southernmost extent of the St John's Strategic Masterplan area (referred to herein as the 'site'; centred on NGR SJ 82700 97750; Plate 1; Figure 1). The proposed scheme involves the erection of two tower blocks, comprising a 60-storey and 55-storey mixed residential and commercial development, with public realm, car and cycle parking and highways works. As such, the construction works will necessitate considerable earth-moving works, with a potential to remove any buried archaeological remains that may exist within the development site.

1.1.2 The archaeological interest in the proposed development area was highlighted in a desk-based assessment prepared by Salford Archaeology in December 2020. The desk-based assessment concluded that the site had the potential to contain below-ground remains of potential archaeological interest including a late 18th-century dye works, an early 19th-century warehouse, mid-19th-century chemical works, a boat house and a row of workers' houses. In addition, whilst there no finds of Roman date have been recovered from the vicinity of the site, the possibility of discovering remains deriving from this period cannot be discounted.

1.1.3 As there was the potential for archaeological remains to be present on the site, the Greater Manchester Archaeological Advisory Service (GMAAS), in their role as advisors to the Local Planning Authority, attached a condition (Condition 13) to planning consent, recommending that 'archaeological evaluation trenching should take place within the site, and pending the result of the above, a targeted open-area excavation'. The condition also stated that the programme of archaeological works should be undertaken in line with a written scheme of investigation (WSI), which was produced by Salford Archaeology in December 2020 (Salford Archaeology 2020).

1.1.4 The archaeological evaluation trenching was carried out in June 2022 and was followed by an open area excavation (Figure 2). The archaeological works were supervised by Julian Thorley and the project was managed by Graham Mottershead, both of Salford Archaeology.

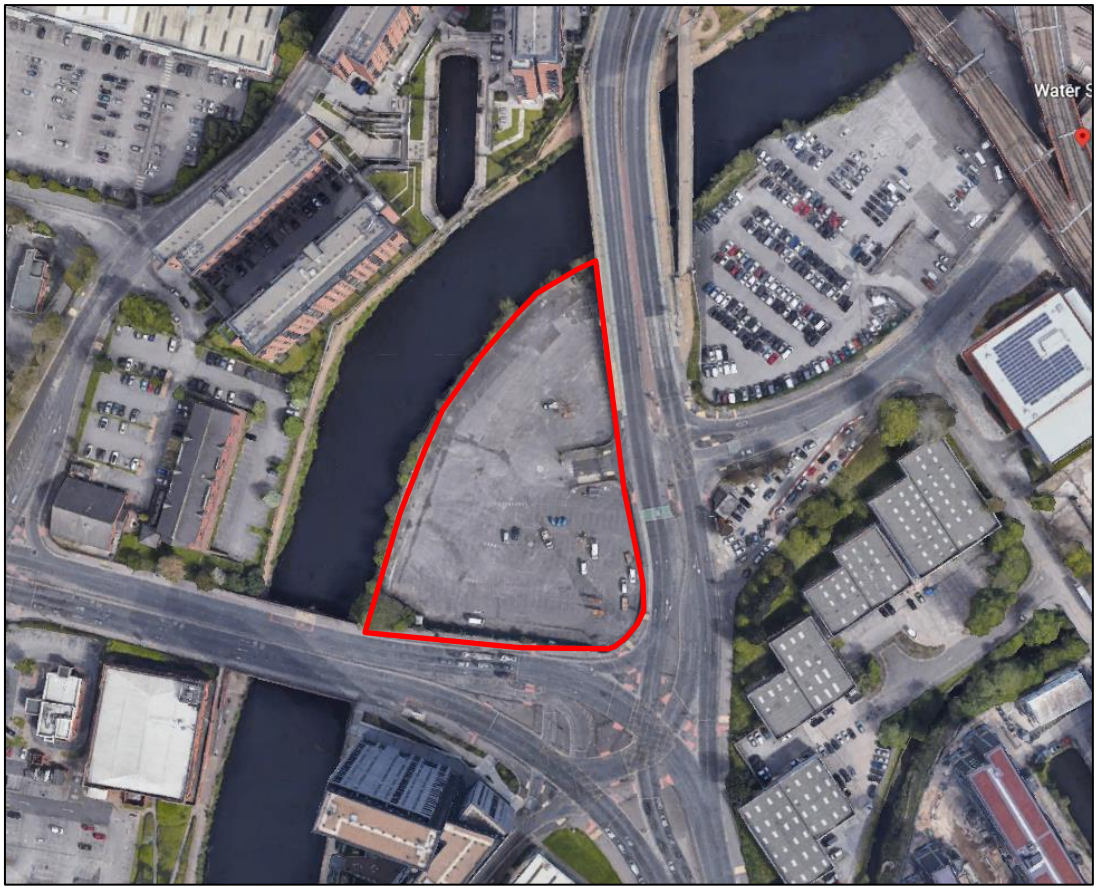

Plate 1: Aerial view of the site with the western (left) and eastern (right) areas outlined in red, north at top

2. AIMS AND OBJECTIVES

2.1 Academic Aims

2.1.1 In the first instance, the main aim of the evaluation trenching was to establish the presence or absence of any buried remains of archaeological interest within the proposed development area and, if present, characterise the level of preservation and significance, and provide a good understanding of their potential. This was achieved via the excavation of six targeted trial trenches, placed across the footprint of former buildings of potential archaeological interest that were identified in the desk-based assessment (Salford Archaeology 2020).

2.1.2 The results obtained from the evaluation merited further archaeological investigation in advance of development. This approach to devising proposals to mitigate the impact of development on the archaeological resource of the development area is in accordance with national guidelines set out in the National Planning Policy Framework: Section 16 – Conserving and enhancing the historic environment.

2.2 Objectives

2.2.1 The principal objectives of the archaeological investigation were:

- to record, as far as is reasonably possible, the location, extent, condition, significance and quality of any surviving archaeological remains observed;
- to establish whether there is any evidence of pre-industrial activity on site, and especially any activity associated with water-borne transport on the River Irwell;
- to establish whether there is any remains associated with the use of the site by the New Quay Company;
- to establish the presence or absence of any buried remains of the late 18th century dye works and it's mid-19th-century incarnation as a chemical works;
- to establish whether there is any below-grounds remains of the early 19th-century warehouse for the New Quay Company;
- to provide sufficient information to enable an informed decision to be made about the need for any additional archaeological mitigation; and
- to make available the results of the work in an appropriate format

2.3 It was anticipated that the archaeological investigation would address several of the agenda for archaeological research of the industrial and modern periods stated in the

current *North West Regional Research Framework* (NWRRF 2021). In particular, the work had the potential to contribute to the understanding of industries that require further study and the development of technology:

- *PM27*: How do the industries associated with the North West evolve and develop during this period?
- *Ind52*: What Industrial and Modern period type sites need further study?
- *Ind53*: What can archaeology tell us about the production and use of consumer products and their typologies from the late 18th to early 20th centuries?
- *Ind55:* What is the evidence for the development of power production?
- *Ind56:* How can we improve our understanding of 20th-century factory organisation
- *Ind58:* How have industrial buildings adapted to new technology and processes?
- *Ind60*: How can we make sense of the relative significance of historic industrial processes and building types perceived as poorly understood and recorded?

3. LOCATION, TOPOGRAPHY AND GEOLOGY

3.1 The site (centred on NGR SJ 82815 97850) is situated on the south-western edge of Manchester city centre, and forms the southernmost extent of the St John's Strategic Masterplan area on Water Street (Plate 1; Fig. 1). The site is bounded by the River Irwell to the north and west, Trinity Way to the east and Regent Road to the south. The site situated entirely within the Castlefield Conservation Area.

3.2 Topographically, the Manchester Conurbation as a region is within an undulating lowland basin, which is bounded by the Pennine uplands to the east and to the north. The region as a whole comprises the Mersey river valley, whilst the rivers Irwell, Medlock, and Irk represent the principal watercourses in Manchester (Countryside Commission 1998, 125). The site lies on the south bank of the River Irwell, and occupies a fairly level terrace at a height of *c.* 26m above Ordnance Datum (AOD).

3.3 The solid geology of the area comprises Carboniferous sedimentary material and a series of Permo-Triassic rocks, consisting mainly of New Red Sandstone. The overlying drift incorporates Pleistocene boulder clays, and sands, gravels, and clays of fluviatile/lacustrine origin (Ordnance Survey Geological Survey 1970).

4. HISTORICAL BACKGROUND

4.1.1 The following information is derived from a desk-based assessment of the site produced by Salford Archaeology in 2020 (Salford Archaeology 2020).

4.2 Prehistoric

4.2.1 The current understanding of any human activity in the Manchester region during the prehistoric period is poor, although it is reasonable to suggest that the Castlefield area may have been conducive for late prehistoric settlement on account of the natural topography and its location close to the confluence of the rivers Medlock and Irwell (UMAU 2002). However, physical evidence is wanting, and there are no known prehistoric remains within 250m of the site, and arguably the best evidence for prehistoric activity in the vicinity was yielded from an archaeological excavation that was targeted on a plot of land adjacent to Liverpool Road in Castlefield (Gregory 2007, 181). During the course of this work, two Mesolithic flints, one Neolithic/Bronze Age waste flake, and a single fragment of late Bronze Age/Iron Age pottery were recovered (HER 13944.1.0), although none was found in securely stratified deposits. More recently, an archaeological evaluation of land at the corner of Quay Street and Lower Byrom Street by Pre-Construct Archaeology in 2001 revealed archaeological features comprising a quarry pit and two postholes at a depth of *c.* 0.5m below the modern ground surface. More detailed excavation carried out subsequently yielded a Neolithic flint blade from one of the pits, although this was considered to be residual (Pre-Construct Archaeology 2002).

4.3 Roman

4.3.1 The first military occupation of Manchester was established during the governorship of Agricola (AD 77-84), and commenced with a five-acre wooden fort, known as *Mamucium*, situated *c.* 400m southeast of the site (Bruton 1909). The fort underwent several phases of development and subsequently, the earlier defences were deconstructed and improved. The military complex evolved in response to ongoing military campaigns, from a purely defensive site to an established supply depot, essential to the expansion and consolidation of control in the north. The maturation of the military complex can be seen in the growing body of evidence for a military annexe, occupying an area to the north and east of the fort (Gregory 2007). Evidence pertaining to this annexe is relatively scant and thus the exact nature of the early settlement is unclear.

4.3.2 Roads from the fort linked Manchester with Ribchester to the north (HER 14.1.0), Castleshaw, and York to the northeast, Wigan to the northwest, Chester to the south, and Buxton to the southeast (HER 28.1.3). It is also likely that the Roman settlement was served by water-borne transport that plied the River Irwell, although this awaits confirmation and there has, to date, been no physical evidence to demonstrate that Roman ships supplied *Mamucium*.

4.3.3 Based on recent archaeological excavations and the distribution of Roman finds, the limits of the Roman settlement appear to have extended northwards from the fort to approximately Quay Street, westwards along Liverpool Road for *c.* 100m from the northwest corner of the fort, eastwards across Deansgate to the area now occupied by the Beetham Tower, and south-eastwards along Chester Road, terminating somewhere in the vicinity of Great Jackson Street.

4.3.4 The site thus lies beyond the western edge of the suspected limits of the settlement core, although it is also possible that Roman remains may exist along the eastern bank of the River Irwell. Six Roman coins, at least five of which dated to the 2nd century, are reported to have been found in 1876 'while foundations were being dug for a bridge over the Irwell, near Quay Street' (Conway *et al* 1909, 84-5). These finds may therefore suggest that the eastern bank of the Irwell witnessed more ephemeral Roman activity on the fringe of the Roman settlement, which was potentially associated with commercial use of the river bank.

4.4 Medieval

4.4.1 There is scant archaeological evidence in the region as a whole that represents the period between the end of the Roman occupation and the Norman Conquest, although the area around Manchester is known to have come under the control of several kingdoms during this period. In AD 620, Edwin conquered and occupied Manchester, and it may have been at this time that settlement in the town was established around the cathedral (Farrer and Brownbill 1911). A gold finger ring (HER 9916.1.0), discovered in antiquity, has been traced to the Castlefield area, providing rare physical evidence for human activity in Manchester during this period.

4.4.2 In AD 919, the Anglo-Saxon king Edward the Elder established a fortified base, or burh, at Manchester, which was then part of Viking Northumbria. It has been suggested that the burh lay within the area around the cathedral, on the northern edge of the modern city centre. The area of the cathedral had certainly become a new focus for settlement by the late 11th century, and the site occupied presently by Chetham's School is thought to have been the site of a castle founded by Manchester's Norman

barons. This early settlement at the confluence of the Irwell and Irk seems to have been bounded on the landward side by Hanging Ditch, whose curving line ran between the two rivers, taking a line that was followed subsequently by Toad Lane, the forerunner of Todd Street and Corporation Street.

4.4.3 Post-Conquest Manchester was established around the manor house and parish church of St Mary, located over 1km to the north-east of the site. In 1223, the right to hold an annual fair was obtained, and the town was important enough to be granted a charter in 1301 (Kidd 1993, 14). A deer park, named Aldport Park (HER 112.1.0) was located towards the south end of Deansgate, bordered to the north by modern day Peter Street and Quay Street, and to the south by the River Medlock. The park is documented from the late 13th century, and is thought to have still been existence in the 16th century (Miller and Cook 2019).

4.4.4 The vicinity of Castlefield remained almost wholly undeveloped until the 18th century; the only known activity in the area during the late medieval period was focused upon a mill at Knott Mill to the west of the site (GMAU 1993). The earliest reference to this mill dates from 1509, when a licence was given for the mill dam. It has been suggested that the mill, and subsequently this part of Manchester, derived its name from the miller (Farrer and Brownbill 1911, 178). The site of the mill is thought to have been incorporated into, or built upon, by the Duke's Warehouse in the late 18th century (HER 9849.1.0).

4.5 Post-medieval and Industrial

4.5.1 The onset of the rapid industrialisation centred on Manchester from the 18th century resulted in a massive expansion of the town's population. It was during this period that some of the principal streets, including Deansgate, Market Street and Shude Hill, developed commercially (Farrer and Brownbill 1911, 180). By the 1780s, the national demand for textiles, particularly cotton, began to rise, resulting in a dramatic increase in mill building that transformed Manchester into a centre of the factory-based cotton manufacturing industry of international repute (Baines 1835). This process of industrial development was facilitated greatly by the introduction of efficient transport systems, initially in the form of water-borne shipping on the River Irwell and, from the mid-1760s, the Bridgewater Canal.

4.5.2 The Mersey & Irwell Navigation was probably completed in 1736 and, by 1740, wharfage facilities for boats of up to 50 tons were provided by a quay established on the Manchester side of the river by Edward Byrom, a wealthy fustian dealer and one of the proprietors of the Mersey & Irwell Navigation Company (McNeil and Newman

2006, 172-173; Hadfield and Biddle 1970). The quay was built a short distance to the northwest of the present site in 1735, at the bottom of what in that year became Quay Street, strategically located to carry much of the town's trade, with a river frontage of 136 yards (George and Brumhead 2002, 22). This street also linked to Water Street, which joined with Quay Street at a right angle and provided a more direct link between the quay and the town, and appears from the map evidence to have been laid out in about 1750 (Gregory and Bell 2008). The second half of the 18th and early 19th centuries were characterised by significant advances in water-borne infrastructure in Manchester, and particularly the expansion of the canal network, and the development of pre-existing areas of wharfage along Water Street (George and Brumhead 2002).

4.5.3 The first true industrial canal in Britain was that built by the Duke of Bridgewater, which was completed from his mines at Worsley to Manchester in 1764, the terminus of which was at Castlefield (Hadfield and Biddle 1970). Of particular relevance to the present study area is the Manchester, Bolton, & Bury Canal, which was in use by 1795, and provided a means of transporting coal to Manchester and Salford from the collieries situated to the north in the Irwell valley (Gray 1989, 6). This canal was linked to the River Irwell via a series of six locks, although it had been proposed originally to construct an aqueduct over the River Irwell to link with the Rochdale Canal. This venture collapsed in 1801, but the proposal ultimately led to the construction of the Manchester & Salford Junction Canal, which eventually opened in October 1839, taking a route immediately to the north of the site.

4.5.4 The development of the present study area between the mid-19th and 20th centuries was dominated by the introduction of railways. The earliest railway in the area dates to 1830 and was constructed by the Liverpool and Manchester Railway (L&MR) Company. This railway linked Liverpool and Manchester, and Liverpool Road Station formed its Manchester terminus, representing the first railway passenger station in the world. This terminus lay either side of Water Street. The line was originally carried across the River Irwell and Water Street by a skewed masonry bridge, designed by George Stephenson (Fitzgerald 1980, 19), and a brick-built viaduct (HER 12145.1.0) and brick and cast-iron girder bridge, which were both constructed by Brockbank and Findlay (Thomas 1980, 50).

4.5.5 Further developments to the rail system occurred in the 1840s due to the opening of a railway line in 1844, running from Ordsall Lane to the newly opened station at Hunt's Bank (later Victoria). In addition, the site is also traversed by a line constructed by the

Manchester & South Junction & Altrincham Railway (MSJ&AR), which opened in 1849, and was designed as a link between London Road (later Piccadilly) Station and the L&MR line at Ordsall Lane (Holt 1986, 114). Adjacent to the site, this line was carried on a brick-built viaduct (HER 3081.1.0), with a bridge across the Irwell, and a cast-iron bridge across Water Street, all of which are extant and form a Grade II Listed Building.

4.6 Development of the site

4.6.1 The development of the site may be traced reasonably well from the sequence of available historic mapping. The earliest reliable plans of Manchester are provided by four successive plans of Manchester produced between 1741 and 1751 by the cartographers Russel Casson and John Berry. These show Quay Street and Water Street, which converged at the buildings of the Old Quay Company on the River Irwell. Under an Act of Parliament of 1721, the company had been empowered to make the River Mersey and River Irwell navigable between Warrington and Manchester (UMAU 2003). The navigation was probably completed in 1736, and by 1740 the company had built a quay and warehousing at the bottom of Quay Street (Hadfield and Biddle 1970, 16-8). The site lies beyond the edge of Casson and Berry's maps, however, suggesting that it lay beyond the urban fringe of Manchester in the mid-18th century.

4.6.2 The following years were characterised by rapid development, which is captured on Laurent's map of 1793 (Plate 2). Laurent's plan shows elements of a dye works to have been established in the site. The Hanley Dye Works (HER 12364.1.0) straddles the north-eastern boundary of the site, with a larger dye works (HER 12367.1.0) lying immediately to the north-east of the site, and another to the south (Figure 2).

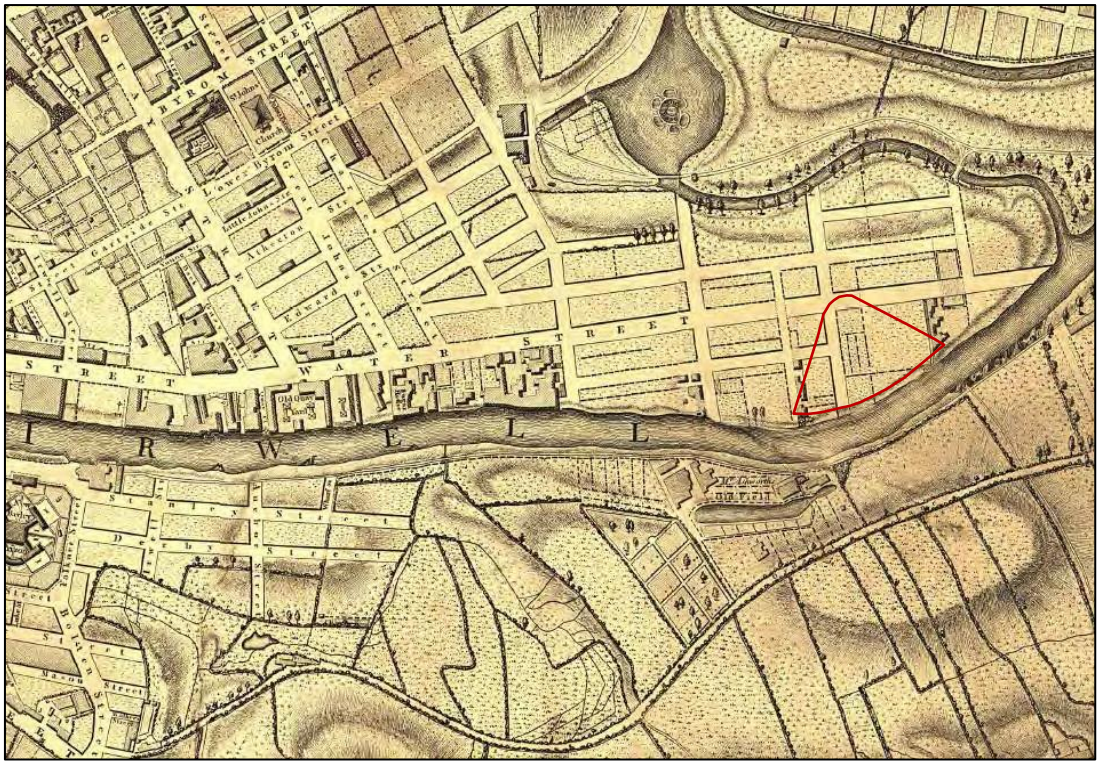

Plate 2: Extract from Laurent's Plan of 1793, showing the site boundary

4.6.3 Bancks & Co's Map of Manchester and Salford, which was published in 1831 (Figure 4), shows the former Hanley Dye Works to have been remodelled or redeveloped as a U-shaped range of buildings associated with the New Quay Company. The south-eastern part of the site appears to have been developed as formal gardens, possibly associated with a bowling green.

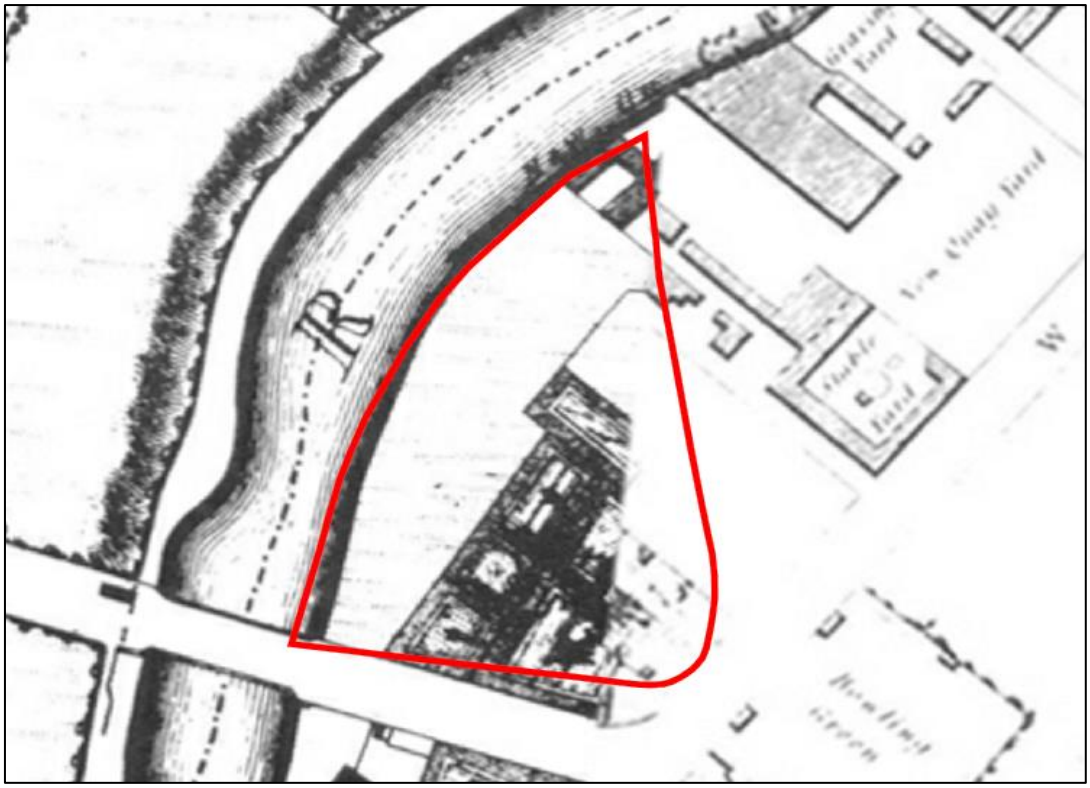

Plate 3: Extract from Bancks's map of 1831, showing the site boundary

4.6.4 The next detailed plan of the area is provided by Adshead's map of 1850 (Plate 4). The U-shaped range of buildings forming the stores for the New Quay Company appears to have been remodelled as a long, linear range, abutted on its southern side by Hanley & Co's Chemical Works, which is likely to have included elements of the 18th-century dye works. This works was probably occupied by Alexander McDougall & Co, listed as 'manufacturing chemists' in a trade directory for 1850 (Slater 1850, 104), presumably supplying materials required by the area's thriving textile-finishing industry. A boat house with its associated slipway had also been built by the mid-19th century, occupying the southwestern corner of the site. The southeastern corner of the site had also been developed by the mid-19th-century, with a row of buildings erected along the north side of Regent Road. Shading on Adshead's map indicates that most of these buildings were houses, with a single property towards the eastern end of the row in use as a shop.

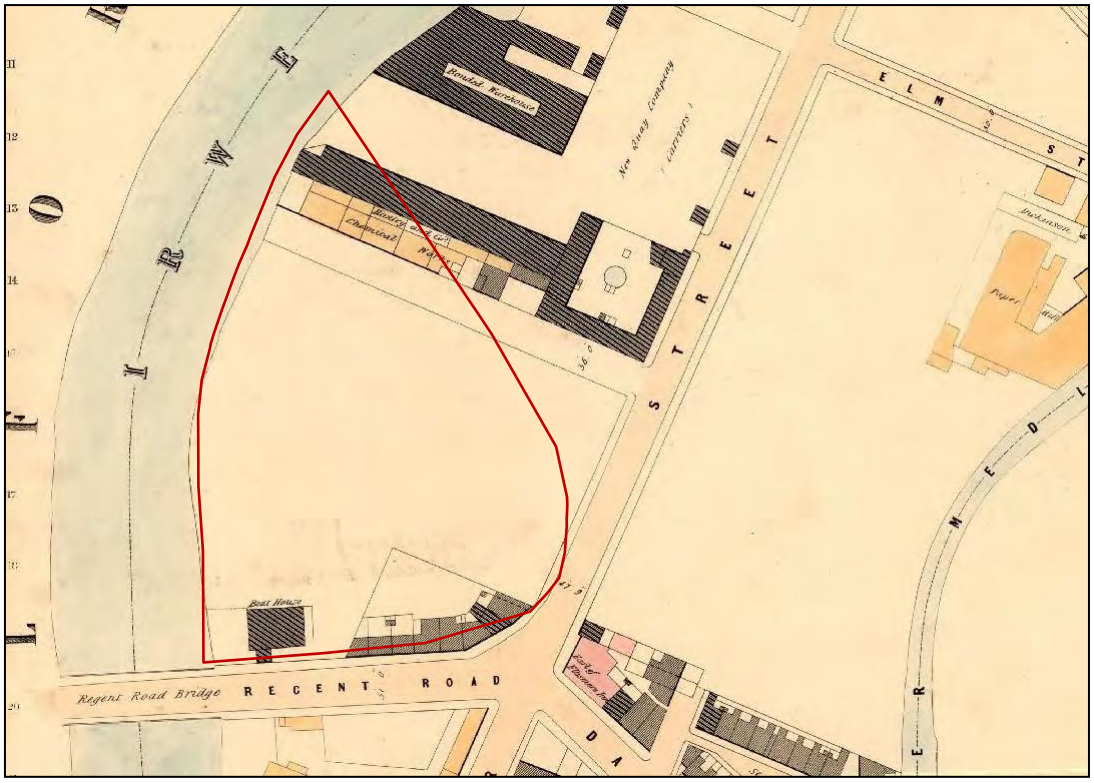

Plate 4: Extract from Adshead's Map of 1850, showing the site boundary

4.6.5 The next available plans of the site are provided by the Ordnance Survey map of 1891 (Figure 9) and a slightly later plan, which was published in 1896 at a scale of 25": 1 mile (Plate 5). These plans show that the site had been redeveloped as a yard for Manchester Corporation. Later maps annotated the buildings at Corporation Yard as a refuse destructor. The houses along the Regent Road / Water Street frontage appear to have been redeveloped as a terrace of single-depth buildings that may have been associated with the corporation yard.

4.6.6 Between 1891 (Figure 9) and 1896 (Plate 5) Manchester Corporation Yard was expanded to the northeast to include a chimney, bounded by rectangular buildings to the northwest and southeast and a larger building to the northeast.

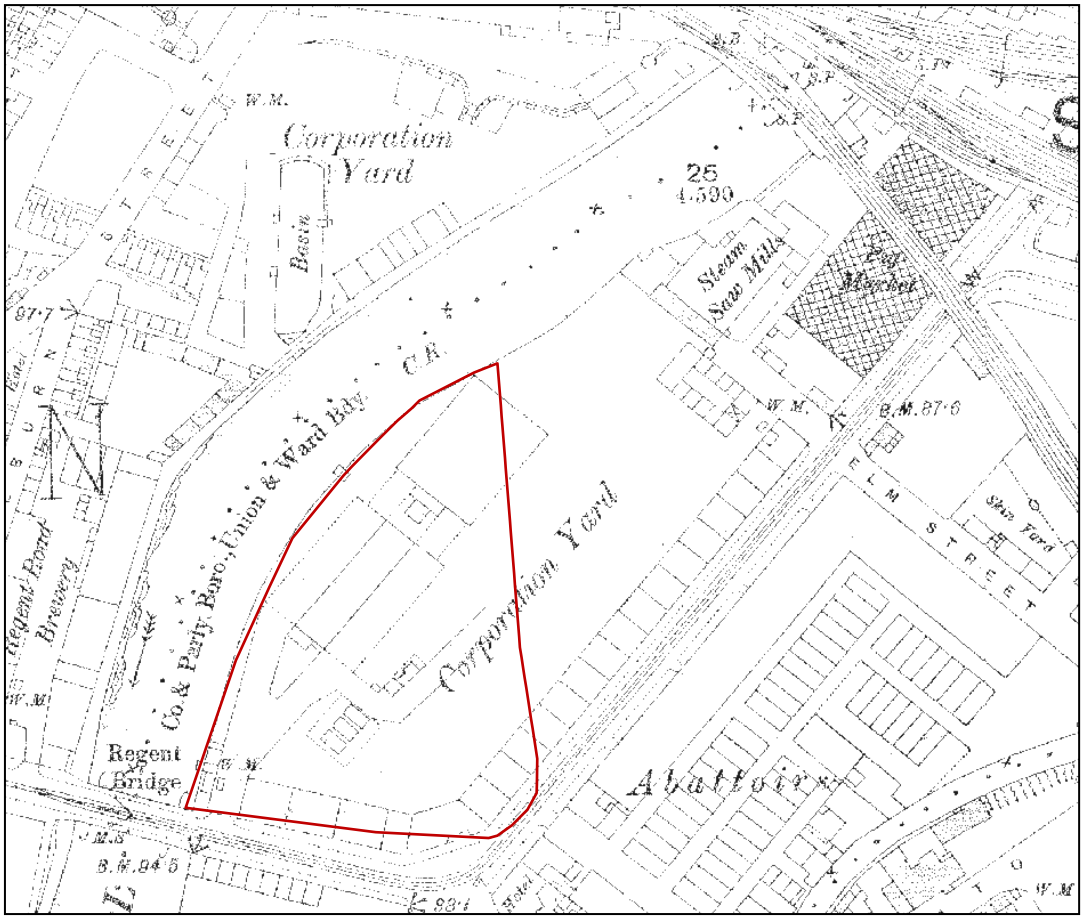

Plate 5: Extract from the Ordnance Survey map of 1896, showing the site boundary

4.6.7 Early 20th-century maps show only minor changes to the site (Figures 10 and 11). The same footprints of buildings were shown in the 1960s. All buildings in the site were cleared subsequently, and the site converted for car-parking use in the late 20th century (Salford Archaeology 2020).

5. METHODOLOGY

5.1.1 The site was initially investigated via the excavation of eight targeted evaluation trenches of various lengths.

- *Trench 1:* this trench measured 30m x 2m, and was aligned northeast/southwest across the footprint of a late 18th-century dye works / mid-19th-century chemical works.
- *Trench 2A:* this trench measured 60m x 2m, and was placed northwest/southeast across an area that had not been developed previously to establish the potential for pre-industrial remains to survive *in situ*.
- *Trench 2B:* this trench measured 30m x 2m and was oriented northwest/southeast to establish the potential for remains to survive *in situ*.
- *Trench 3:* this trench measured 20 x 2m, and was placed east/west across the centre of the site to investigate a large feature that was identified but not excavated during the 1990-91 archaeological investigation.
- *Trench 4:* this trench measured 100m x 2m, and was placed northwest/southeast across an area that had not been developed previously to establish the potential for pre-industrial remains to survive *in situ*.
- *Trench 5:* this trench measured 40m x 2m, and was placed northwest/southeast across an area that had not been developed previously, to establish the potential for pre-industrial remains to survive *in situ*.
- *Trench 6:* this trench measured 40m x 2m, and was placed across the footprint of the mid-19th-century boat house and workers' housing along Regent Road.

5.1.2 As significant archaeological remains were discovered in the evaluation trenches, further archaeological investigation was required. These additional works involved excavating an open area trench in the northern part of the site, which was agreed on in consultation with the client and GMAAS.

5.1.3 *General Methodology:* all archaeological work was conducted following the CIfA Standards and Guidance for archaeological field evaluation. Prior to the commencement of any excavation works, the trench locations were laid out accurately with respect to the Ordnance Survey national grid, and scanned for any live services using a cable avoidance tool. The excavations were scanned regularly as work progressed.

5.1.5 Excavation of the modern ground surface was undertaken by a machine of appropriate power using a toothed bucket and, where necessary, a breaker. The uppermost levels of overburden/demolition material were then be removed using the same machine, but fitted with a toothless ditching bucket, to the top of the first significant archaeological level. Machine excavation was then used to define carefully the extent of any surviving foundations, floors, and other remains.

5.1.6 All machine work was supervised closely by a suitably experienced archaeologist. Thereafter, structural remains were cleaned manually to define their extent, nature, form and, where possible, date.

5.1.7 All information identified in the course of the site works was recorded stratigraphically. Results of the evaluation were recorded on *pro-forma* context sheets, and were accompanied with sufficient pictorial records (plans, sections and high-resolution digital photographs) to identify and illustrate individual features. Primary records were available for inspection at all times.

5.1.8 *Context Recording:* all contexts were recorded using *pro-forma* sheets, and details were incorporated into a Harris matrix. All written recording of survey data, contexts, photographs, artefacts and ecofacts were cross-referenced from record sheets using sequential numbering.

5.1.9 *Photography:* a full and detailed photographic record of individual contexts was maintained and similarly general views from standard viewpoints of the overall site at all stages of the excavation were generated. Photography was undertaken using high-resolution digital cameras. All frames included a visible, graduated metric scale. Photographic records were maintained on photographic *pro-forma* sheets.

5.1.10 *Planning:* the precise location of all archaeological structures encountered was surveyed by EDM tacheometry using a total station linked to a pen computer data logger. This process generated scaled plans within AutoCAD, which were then subjected to manual survey enhancement. The drawings were generated at an accuracy appropriate for 1:20 scale, but can be output at any scale required. All information was tied in to Ordnance Datum.

5.1.11 *Finds policy:* finds recovery and sampling programmes were in accordance with best practice (following current Chartered Institute for Archaeologists' guidelines) and subject to expert advice in order to minimise deterioration. Finds storage during fieldwork and any site archive preparation followed professional guidelines (UKIC).

6. EVALUATION RESULTS

6.1 **Trench 1** (Plates 6-8; Figs 2-3)

6.1.1 Trench 1 was in the north of the site, measuring 30m by 2m to target the footprint of a late 18th-century dye works that was converted into a chemical works in the mid-19th century. The trench was excavated along a north-east/south-west orientation to avoid live services.

6.1.2 Archaeological remains were encountered at a depth of *c* 0.9m and consisted of the remnants of brick flues, a potential engine bed [104] and associated walls [105-6].

6.1.3 A brick flue [103] was excavated in the north-east end of the trench, measuring 4.16m by 1.16m. The surface of the flue consisted of red handmade bricks. The structure sloped downwards to a brick surface [104], which measured 0.9m by 0.78m. The brick surface [104] was bounded by one-brick wide walls (0.23m by 0.11m) and a chute, which were all constructed from yellow firebricks. Some of the firebricks were inscribed 'Nettle'.

6.1.4 A single skin wall [111] formed a partition within the flue, measuring 0.75m (the flue width). The fabric of the wall consisted of yellow firebricks. An arch was constructed within the lower courses of the wall. The wall was not keyed into the yellow firebrick walls.

6.1.5 The flue continued south-west, infilled by rubble (107) and bounded by wall 105, which measured 2.77m long and 0.55m wide. Later additions included a 20th-century rebuild [106] at the north-east end of the wall [105].

6.1.6 A potential engine bed [108] and sub-circular cement base [109] were partially excavated at the south-west end of wall [105]. The engine bed was constructed from handmade bricks, with a one-brick wide firebrick course along the south-west side of the wall. The upper course of flue [103] was exposed on the north-east side of the engine bed, curving in a south/south-east direction. A short section of a wall that was two-bricks wide was exposed to the south-west. The area between the two walls and engine bed was infilled by deposit (110).

6.1.7 Rubble deposit (103) overlay the buried archaeological remains within the trench and measured 0.26m thick. The rubble deposit was likely associated with the demolition of the buildings on the site in the late 20th century. Sandy clay (102) was situated above the rubble deposit and measured 0.58m thick. The sandy clay was a levelling layer for the modern tarmac surface (101).

Plate 6: Trench 1, showing brick flue [103], surface [104], partition [111] and wall [105], looking south

Plate 7: Wall [111], showing arch, looking south

Plate 8: View of engine bed 109 and flue, looking north-east

6.2 **Trench 2** (Plate 9-10; Figs 2-4)

6.2.1 Trench 2 was excavated to the south of Trench 1 and was broadly aligned north-west/south-east across an area that had potential for pre-industrial remains. The trench was excavated in two sections (2A and 2B) to avoid live services. Trench 2A measured 22m by 2m and was excavated to a maximum depth of *c* 3m. Trench 2B measured 16m by 2m and was excavated up to a 3m depth.

6.2.2 The natural geology (205) was exposed in the north-west end of the trench 2A, directly below a black clinker levelling layer (201). The remnants of an L-shaped brick wall [206] was cut into the natural geology. The wall was one and a half bricks wide and

continued beyond the north-west and south-west trench edges. The wall measured 1.4m long in a south-easterly direction before it returned south-west. The south-west return of the wall measured 0.62m and survived up to three courses high in the north-east facing section of the trench.

6.2.3 The natural geology (205) and wall 206 were overlain by black clinker (201). Rectangular granite setts were laid on top of the black clinker levelling layer (201). The modern concrete surface (200) was poured above the granite setts [207].

6.2.4 The south-east end of the trench was devoid of archaeological remains. The natural geology was 1.7m deep, below demolition rubble (204). The demolition layer (104) measured 1.4m deep and consisted of brick and concrete rubble.

6.2.5 A modern machine cut [202] truncated the granite setts [207], black clinker layer (201), demolition rubble (204) and natural geology (205). The cut consisted of straight, near vertical sides and a flattish base. The cut measured 2.8m deep and had been filled by reddish, pink sandy clay (203). The cut measured 2m wide and was also visible in trench 3. A poured concrete and rubble base was on the north-west edge of the cut.

Plate 9: Trench 2A, showing wall [206], cut [202], natural (205) and modern cut [202] in the background, looking east

Plate 10: Modern cut [202] filled by (204), looking broadly north

6.2.6 Trench 2B was excavated immediately to the south-east of Trench 2A, on the east side of live services. The same black clinker layer (201) overlay the natural geology 205) in the north-west end of the trench, which was at a depth of *c* 0.75m below the modern ground surface.

6.2.7 Towards the south-east end of the trench, a 12-course high handmade brick wall [210] was exposed in the south-west facing section of the trench. The wall was at least two and a half bricks wide (0.6m) and had an exposed length of 3m. A black silty layer (211) was identified below the wall and measured 0.6m thick. The deposit contained frequent pebbles, brick rubble, pottery sherds and clay tobacco pipe stems that possibly dated to the late 18th or early 19th century.

6.2.8 A modern machine cut [208] was visible within roughly the centre of the trench, truncating the black clinker layer (201), wall [210], deposit (211) and the natural geology (205). The cut comprised a near vertical south-east edge and a sloped/tapered edge to the north-west. The cut was excavated to a maximum depth of 3.2m, however, the base of the cut was not exposed. The cut was filled by pinkish, red, silty sand hardcore with gravel inclusions.

6.3 **Trench 3** (Figs 2 and 4)

6.3.1 Trench 3 was excavated east/west across the centre of the site to investigate a large feature that was identified but not excavated during the 1990-91 archaeological investigation. The trench measured 20m by 2m and was excavated to a maximum depth of *c* 3m.

6.3.2 The natural geology (303) was excavated at a depth of *c* 2.4m and was below light brownish, yellow, sandy clay (302). Layer (302) consisted of redeposited natural geology that measured 1.5m thick. Black clinker (301) overlay layer (302) and was a levelling layer beneath concrete 300.

6.3.3 A modern machine cut [304] truncated the natural geology (303), redeposited natural (302) and black clinker layer (301). The cut measured an exposed length of 6m and was excavated to a depth of 2.7m below the concrete surface 300. The cut consisted of near vertical sides and a flat base. Pinkish, red hardcore with gravel inclusions (305) filled the cut.

6.3.4 The trench was devoid of archaeological remains.

6.4 **Trench 4** (Plate 11; Figs 2 and 5-6)

6.4.1 Trench 4 was broadly aligned north-west/south-east across an area that had not previously been developed to establish the potential for pre-industrial remains. The trench should have measured 100m by 2m, however, the trench had to be excavated in stages to avoid modern services.

6.4.2 The remains of a 19th-century brick-lined drain [405] was excavated in the south-east end of the trench. The drain was aligned east to west and measured an exposed length of 2.1m. The fabric of the drain consisted of two strings of handmade bricks, which were capped by a row of handmade bricks.

6.4.3 The drain was cut into the natural geology (403), which was excavated *c* 1.19m below the modern ground surface. Black clinker (402) overlay the natural geology and 19th-century drain. Cobbled setts [401] had been laid above the black clinker layer. Modern concrete 400 was situated directly above the cobbled surface.

6.4.4 A concrete pad was exposed roughly in the centre of the trench, which had an exposed length of 0.7m. The concrete had a thickness of 0.4m. The concrete pad truncated the natural geology (303), black clinker layer (402) and cobbled surface [401].

Plate 11: Brick drain 405, looking south-east

6.5 **Trench 5** (Plate 12-3; Figs 2 and 5)

6.5.1 Trench 5 measured 40m x 2m, and was placed north-west/south-east to establish the potential for pre-industrial remains to survive *in-situ.*

6.5.2 A handmade brick surface was exposed within the north-west end of the trench. The surface measured 1.2m wide and had an exposed length of 8m. The surface was at least four course high.

6.5.3 Concrete surface 505 measured 2.36m long, 0.9m thick and continued beyond the trench edges. The ground beneath the concrete appeared to be oil stained, suggesting that it may have served as an engine bed. A post-WII wall was built on top of the concrete surface.

6.5.4 A second concrete surface/potential engine bed was excavated in the south-east part of the trench and was aligned west/north-west to east/south-east. The possible surface measured 10.26m by 1.66m and was 0.76m thick.

6.5.5 A modern red brick wall [503], broadly aligned east to west, truncated earlier wall [504]. Wall 503 measured an exposed length of 8m and was 0.56m wide.

6.5.6 The natural geology (507) was generally 1.1m below the modern ground surface (500). Black clinker layer (502), measuring 0.55m thick, overlay the natural geology

(507) and structural remains. Cobbled surface [501] had been laid above the black clinker levelling layer. The modern ground surface 500 was directly above the cobbles.

Plate 12; Brick surface 503, looking east/south-east

Plate 13: View of Trench 5, showing concrete bases, looking west/north-west

6.6 **Trench 6** (Plate 14-5; Figs 2 and 7)

6.6.1 Trench 6 measured 40m x 2m and was positioned across the footprint of the mid-19th-century boat house and workers' housing along Regent Road. The trench was broadly aligned west/north-west to east/south-east and was excavated to a maximum depth of 1.2m. The trench location was altered to avoid modern services.

6.6.2 A wall [602] was excavated in the south-east end of the trench. The fabric of the wall consisted of handmade bricks bonded with lime mortar, indicating an early 19th century date. The wall was one brick wide, two courses high and ran north-east to south-west through the trench.

6.6.3 A second wall [604] was excavated to the north-west of wall [602]. The wall had been erected within a relatively wide construction cut [603]. The construction cut measured 1.04m wide and had an exposed length of 2m. The wall [604] measured one and a half bricks wide (0.36m) and was orientated north to south. The fabric of the wall consisted of frogged bricks bonded with hard black mortar, which would indicate a late 19th- or early 20th- century construction date. The construction cut was backfilled with loose, greyish, brown, silty clay (605) with organic material, wood chippings and rubble inclusions.

6.6.4 Structure [606] was partially excavated adjacent to wall [607]. The structure appeared to form a rectangular footprint that extended beyond the trench edge. The fabric of the walls consisted of reused handmade bricks that were bonded with hard, black mortar. The wall measured 1.22m along a north to south alignment before it returned to the east. The east to west section of the wall measured 0.98m. The structure may have been associated with an outbuilding, privy or drainage feature. The presence of black mortar is indicative of a post-1860s construction date.

6.6.5 Wall [607] was situated to the north-west of wall [606]. The wall was aligned north-east to south-west and measured 1.66m long and 0.48m wide. The wall had been constructed from reused handmade bricks bonded with black mortar.

6.6.6 A flagstone surface [608] was exposed in the west/north-west part of the trench. The surface measured 1.06m by 0.95m and continued beyond the north-east trench edge. The surface was bounded to the south-west by wall [609]. Wall [609] consisted of handmade bricks bonded with a loose, greyish lime mortar. The wall measured 1.20m by 0.38m and was orientated north-west to south-east. The surface and wall were likely associated with a courtyard to the rear of workers' houses.

6.6.7 Wall [610] was situated in the west/north-west end of the trench. The fabric of the wall comprised frogged bricks and black mortar. The wall was likely to have been broadly contemporary with wall [604]. The wall measured 1.66m by 0.46m and was orientated north to south.

6.6.8 All structural remains exposed within the trench were cut into the natural geology (612), which was at a depth of 1.05m. The natural geology and archaeological remains were covered by black clinker (601) that measured 0.6m thick. A brick rubble layer (611), presumably associated with the demolition of buildings on the site, was situated above the clinker layer and measured 0.24m thick. The modern road surface 600 was set above later (611).

Plate 14: Trench 6, looking west/northwest

Plate 15: Wall 602, earliest archaeological remains excavated within Trench6, looking north-east

6.7 **Open Area** (Figs 2 and 8)

6.7.1 An open area excavation was recommended in the north of the site, targeting the remains of the flues in trench 1 and the area immediately to the south-east. The open area excavation uncovered the remains of a power plant associated with a late 19th-century refuse destructor (Plate 16).

6.7.2 The flue partially exposed in trench 1 was fully excavated in the north-west part of the open area trench. The walls and surface of flue 001 consisted of a mixture of heat-affected handmade bricks, machine-made bricks and yellow firebricks (Plate 17). The walls of the structure were one and a half bricks wide (0.36m) and were laid header and stretcher bond. No mortar was visible between the brick courses. The flue headed north-west from the chimney base 006/016 before it returned north-east up to flume 004, measuring 11.4m long. The interior of the flue was 0.74m wide. The brick surface of the flue was excavated at a depth of 0.22m before it gradually sloped downwards to a maximum depth of 1.18m, along the north-east return.

6.7.3 Flue 002 was situated directly to the west of flue 001 (Plate 17). The flues were connected at the chimney base 006/016 to the south-west, measuring a maximum width of 1.5m. The flue had similar dimensions to flue 001, measuring 0.75m wide. The flue had an excavated length of 7.2m and was orientated north-west to south-

east. The walls of the flue were one and a half bricks wide (0.36m) and were built from handmade bricks, with an additional internal skin of firebricks (in total the wall was 0.48m wide). Flues 002 and 001 adjoined at the junction with the chimney base.

6.7.4 The north-west wall of flume 004 truncated wall 003, which ran north-east to south-west along the north-west trench edge. The wall measured 10.72m long, 0.91m wide and 1.03m high. The fabric of the wall comprised handmade bricks bonded with greyish brown, sandy mortar.

6.7.5 Flume 004 was situated at the north-east end of flue 001 (Plate 6, p 22). The flume consisted of a handmade brick surface, which was bounded by yellow firebrick walls. The flume sloped downwards to the base of the flue but was separated by a single skin wall, built within the interior of the flue. A bricked-up arch was visible in the lower courses of the single skin wall.

6.7.6 The remains of a brick surface 019 were situated immediately north-east of the flume 004 (Plate 18). The surface was bounded on the north side by a one-course wide, curved, yellow firebrick wall, which survived up to one course high. The surface was bonded with greyish, black, hard mortar. The surface measured 1.1m along a north-west to south-east alignment before it turned towards the north-east for a length of 4.5m.

6.7.7 Frogged bricks infilled an area on the north side of the curved firebrick wall associated with structure 019. This area was partially excavated in the north corner of the trench and has been provisionally interpreted as a furnace/cell.

6.7.8 A poured concrete surface 022 lay on the south-east side of structure 019.

Plate 16: Aerial photograph of open area excavation, broadly orientated north-east

Plate 17: Flue 001 on the right and flue 002 on the left, flue 006 in the bottom right of the photograph, looking north-west

Plate 18: Structure 019 in the centre, concrete 022 to the left and potential incinerator 022 to the right, looking south-west

6.7.9 An octagonal chimney 005 was situated within roughly the centre of the excavation trench (Plate 19). The walls of the chimney were one brick wide (0.24m) and seemed to have consisted of at least three building phases. The inner walls of the chimney were constructed using yellow firebricks, which were severely heat-affected and damaged. An outer skin of bricks had been added later, consisting of frogged bricks. The outer skin of bricks had likely been added to reinforce the structure in the 20th century. Although the bottom part the of the chimney would have originally been lined with refractory bricks, the excavated firebrick lining did not seem to be part of the chimney's original construction, as it blocked the flow of smoke from flues 006 and 007 into the chimney. Removal of the refractory brick lining showed that it was not keyed into base 016 or concave flues 006 and 007 (Plate 20-2).

6.7.10 Flues 006 and 007 extended from the chimney in a north-west and south-east direction and were both set in surface 016. Flues 001 and 002 fed into flue 006 (Plate 19-20). The fabric of flue 006 consisted of a mixture of standard red and occasional yellow firebricks. The structure had a concave base, which was built from two courses of bricks laid header-on-edge and bonded with sandy mortar. Flue 006 measured 1.64m long, 1.07m wide and 0.36m deep. The removal of the firebrick lining within chimney 005 showed that the lower course of bricks used in the construction of flue 006 (beneath the firebrick surface) were bonded with sandy mortar.

6.7.11 Flue 007 was similar in construction to flue 006 and was situated on the opposite side of the chimney. A modern service pipe 029 had truncated most of flue 007. Both flues 006 and 007 had been blocked by a lining of firebricks within chimney 005.

6.7.12 The series of flues on the north-west side of the chimney 005 were mirrored to the south-east. Flue 009 was situated at the base of the chimney, but had been heavily truncated (Plate 19 and 24). The flue had a red brick surface and was bounded by one-brick-wide (0.24m) firebrick walls. The remnants of the flue represented the meeting point of flues 010 and 011 at the chimney base, the same as flues 001 and 002 to the north-west. The flue had a maximum width of 1.5m and survived up to 1.9m long.

6.7.13 Flue 010 was situated to the south-east and was almost identical in layout to flue 002 (Plate 24). The fabric of the flue consisted of red bricks walls that were one brick wide (0.24m) with a skin of yellow firebricks lining the interior of the flue (total width of the wall 0.36m). Like flues 001 and 002, flue 010 gradually descended as it branched away from 009. A barrel-vaulted roof capped the flue, which was formed from two courses of bricks laid header-on-edge (the inner course was firebricks). The flue measured 1.5m deep from the key brick of the arch to the brick surface.

6.7.14 A second flue 011 branched south-east from flue 009 (Plate 24). The flue was of similar construction to flue 010, but was evidently bonded with hard grey mortar. The north wall of the flue was two bricks wide (0.48m). The southern wall was narrower than the north wall and was one and a half bricks wide (0.36m). The north wall of the flue was built into the remains of a wall that ran north-west to south-east between the chimney base 016 and engine bed.

6.7.15 Between flues 010 and 011 were the remains of a brick structure 012, constructed from red bricks and bonded with hard, grey mortar. The structure measured 1.05m by 10.3m by 0.47m.

6.7.16 Flues had also been built into the lower courses of the north-east and south-west facing elevations of the chimney walls. These flues were demarcated by arches. The north-east flue was formed from two courses of bricks laid header-on-edge and bonded with hard, greyish, black mortar (Plate 22). The arch of flue 028 was built in the south-west wall of the chimney and was enclosed by structure 008. This flue consisted of an arch formed from three rows of bricks laid header-on-edge and bonded with sandy mortar. Further excavation showed that structures 016 and 008 had a depth of 2.64m. The flue was 0.84m wide and had an excavated height of 1.61m (Plate 23).

6.7.17 Structure 008 was constructed from standard red bricks and yellow firebricks, bonded with hard, greyish, black mortar and laid stretcher bonded. Yellow firebricks lined the interior of the structure and were keyed into the walls, which were two bricks wide (0.48m). The structure consisted of three walls that abutted structure 016 to form a rectangle. The structure measured 4.29m by 1.17m.

6.7.18 The octagonal chimney 005 was set in a square brick structure 016. The structure measured 5.26m by 5.14m and was excavated up to 12 courses high (Plate 19). Pipe 029 truncated the south-east side of the structure, which broadly ran north to south. Multiple phases were evident within the structure: the lower courses consisted of handmade bricks and sandy mortar, whilst the upper courses (at least eight) were a mixture of reused handmade bricks and machine-made bricks bonded with hard, greyish, black mortar (Plate 20). An extra skin of bricks 030 was added on the north-east elevation of the structure, between engine beds 018 and 025.

Plate 19: Octagonal chimney 005 built into base 016, with structure 008 in the bottom of the frame, broadly looking north/north-west

Plate 20: Opposite side of flue 006 showing handmade bricks at the base of 016 and sandy mortar, looking south-east

Plate 21: Cross-section of flue 006 after the removal of the firebrick lining within chimney 005, looking north-west

Plate 22: Arch in the north-east elevation of chimney 005, looking north-east

Plate 23: Flue 026 in the south-west of chimney 005, bounded by structure 008, showing the depth of the flue

Plate 24: Flues 009, 010 and 011, looking south-east

6.7.19 A small boiler room was situated on the south-east side of flues 010 and 011 (Plate 25). Wall 013 demarcated the boiler room to the north-east. The wall consisted of standard red degraded bricks that were at least one brick wide (0.24m), with an additional one brick wide (0.24m) refractory wall lining the interior of the boiler room (total width 0.48m). The wall was bonded with greyish / white, sandy mortar. The south-west wall of flue 011 appeared to be keyed into wall 013. The wall measured 6.23m long and survived up to 1.15m high. The south-west corner of the structure comprised inward-curving refractory blocks, which may have represented the boiler props. The outer walls of the structure represented the side walls of the boiler housing.

6.7.20 The surface of a flue 033 was excavated at the base of wall 013, which wrapped around the north-east and south-west side of the boiler bed. The south-east and north-west sides of the boiler bed were truncated. The flue had an excavated length of 4.3m and was 0.72m wide. The flue surface was constructed from standard bricks. The surface gradually rose to the south-west.

6.7.21 The base of the boiler bed 032 dropped a further 1.2m below flue surface 033. The boiler bed comprised of a standard red brick surface, with firebrick walls. The upper course of the walls consisted of rectangular stone blocks. Hot gases escaping from the flame bed may have exited via flue 010, the opening of which was visible beneath 033, demarcated by an arched recess. A metal door with an attached chain was situated between the boiler house 013 and flue 010. The metal door and chain were visible within the boiler bed, flue 010, and through a narrow slot, which was visible between the two structures. Flues 010 and 011 were both potentially associated with the boiler setting

Plate 25: Boiler house at the south-east end of flues 010 and 011, looking north-west

6.7.22 An engine bed was excavated on the north-east side of chimney base 016 (Plate 26-27). The flywheel pit was bounded by structures 018, 015, 024 and 14 and was a cruciform shape in plan. Brick base 018 measured 5.83m by 3.79m and was excavated to a depth of 0.79m. The structure consisted of two rectangular brick bases adjoined by a two-and-a half brick wide wall (0.62m) that was bonded with hard, grey mortar. Holding down bolts were within the two rectangular brick bases, protruding from square openings. The square openings were in each corner of the two rectangular bases in a near identical arrangement. The bolts would have secured the machinery associated with the engine in place. The upper courses of the structure comprised machine-made bricks and hard grey mortar. A shallow rectangular recess

was exposed in the south-westmost base. A two-brick wide wall, keyed into 018, ran north-west up to engine bed 015. The wall consisted of machine-made bricks and hard grey mortar.

6.7.23 Engine beds 015 and 025 lay 1.08m to the north-west of 018. The brick settings ran parallel to each other, with engine bed 025 abutting the square chimney base 016. Brick base 015 measured 3.4m by 1.4m and had an exposed height of 1.52m (19 courses high). Hard, grey mortar was adhered to the surface and an iron rod protruded from a square opening at the south-east end of the structure. In total, two further square recesses (for holding-down bolts) ran along the south-west side of the structure. The same arrangement of holding bolts was visible on the surface of brick setting 025. The upper seven courses of the structure was constructed from machine made bricks and hard, grey mortar, whilst the lower courses appear to have been bonded with sandy mortar.

6.7.24 Engine bed 025 was positioned 1.4m to the south-west of engine bed 015. The engine bed ran parallel to 015, measured 3.4m by 1.81m and was excavated to a height of 1.3m (14 courses high). The fabric of the structure comprised reused handmade bricks and machine-made bricks with sandy mortar, though the upper four courses were constructed from machine-made bricks and hard, greyish black mortar. A modern pipe 029 truncated the upper courses of the structure.

6.7.25 The deep channel created by the engine beds would have functioned as the flywheel pit. The flywheel pit was situated between 015 and 025. Presumably, beds 015 and 025 secured the wheel and associated machinery into place. Engine beds 018 may have housed the cylinders and pistons, which would have been powered by steam.

6.7.26 Wall 014 extended north-west from engine bed 015, measuring 6.28m before it returned along a south-west alignment for 1.3m. The wall continued south-east up to engine bed 025. The wall was one and a half bricks wide (0.36m) and was excavated to a height of 1.05m. The fabric of the walls comprised machine-made bricks bonded with hard, grey mortar, with later repairs and additions constructed using single-frogged bricks and cement.

6.7.27 A rectangular brick structure 031 was at the north-west end of wall 014. The structure measured 2.35m by 1.76m and survived up to 1.06m. A one-and-a-half wide brick wall (0.36m) ran through roughly the centre of the brick platform. The fragmented remains of a flagstone surface were visible on both sides of the wall. Hard, black mortar was adhered to the remnants of the flagstone on the south-west side of the wall. The structure was poorly built and consisted of machine-made bricks and

blackish, grey hard mortar. Adjoining structure 016, was a smaller square brick structure that measured 1.04m by 1.04m and consisted of a brick base that was capped by flagstones. Wall 014 and structure 031 were associated with the engine bed/room.

6.7.28 The remnants of a potential handmade brick and machine-made brick surface 024 were excavated on the north-east side of engine bed 015 (Plate 27). The surface appeared to pre-date wall 021, which was situated immediately to the north-east of the surface. The surface was at least five courses high and was bonded with sandy mortar. The surface measured 3.95m by 0.76m and was truncated at both ends.

6.7.29 Wall 021 extended south-east from the north-east end of flume 004. The wall measured 12.4m long and survived up to 0.7m high. The fabric of the wall consisted of a mixture of reused handmade bricks and machine-made bricks bonded with hard, black / grey mortar. The base of the wall abutted earlier surface 024. The wall was two bricks wide (0.48m) for 5.8m, however, the structure measured up to three bricks wide (0.72m) on the south-west side of a sunken structure.

6.7.30 A sunken structure or tank was formed from walls 026 and 023, which were built against the north-east side of wall 021 (Plate 28). The tank had an excavated length of 2.94m and was 1.10m wide. The interior width of the structure measured 0.74m. Wall 023 was one brick wide (0.24m) and was built using machine-made and reused handmade bricks, whilst wall 026 comprised a single rectangular stone block. The interior of the structure remained unexcavated. A modern monitoring well, encased in concrete, extended upwards from within the structure.

Plate 26: Engine bed and flywheel pit, showing 018 in the foreground and 015 and 025 in the background, looking north-west

Plate 27: Alternative view of engine beds and flywheel pit, looking west

Plate 28: Surface 024, Wall 021 to the left and tank, looking south-east

6.7.31 Beneath poured concrete surface 022, were the remains of earlier working floor surfaces. Flagstones 035 were excavated adjacent to structure 026 and covered a 10m by 1.9m area. A patch of rectangular setts was exposed in the south-east part of the surface. Each sett measured *c* 310mm by 100mm.

6.7.32 Running north-west to south-east, through the floor surface, where the remains of a stone-capped channel 036 that contained a steampipe. The stone-capped area measured 10m by 0.8m and was 0.8m deep. The steampipe was situated at a depth of *c* 0.65m. An iron slab was excavated at the south-east end of the channel and may have provided access into the channel.

6.7.33 The north-east side of the stone-capped steampipe was bounded by rectangular stone setts, which continued beyond the north-east limit of excavation. Poured concrete 022 overlay surfaces 035-7.

Plate 29: Surfaces 035 and 037 on either side of stone-capped steampipe 036, looking north-west

7. DISCUSSION

7.1 History of waste and its disposal

7.1.1 Before 1875, private contractors had often undertaken waste collection, though those with little money or bad landlords would not have had this option. Waste products were often recycled and were in high demand. Coal ash ('dust') was sold to brick-making yards or used in soil conditioner. The value of 'dust' encouraged dust contractors to recover all dust waste, however, the market collapsed in the mid-19th century (Maxwell 1898). Nightsoil men removed privy waste, which was mixed with used hops and was also sold as fertiliser. In the poorer districts, waste excrement and refuse was poured directly into watercourses and ditches, causing several cholera outbreaks (Flanders 2011, 160).

7.1.2 Many waste products or unwanted items could be recycled and turned into profitable items, leading to several informal waste collection or disposal techniques. Street buyers of various categories had businesses that included the resale of second-hand items, such as clothes and furniture. Poorer members of society, such as charwomen, attempted to earn a living by collecting used tea leaves that were resold to tea dealers that would mix them with new tea leaves for resale (Flanders 2012, 159-162). Rags were sold to paper-making factories, fat and marrow supplied soap and glue-making industries, and broken pots and oyster shells could be used as aggregate or ground and added to manure. The rag-and-bone men collected some of the items listed above, and survived well into the second half of the 20th century.

7.1.3 According to advice books of the time, well-ran households produced no food-waste, with leftovers transformed into new dishes, fed to household pets, or used to fertilise kitchen gardens. Servants often sold any remaining household waste, referred to as wash, to dealers who used it as pig feed.

7.1.4 During the cholera outbreaks of the mid-1800s, public health campaigns began to emerge with social reformer, Edwin Chadwick, publishing his report 'the Sanitary Condition of the Labouring Population', which argued for the importance of waste removal and management facilities to improve health. The Public Health Act of 1875 made it compulsory for people to dispose of waste in 'moveable receptacles', otherwise known as dustbins. The local authorities became responsible for the regular removal and disposal of waste. The act dramatically increased the amount of waste that needed to be disposed and there was a perceptible push for incineration, as it was believed that it would be cheaper to burn the refuse and to sell by-products than to dispose of the refuse by tipping, which was costly (Tucker 1977, 5). Other means

of waste disposal included sinking it in the sea, which was undertaken at Liverpool from the late 19th century (Tucker 1977, 8).

7.1.5 Early efforts at refuse treatment concentrated on turning waste into useful, harmless, and profitable products. Attempts to create incinerators began in 1870, when Mead and Co., dust contractors at Paddington, made an unsuccessful effort to burn refuse in a poorly ventilated closed furnace. In 1872 special furnaces were manufactured for converting sewage into innocuous manure, but they absorbed heat and were coal-fired. Another early "ordinary type" furnace was built at Manchester Corporation's yard in 1873, though it also required coal to burn the refuse and was inefficient (Maxwell 1898, 85).

7.1.6 The first operational incinerator was designed and patented by Alfred Fryer in 1876 and engineered by Manlove, Alliott and Co. Ltd of Nottingham (Maxwell 1898, 86-7). The first place to be fitted with Alfred Fryer's destructor was Manchester Corporation's Cleansing Yard at Water Street.

7.1.7 Destructors had to reach extremely high temperatures to dispose of waste, and in the coming decade, the heat generated from the destructors was utilised for steam production. A steam engine could supply power to generate electricity, power sewerage pumping works, or operate mortar mills. Public authorities could, thus, make a profit from the incineration of waste (Tucker 1977, 8).

7.2 Destructor design and operation

7.2.1 Tucker (1977, 6) notes that Fryer treated refuse by separating it into three components,

'(*a) dust-bin, ash-pit and midden refuse,*

(b) garbage, i.e. vegetable matter, sweepings from the markets, etc., and

(c) urine.

Part (b) was carbonized into a useful charcoal, and part (c) was concentrated into a useful manure. It is part (a) which we are concerned with. The plant for treating it was called a destructor, and comprised a furnace with certain distinguishing features. These were:

(1) once combustion had been started, the heat of combustion kept the material at a high temperature,

(2) a reverberatory roof reflected the heat on to the burning mass to ensure the maintenance of the high temperature,

(3) the hot gases produced circulated in a flue in, such a way as to dry out the incoming wet refuse and so make it suitable for combustion,

(4) the destructor required little attention; the slope of the pre-heater, the grate, and the furnace mouth were such that the material tended to feed itself through,

(5) the product taken from the destructor was of about one- third the mass of the input, and could.be ground with lime into an excellent mortar'.

7.2.1 Alfred Fryer's destructor consisted of two or more furnaces/cells that were usually arranged in back-to-back pairs or in a single row, and enclosed in a rectangular block of brickwork having a flat top, on to which the house refuse was tipped from the carts (Goodrich 1912,15; Maxwell 1898, 90-4). This type of destructor was top-fed (Plate 30). Each cell measured 9ft. by 5ft. and was covered by a fire brick arch 3ft. 6 inches above the grates. The base of the furnaces had an inclination of '1 in 3' from back to front. The back, or higher part of the furnace, formed a firebrick hearth or dead plate, with the lower end having fire-bars. A wall at the back of the cell divided the furnace in half. The feeding hole was situated at the upper end of the slope, which allowed refuse to be poured into the furnace. On the opposite side was an opening from the main flue that allowed the products of combustion to escape. The main flue only had one opening for each pair of cells and formed the dust chamber, which was beneath the hearth. Another opening, with a cover, was above the middle of one or more of the furnaces, so that condemned meat and other materials could enter at the hottest part of the fire. The refuse in the cells was manually pushed forward, towards the fire bars. The furnaces and the flues were lined with firebricks throughout (*ibid*).

7.2.2 Typically, groups of six cells were erected within a rectangular building that usually measured approximately 21ft. by 24ft. The refuse was fed into the top of the furnace via an inclined tipping platform, which was situated about 2ft. 8 ins above the destructor. Occasionally, a lift was used to lower the refuse to the furnace platform, however, the tipping chute was more favourable. The destructor chimney shaft was required to be between 120ft to 200ft to create a good draught. The lower part of the chimney had a firebrick lining.

7.2.3 A problem with Fryer's design, was that the outlets for the products of combustion were at the back, and that whilst a charge was burning on the furnace bars, the next lay on the dead hearth at the back of the outlet, where it dried and partially decomposed, producing offensive vapours, which then passed into the flue. A second furnace, sometime called a cremator, was placed in the flue leading to the chimney shaft to resolve the issue, however, this was costly and often bypassed (*ibid*).

7.2.4 Maxwell's (1898) book also described how the destructors were operated, suggesting that once the charging hole was ready, the material was shovelled into and on top of the charging hole. A second man stood at the opening and pushed the waste down the incline onto the drying hearth until the hearth was covered. The amount of material put onto the hearth ranged between 20 and 30 cubic metres at a time. A third man stood at a lower level, adjacent to the furnace, to draw the material from the drying hearth and spread the partially dried material evenly over the firebars. Once incinerated, clinker fell to the ground and was cooled with water. The fine ash fell into the dust hearth, and after passing through the furnace, had been reduced to 25 percent of its weight (*ibid*).

7.2.5 Whilst incineration was taking place, the hot gases escaped over the bridge into a central flue that measured 6ft. high and 10ft. 4 ins wide, which prevented unburnt material to pass into the chimney (*ibid*).

7.2.6 An interesting improvement was made to Fryer's furnace at Ealing by Mr C Jones (M. Inst. C. E.), who introduced an automatic system that reduced the amount of cold air that flowed into the flues during the feeding and clinkering processes. A cast iron hinged door was placed over the opening of the dust chamber, attached by a chain to the furnace door. The system was arranged so that when the furnace door was opened, the dust chamber was about 'fourth-fifths of its area closed' and that when the furnace door was shut the flue door was open. In addition, concave water pits were installed beneath the firebars to prevent dust from blowing around and to catch ash drops (*ibid*).

7.2.7 Mr Stephenson Macadam (Ph.D. F.I.C.) massively criticised the Fryer destructor for its efficiency, stating that '*the heats are not sufficient for fully dealing with combustion of the refuse'*. He also observed '*evolving organic and sulphur gases most abundantly rendering the atmosphere quite suffocating and nauseous, whilst fine dust was being blown around and over into the neighbouring properties'* (Maxwell 1898, 94).

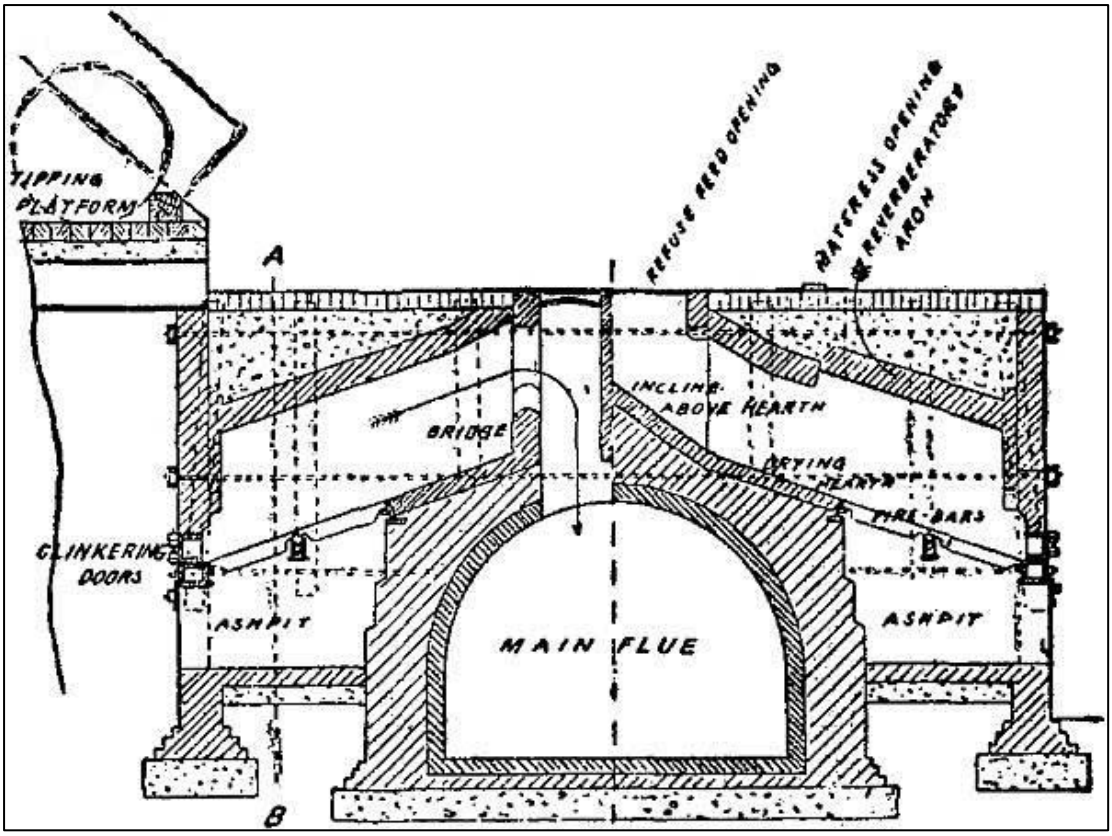

Plate 30: Extract from Maxwell (1898), 'The Removal and Disposal of Town Refuse', showing a cross-section of Alfred Fryer's refuse destructor

7.2.8 In the years after Fryer's destructor, it was widely observed that improvements needed to be made, though all later designs incorporated the main features of Fryer's destructors, consisting of several cells (each of which were an independently fired furnace unit) that were linked to a system of flues and boilers. In order to properly burn the refuse, higher temperatures (over 1000 degrees Fahrenheit) needed to be achieved, which would also provide adequate heating for steam-raising. In addition, the hot gases produced from the furnace required thorough combustion to avoid offensive and toxic fume pollution. Water-tube boilers were best for steam-raising, however, Lancashire boilers and other flue-type boilers were regularly used (Tucker 1977). Another improvement included the installation of semi-automatic parts.

7.2.9 An improved furnace was patented by Henry Whiley, superintendent of the scavenging department at Manchester Corporation's Water Street depot, in 1891. Maxwell's book states that Manchester Corporation had a large installation of this type of furnace after giving it an extended trial. The furnace was designed primarily to save on manual labour with the cells being fed, stoked and clinkered automatically. Maxwell (1898, 96) describes the machinery as having *'no drying hearth, and the refuse carts tip directly into a trough or hopper at the back which conducts the material directly on*

to movable eccentric grate bars. These bars automatically traverse the material forward into the furnace, and finally push it against a flap-door which opens and allows it to fall out' (Plate 31).

7.2.10 Initial issues with the design included refuse sticking in the hopper, however, a bigger problem was that the motion of the bars allowed fine refuse to drop through unburnt. Therefore, the destructor was only suitable for waste disposal sites that *'screened'* rubbish, such as the Water Street depot. There was also some difficulty with the continual flapping of the door when the clinker passed out, which allowed cold air to pass into the furnace. Like the Fryer cell, the outlet for the products of combustion into the main flue was close to where the crude refuse was fed into the furnace, which meant that unburnt and unpleasant odours continued to escape. This was also partly due to temperatures reaching 1000 degrees Fahrenheit in the furnace, when between 1250 to 1500 degrees Fahrenheit was believed to make the gases innocuous. Forced draught was applied by means of a Root blower (Maxwell 1898, 96). Sources suggest that Manchester Corporation had 28 destructors of Whiley's design and that it was very successful at Manchester Corporation, but had limited success when installed at a site in Huddersfield (Goodrich 1901, 106).

7.2.11 The Manchester Courier and Lancashire General Advertiser reported on the opposition of building a refuse destructor at Withington based on visits to several destructors in Manchester, which had caused nausea and vomiting. The report stated that '*The committee first visited the Manchester destructor at Water-street, where they became conscious of a foul smell of putrid fish and vegetables, which was "simply horrible*' (Manchester Courier, 7th November 1891). Another article stated that Manchester had more refuse destructors than any other town in England (Manchester Courier and Lancashire General Advertiser, 21st September 1892).

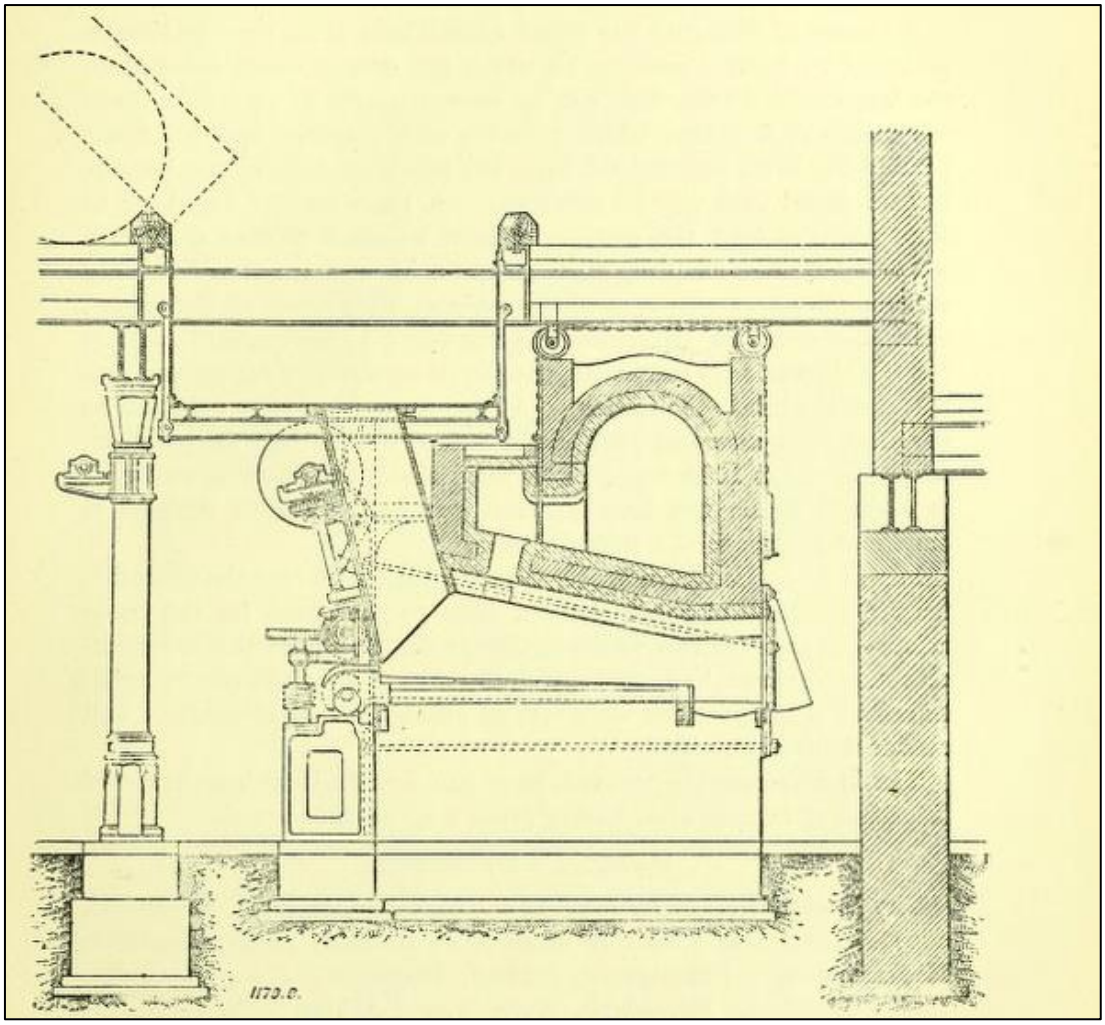

Plate 31: Extract from Maxwell, 'The Removal and Disposal of Town Refuse', showing a cross-section of Whiley's destructor

7.2.12 Horsfall's furnace was a high temperature destructor (invented in 1887) that had been installed at various waste management sites throughout the UK in 1898 (Goodrich 1912, 20; Maxwell 1898, 98). Horsfall's destructor incorporated the general features of Fryer's destructor, however, details of the furnace differed (Plate 32). The main differences were the arrangement and position of the outlets for the products of combustion, and the introduction of a blast furnace and steam jet, which allowed temperatures of up to 2000 degrees Fahrenheit to be reached. Horsfall's improved design contained patent self-feeding apparatus worked by eccentric gear, and a steam jet played an important role in getting the furnace up to high temperatures.

7.2.13 The flues and flue opening were positioned at the front of the reverberatory arch, over the hottest part of the fire. The gases given off by the drying refuse at the back, therefore, had to pass over the hottest part of the furnace (claimed to reach temperatures as high as 2000 degrees Fahrenheit) and through apertures in a red-

hot reverberatory arch before they could escape. The flues passed over the top of the reverberatory arch, down the side walls to the main flue beneath. The furnace was surrounded by hot gases which dried the green refuse. In addition, the hopper or trough was also improved and lowered to the grate bars.

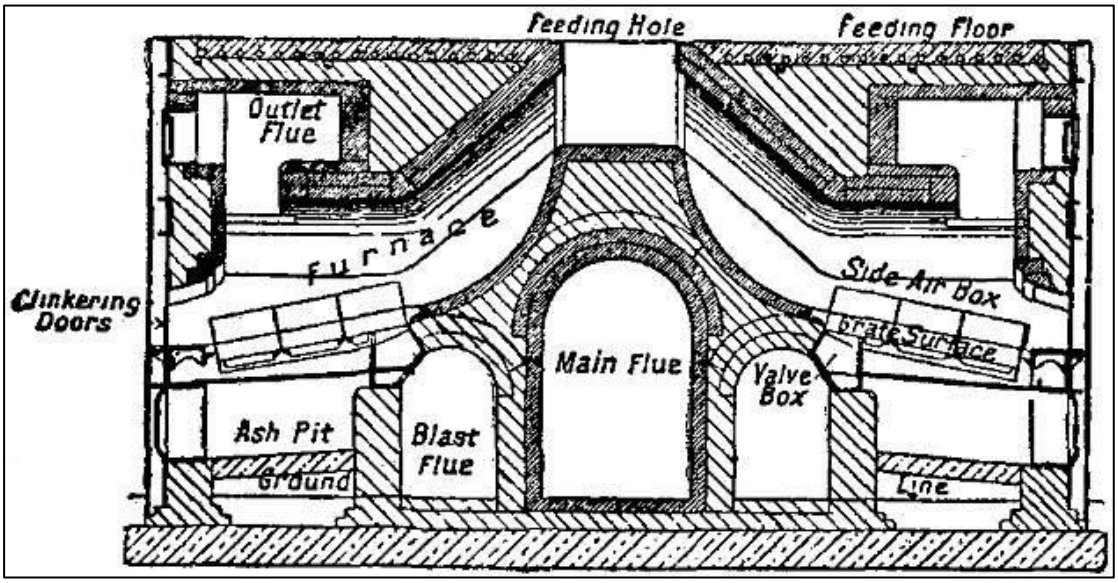

Plate 32: Horsfall's improved refuse destructor

7.3 Manchester based engineers manufactured several improved types of destructors in the late 19th century. Messrs Meldrum Brothers Limited of Manchester received praise from Mr Stephenson Macadam in the Journal of the Society of Chemical Industry for their 'modern apparatus' (Maxwell 1898, 121). Messrs Meldrum Brothers Limited altered one of Henry Whiley's cells at Manchester to give an increase of 50 per cent (Goodrich 1901, 107). Another modern destructor of the time was Beaman and Deas' Destructor that was patented in 1898 and commanded a large amount of attention from the Public Authorities. Deas had patented a design five years earlier for a destructor furnace in Manchester (patent no. 15598; Leigh Chronicle and Weekly Advertiser, 1st September 1893). The improved furnace was known as a good steam or power producer, and it was recommended that a boiler should be fitted to each pair of cells, which could go on to supply power to machinery.

7.4 Manchester Corporation Cleansing Yard, Water Street

7.4.1 *The Removal and Disposal of Town Refuse* by William Maxwell (1898, 293-296) described the Manchester cleansing department as the largest in the kingdom, with several depots distributed throughout the city, the largest of which were situated at Water Street and Holt Town. It was reported to have employed nearly 2000 men, 400 horses and 500 vans, and its payment for the year 1897 amounted to £172,874, whilst

the amount received from sales was £41,080. The process of waste management comprised the separation of sewage and ash for use as fertiliser. Once this task had been undertaken, the rough refuse, including paper, broken bottles, old boots etc were burnt in destructors, and reduced to a clinker (Maxwell 1998, 293).

7.4.2 Maxwell's book (1898, 295) states that '*the oldest of the furnaces now in existence at Water Street were probably the first of the kind ever erected'*. The Manchester Courier and Lancashire General Advertiser reported on an exhibition of sanitary appliances. Certificates with special commendation were awarded to '*Manlove, Alliott and Co (Nottingham) for Fryer's patent disinfecting apparatus, which is used at Manchester Corporation's health yard, Water Street'* (Manchester Courier and Lancashire General Advertiser, 10th August 1877). Originally, four Fryer cells were erected at Manchester Corporation Yard, Water Street (Goodrich 1901, 106). Later sources state that the Fryer destructor in Manchester, "*the first refuse destructor*", remained in operation in 1912, though the original cells had been fitted with steam-jet blower forced draught (Goodrich 1912,37).

7.4.3 In 1898, the cleansing yard apparently consisted of 12 modern-type destructor cells, two Galloway boilers that powered driving engines of 300-horsepower and a 200 ft. high chimney shaft (Maxwell 1898, 294; Goodrich 1901, 49). By 1898, the heat produced from the destructors at Water Street was being used to make steam. Refuse, instead of coal, was used as fuel to heat the boilers. The steam engines powered several mortar mills that were situated close to the destructors, and in 1898, Maxwell suggested that these would soon be used to generate electricity that would light the cleansing department's buildings (*ibid*).

7.4.4 Maxwell's book also provides information regarding four of the destructors at Water Street, one of which was described as an 'old type', probably referring to the 1873 crude furnace designed by the Corporation (Plate 30; Goodrich 1901, 106; Maxwell 1898, 85, see p49). The most efficient destructor at the Water Street site, in 1898, appears to have been Whiley's furnace, patented in 1891 by Henry Whiley, superintendent of the Water Street cleansing department (Plate 30). Goodrich (1901, 106) noted that Fryer's furnace at the Water Street depot was remodelled and enlarged by Henry Whiley a few years after Fryer's destructor was installed. In addition, several Lancashire and Galloway boilers had been fitted at the Manchester depots for burning refuse directly on the grates (Goodrich 1901, 106). Entries No. 3 and No.4 in the extract below (Plate 33) may refer to this arrangement, which had

'*satisfactory results*' (Goodrich 1901, 106). A photograph taken in 1910 shows a 12-cell destructor at the Water Street depot (Plate 34).

Destructor.	Description.	Cells.	Approximate amount of refuse burnt per cell per 24 hours.	Cost per ton of burning refuse.
			Tons.	d.
No. 1 (Water St.)	Corporation design, old type	12	6 to 8	6·9
No. 2	Whiley's patent, fitted with automatic movable fire-bars	12	6 to 8	3·47
No. 3	Galloway boilers, fitted with movable bars, hand-worked	2	10	16·8
No. 4	Galloway boilers of ordinary type with fixed bars	2	6 to 8	24·00

Plate 33: Extract from Maxwell (1898), 'The Removal and Disposal of Town Refuse'

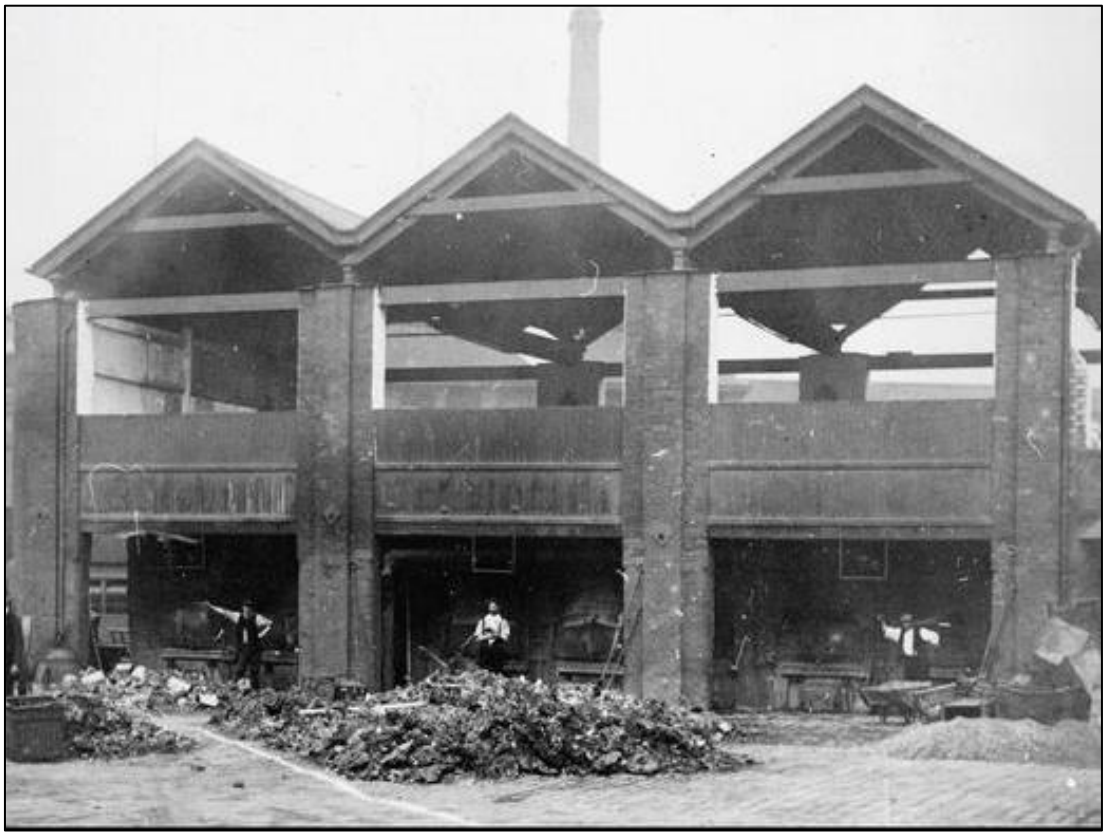

Plate 34: 'Cleansing' destructor, Manchester Corporation Yard, Water Street, taken in 1910, courtesy of Manchester Local Image Collection

7.5 An article in the Preston Herald states that Manchester Corporation Water Street depot had several furnaces at work in 1888, stating that '*These destructors are not quite the same as Fryer's, and the superintendent of the Manchester sanitary department is of the opinion that the principle of feeding the furnaces from the front is better than that used at Fryer's destructor, as tending to the dry material before combustion takes place. The cost of the destructors at the Manchester Corporation water-street depot are estimated by the superintendent of the Manchester sanitary department to have been about £50 per cell, but this is considered an underestimate*.' (Preston Herald, 7th November 1888). This could refer to the alterations that Henry Whiley had made to the original Fryer destructor, which were also mentioned by Goodrich (1901, 106; see pp. 49).

7.5.1 The refuse destructors continued to operate throughout the first half of the 20th century (Lancashire Evening Post, 12th December 1934). New refuse disposal and separation plant had been installed at the Water Street depot in 1929, which had been constructed by Messrs Petrie and McNaught Limited, Engineers of Rochdale. In addition, a new hopper and a clinker house had also been built, though the footprint of the main buildings remained unchanged, which are captured on aerial photographs taken in 1930 (Plate 31; Fig. 11). A handbook shows the different kinds of equipment and incinerators at the site (City of Manchester Cleansing Department 1929; Plates 32-34). The new equipment was completely covered and expected to improve working conditions by eradicating dust (City of Manchester Cleansing Department 1929, 5). The new plant also seems to have been erected shortly after the abolition of operating destructor plants during night-time. The separator plant seems to have included a magnetic separator that extracted small pieces of metal from the dust and cinder before it passed into the rotary screen. It also appears as though a new steam engine was installed (Plate 32).

7.5.2 The Water Street cleansing depot was still in existences throughout the 1970s, but was demolished at some point between 1981 and 1994.

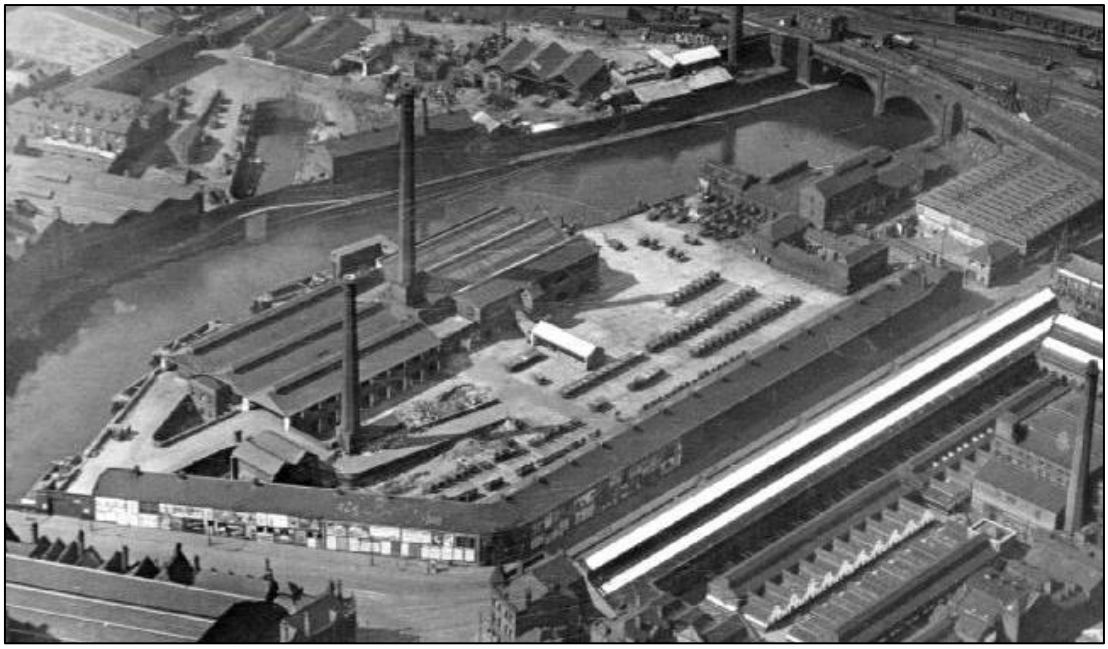

Plate 31: Aerial view of Manchester Corporation's cleansing yard in 1930, courtesy of Manchester Local Image Collection

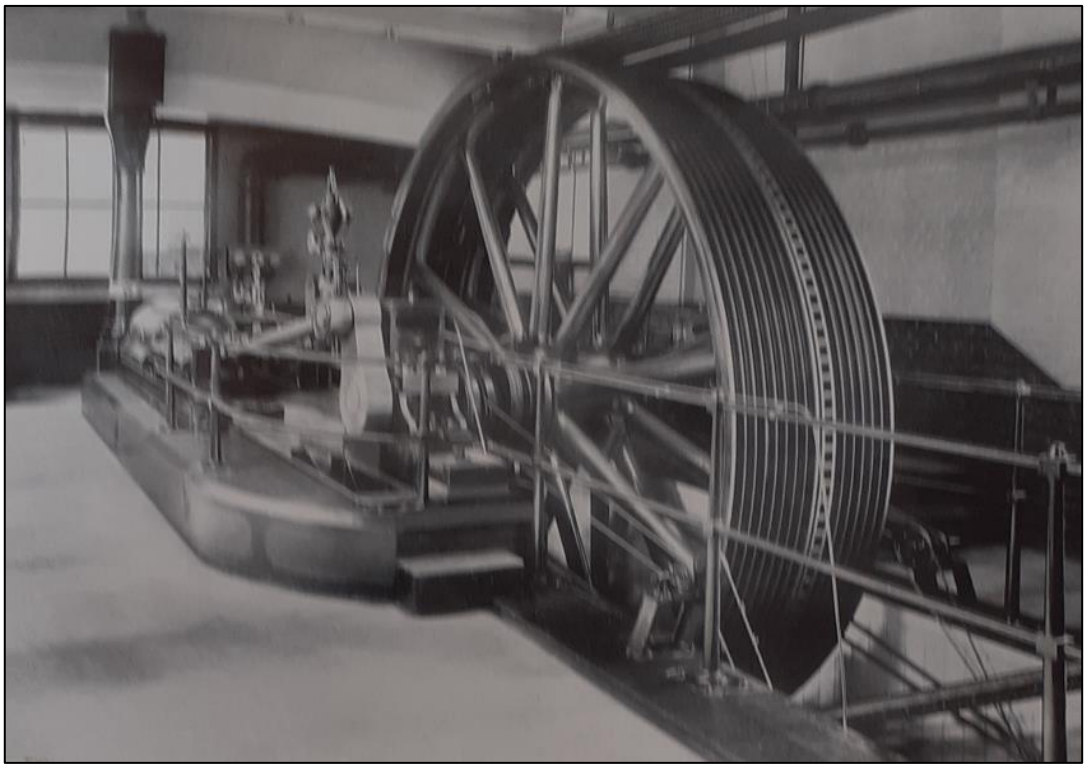

Plate 32: Steam Engine of 300 h.p.,50 revolutions per hour (City of Manchester Cleansing Department 1929, 23)

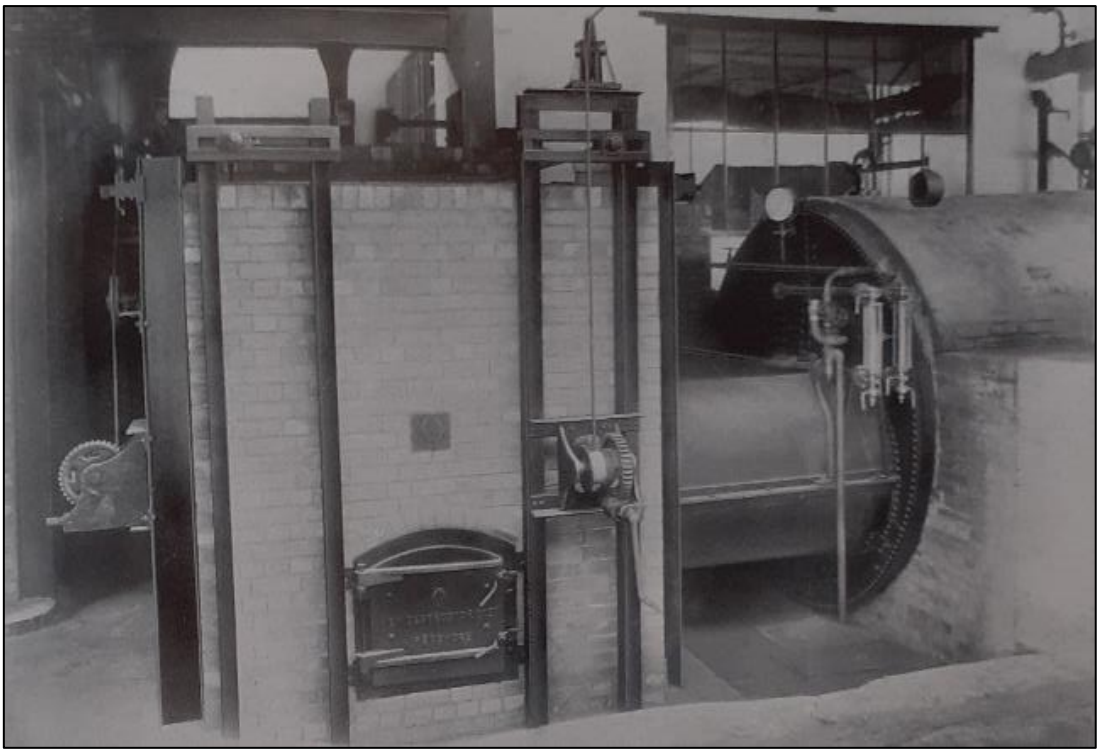

Plate 33: Combustion chamber of incinerator and its connection to the Lancashire Boiler (City of Manchester Cleansing Department 1929)

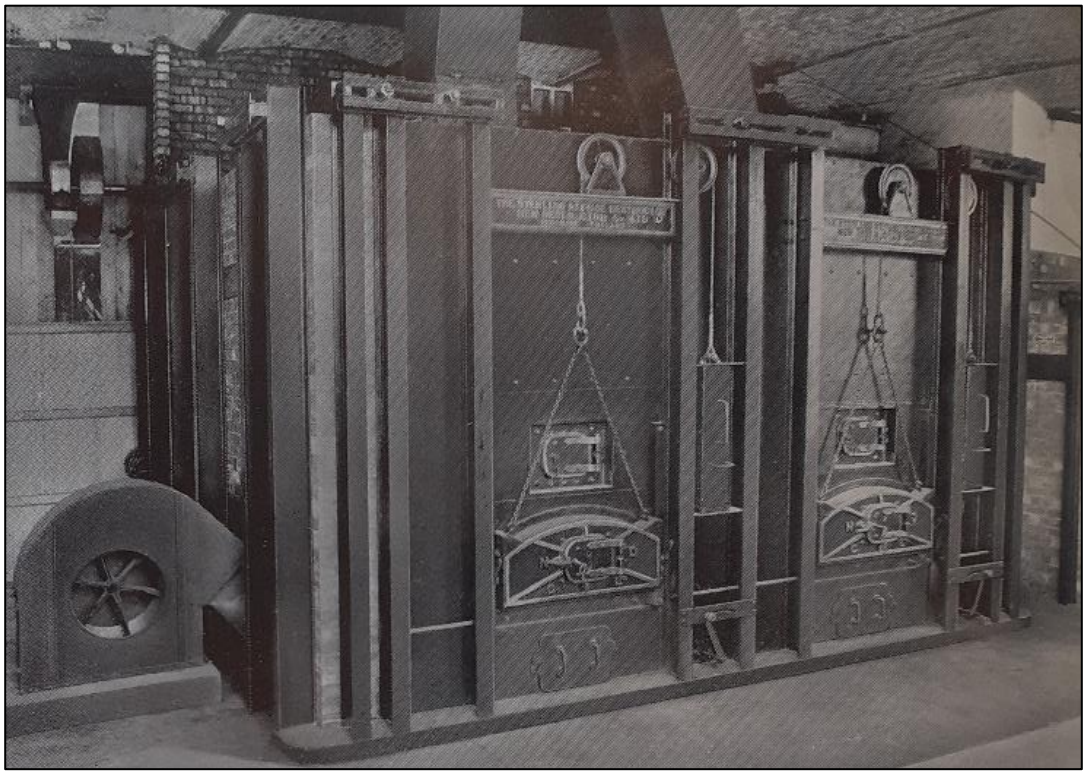

Plate 34: Incinerator for burning the putrescible elements of the refuse (City of Manchester Cleansing Department 1929)

7.5.3 As mentioned above, the incinerated refuse created clinker that was used to create mortar, grit the 'greasy streets' and was also mixed with the sewage to make a dry, portable manure. The clinker was removed from within the destructor cells and ground into mortar, which had a value of 4s. per ton. The mortar produced at Water Street made a profit of £795 in 1895 (Maxwell 1898, 294).

7.5.4 Generally, the best kind of clinker was produced from front and back-fed destructors, as was the case at Manchester Corporation from at least 1888 (Goodrich 1904, 96). Good quality clinker could be used for mortar making, and by the beginning of the 20th century, over 100 mortar mills were operating at destructor sites. There seems to be a lack of information regarding the mortar mills and generation of electricity at the Water Street depot.

7.6 Other waste at Water Street

7.6.1 A table taken from '*The Removal and Disposal of Town Refuse'* (Maxwell 1898, 295) shows the approximate quantity of material disposed of at the Water Street and Holt Town depots. The Corporation made oil, tallow and soap from fish and animal refuse, whilst slaughter-house refuse, ash and night soil were mixed with other ingredients to make manure. Any remaining waste that could not be repurposed went to the tips (Plate 35).

	Water Street. Tons.	Holt Town. Tons.
Dry soil or pail contents and ash-box refuse	84,496	106,568
Night-soil	804	17,611
Fish refuse	714	474
Slaughter-house refuse	3,209	1,692
Market garbage	6,183	—
Street sweepings	37,869	—
Warehouse refuse	4,958	—
	138,233	126,345
Holt Town	126,345	
Refuse sent direct to tips	68,535	
Total	333,113	

[1] *London*, November 12th, 1896.

Plate 35: Extract from Maxwell (1898), 'The Removal and Disposal of Town Refuse'

7.6.2 Manchester Corporation's waste management department operated several other profitable industries including the treatment and manufacture of manure. This was largely due to the prevalence of the pail system and middens. The manure (a mixture of coal ash or clinker with night soil and other ingredients) produced by the

Corporation was used to reclaim land at Carrington Moss for agricultural purposes, which became one of the most fertile estates in Manchester. Manure from the Corporation's yard was transported to Carrington Moss via a light railway, built in 1886-1887. The success of this venture, and the continuous supply of sewage, led to the city purchasing Chat Moss in 1895, in the hope of creating more fertile ground for crops. Chat Moss light railway was built in 1897-1898, though Manchester Ship Canal was also used to transport waste. By the late 1930s, however, the extensive use of the water closet meant that the Mosses were no longer used for the disposal of sewage, and the light railways were sold in 1940. The Cleansing Department became mainly responsible for the collection and disposal of household and trade refuse (Manchester Archives: GB127.M595).

7.6.3 **Electricity**

7.6.4 Electricity for public supply began to develop in the early 1880s and it became obvious that the heat and steam produced from the refuse destructors could be harnessed to drive a dynamo (Tucker 1977, 6). It was not until late 1893 that the first public demonstration of burning town refuse to generate electricity took place (Tucker 1977, 9). The display took place at Halifax, where a boiler constructed to the patents of Frenchman Livet, powered a Parsons turbo-electric generator (*ibid*).

7.6.5 The earliest destructors to generate electricity for public supply included plants at Ealing (opened in October 1894), Cheltenham (May 1895) and Oldham (opened in March 1896). All three used existing refuse destructors. Reports concluded that the steam produced from the refuse destructors was sufficient for the electrical requirements during the daytime, but coal-fired boilers would need to be used at evenings (Cheltenham electrical works had a 176kW capacity, with the steam from the destructor providing 50kW), which led to the invention of the thermal storage system.

7.6.6 The first successful destructor and electricity works to be constructed together for combined working was established at Shoreditch, London in 1897, though the next five years saw a decline in the demand for electricity due to improvements in gas lighting (Tucker 1977, 9). By 1912, however, there were 338 municipal refuse incinerators in Britain and 80 percent of them were used to generate electricity for the town supply (Tucker 1977, 5). Goodrich (1912, 53) states that there were 76 combined destructor and electricity works either in operation or being built. The combined station ceased operation completely in the 1940s, but the destructor continued to supply steam to the adjacent public baths into the early 1960s.

7.6.7 Tucker (1977, 18) suggests that the consumption of electricity per head of population had increased much faster over the years than the production of refuse per head. The electricity which could be generated from the burning of refuse, therefore, became a negligible proportion of the total amount generated, and combined destructor/electricity generating stations went out of use. However, Goodrich (1901, 106) notes that the destructors in Manchester could not deal with the immense amount of refuse that was produced by the city, and that 70,000 tons were sent to landfill.

7.7 Modern Incinerators

7.7.1 In the 1970s, new attempts to incinerate waste for disposal and energy recovery were made at Edmonton (London) and Nottingham. Edmonton has been operating for the past 50 years and claims to have saved 21 million tonnes of waste from going to landfill (http://northlondonheatandpower.london). The waste incinerator will need replacing in 2025 and plans to upgrade the site at Edmonton Ecopark are already underway, with plans to create the greenest energy recovery facility (incinerator) in England.

7.7.2 Recently, UNIPER has identified the need to recover energy from waste within the East Midlands and is building a low-carbon incinerator in place of Ratcliffe-on-soar's coal power station. The facility will generate energy from non-hazardous domestic and commercial waste left over from the recycling process. The project proposes that it will generate enough power for 90,000 homes, prevent 500,000 tonnes of waste per annum going to landfill or exported outside of the UK (uniper.energy,EMERGE), though environmentalists are against the scheme (Nottingham post, 9th March 2022).

7.7.3 Between 2016 and 2018 the number of energy recovery incinerators (R1 accredited-recover energy) went up 18.5%, whilst incinerators without R1 accreditation (do not recover energy) had gone up 28.8% (/www.gov.uk/government/statistics/uk-waste-data). As of October 2021, there are 48 R1 accredited incinerators. Both Incineration (combustion) and Advance Thermal Therapy are currently used to treat residual waste and recover energy in the UK.

7.7.4 Like late 19th-century furnaces, temperatures are required to reach over 1500 degrees Fahrenheit and in the same way, it uses the heat generated from combustion to produce steam from a boiler, which goes on to generate electricity. Of the total available energy in the waste, up to 80% can be retrieved in the boiler to produce steam. The steam can be used for the generation of power via a steam turbine and/or used for heating. An energy recovery plant that produces both heat and power is commonly referred to as a Combined Heat and Power (CHP) Plant and this is

currently the most efficient option for utilising recovered energy from waste via a steam boiler.

7.8 **Phasing**

7.9 **Phase 1: late 18th-century dye works**

7.10 None of the excavated remains seemed to correspond with the late 18th-century dye works or mid-19th-century chemical works, which lay slightly north of the open area excavation trench. However, a fragmented brick surface 024 was exposed beneath wall 021 (Fig. 8). The surface also appeared to pre-date the corporation yard.

7.11 **Phase 2: The Ordnance Survey map of 1891 (Fig. 9)**

7.12 The Ordnance Survey map of 1891 is the first available map that captures the development of Manchester Corporation Cleansing yard. By 1891, the site probably had several different types of destructors in use, including a Fryer type, a design patented by Whiley in 1891 and potentially some 'old type' furnaces that were built by the Corporation in 1873. None of these destructors, associated boilers, or buildings lay within the excavation area, which remained undeveloped (Fig. 9).

7.13 **Phase 3: The Ordnance Survey map of 1896 (Plate 5, p17) and 1908 (Fig. 10)**

7.14 The excavated remains were first captured on the 1896 Ordnance Survey Plan (Plate 5, p 17). The same footprint of buildings was shown on the Ordnance Survey map of 1908 (Fig. 10). Comparisons between the 1908 map and the geo-rectified survey (Fig. 10) show that the excavated remains of the chimney (005 and 016), engine room (015, 018, 025 and 014) and boiler houses directly overlay the buildings shown on the map. These buildings were likely associated with '*12 modern-type destructor cells, two Galloway boilers that powered driving engines of 300-horsepower and a 200 ft. high chimney shaft'* described by Maxwell in 1898.

7.15 Flues 001, 002, 006, 007, 010 and 011 were also likely contemporary with the late 19th century phase of development. Flue 028, built in the lower courses of the chimney structure, was also contemporary with this phase and appeared to have been associated with an earlier building to the south-west.

7.16 Flue 001 was connected to flue 019, which was located at ground level and was likely associated with curved firebrick structure 020. Structure 020 may have represented the wall of a furnace, with flue 019 adjoining the hearth. By 1901, Goodrich (1901) writes that the Water Street depot had 28 destructors of the Whiley-type, which may

suggest that the partially exposed remains of the furnace was most likely to represent this type.

7.17 The boiler room (013, 032 and 033) was also likely contemporary with this phase. The rectangular buildings aligned northeast to southwest, on either side of the chimney were identical and would have both housed boilers. Wall 003 may have been associated with boiler housing on the north-west side of the chimney.

7.18 Refractory bricks were keyed into the red brick outer walls of the flues and boiler house, as was standard at destructor sites. The mortar in the lower courses of the chimney, the boiler room and within the flue walls and bases, was brown and sandy and, in some cases, was no longer visible. The structures had likely been affected by heat, causing the mortar to disintegrate.

7.19 Presumably, the working floor surface (035-7), wall 021 and the sunken structure 026 that was built with surface 035 were also associated with this phase of activity.

7.20 **Phase 4**

7.21 A square structure 008 was built above flue 028. The square structure may have been constructed at a slightly later date as it was not keyed into chimney base 016. The function of the structure is unknown and was not captured on any of the historic maps.

7.22 Wall 003 was truncated and modified to accommodate the north-west wall of flume 004, which was situated at the north-east end of flue 001.

7.23 An additional wall, with metal door and operating chain may have been a later addition that was installed between flue 010 and boiler 013.

7.24 **Phase 5**

7.25 A single skin wall seems to have been added between flue 001 and flume 004, which was not keyed into either structure. The function of the wall is unknown but may have been constructed to improve temperatures, draught or prevent unburnt refuse from entering the flue to the chimney. A low arch opening was situated at the base of the wall, which was later blocked.

7.26 **Phase 6: 1929 improvements**

7.27 A handbook recorded that new machinery was added to Manchester Corporation Yard in 1929. The existing arrangement of buildings remained unchanged though hoppers were added on the north-west and south-east side of a building that was immediately to the north-east of the excavation trench. During the installation of new machinery, repairs may have been undertaken in the existing engine house, potentially to fit a

new engine. The presence of machine-made bricks and hard grey in the upper courses of the engine bed may be associated with this phase.

7.28 **Phase 7: Ordnance Survey map of 1948 (Fig. 11)**

7.29 The 1948 Ordnance Survey map (Fig. 11) shows that the building on the north-east side of the chimney was a ‘ruin’. A new fire brick lining and skin of frogged bricks may have been constructed within the chimney 005 around this time. The firebrick lining seemed to have blocked flues 006 and 007 and a flue in the north-east elevation of the chimney. The flue built within the lower courses of the chimney, in the south-west elevation, may have remained in use.

8. CONCLUSIONS

8.1 Key Results

8.1.1 Th excavation at the site has revealed the well-preserved remains of a power plant associated with a refuse destructor, primarily comprising a boiler house, engine room, chimney and mirrored arrangement of flues. These were associated with recovering steam from the refuse destructor to drive an engine. It is unclear whether the engine powered the onsite mortar mills or generated electricity. Sources regarding the generation of electricity at the Water depot and mortar mills are limited.

8.1.2 Documentary sources state that Manchester Corporation Yard had several destructors on the site in 1898, including a design by Alfred Fryer that seems to have been the first ever destructor erected. Other varieties included a patented design by Henry Whiley, at least two Galloway boilers fitted with two cells and an 'old type' destructor (could refer to a crude furnace of 1873). Several Lancashire and Galloway boilers for burning refuse directly on the grates were also at the site. By 1901, the Water Street depot had 28 destructors of Whiley's design (Goodrich 1901, 106). Messrs Meldrum Brothers Limited had also altered one of Henry Whiley's cells at Manchester to give an increase of 50 per cent (Goodrich 1901, 107).

8.1.3 The remains of excavated flue 001 on the north-west side of the chimney was likely to have been connected to a furnace that lay just beyond the excavation trench. Flue surface 019 probably represented a flue close to the rear of the furnace and the curved refractory bricks 020 may have demarcated the walls of a furnace. The mirrored arrangement of flues suggests that flue 011 would have had the same function as flue 001, and would have likely been connected to a furnace. In addition, another boiler house, like that excavated, possibly lay beyond the north-west limit of excavation, with flue 002 allowing hot gases to escape from the boiler room, like flue 010, which was mirrored to the south-east. Wall 003 may have been associated with the boiler housing on the north-west side of the chimney.

8.1.4 Outlet 028, which headed south-west from chimney 006 may have allowed hot gases to escape from furnaces/destructors in the building to the south-west.

8.1.5 Several phases of repairs, additions and possible improvements were visible within the remains. These included the possible addition of outlets, blocking of flues and possible addition of a metal door and chain between the boiler room and a flue. Improvements to the flues may have been undertaken to raise the temperature of the furnace, so that refuse could be properly incinerated, to alter the draught from the

chimney. Other adaptations may have included the installation of a cremator or similar structure to help with eliminating noxious gases that were produced from Fryer's and Whiley's destructors.

8.1.6 Various sources mention alterations undertaken at the Manchester Corporation Yard (Water Street) destructors. The existing destructors were continuously developed throughout the late 19th century, with several different kinds of accessories and upgrades available for installation at existing premises. The way in which the refuse was fed could be altered as was this case at Preston (Goodrich 1912, 69). Alterations were easily undertaken as the fundamental designs of destructors were based on Fryer's. In addition, it is noted in various sources that electricity generating plant could easily be added to existing destructor sites, which would require some alterations to the engine room.

8.1.7 The dark, greyish mortar present within the remains would have likely been manufactured at the onsite mortar mills, produced from clinker, a by-product of incineration.

8.1.8 The excavated remains of the chimney, engine house and boiler house may correspond to the '*12 modern-type destructor cells, two Galloway boilers that powered driving engines of 300-horsepower and a 200 ft. high chimney shaft'* described by Maxwell in 1898. The flues were most likely connected to a Whiley-type destructor as these were the most common kind of destructor at the Water Street depot.

8.2 Significance

8.2.1 The archaeological investigation has provided a detailed record of buried archaeological remains of regional significance pertaining to the industrial period. The buried archaeological remains excavated were associated with the steam power plant supplied by refuse destructors at Manchester Corporation Cleansing Department, Water Street. The site housed the first ever incinerator, designed by Alfred Fryer.

8.3 Key initiatives

8.3.1 Several key initiatives in the current North West Archaeological Research Framework have been addressed in the course of the archaeological investigation (https://researchframeworks.org/nwrf/industrial):

8.3.2 Ind52: What Industrial and Modern period type sites need further study?

8.3.3 The investigation revealed the remains of a steam power plant, which was supplied with heat from waste incinerators. The plant was used to power several onsite mortar

mills. Although there are several reports on refuse destructors that date to late 19th and early 20th centuries, destructors seem to be under studied and there is a lack of current research. The excavation has provided the opportunity to investigate the site of an early refuse destructor and has also identified a potential area that could warrant further study.

8.3.4 Ind55: What is the evidence for the development of power production?

8.3.5 The investigation provided the opportunity to examine an interesting site that used waste, instead of coal, to fuel a steam power plant. As mentioned in the report, destructors were regularly used to generate electricity. This was a key development in power production and is still in use today.

8.4 Dissemination

8.4.1 The project archive comprises site drawings, context sheets, matrix, digital scans and surveys and photographs. A copy of this report will be deposited with the Greater Manchester Historic Environment Record held by the Greater Manchester Archaeological Advisory Service. All drawn records will be transferred to a digital format and then a copy will be deposited with the Archaeological Data Service (ADS). Consequently, a summary of the results of the archaeology investigation will be published in the journal *Industrial Archaeology Review*.

9. ARCHIVE

9.1.1 The results of the archaeological investigation will form the basis of a full archive to professional standards and in line with current CIfA guidelines updated 2014. The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The deposition of a properly ordered and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the CIfA in that organisation's code of conduct. As part of the archiving process, the on-line OASIS (On-line Access to Index of Archaeological Investigations) form will be completed. The site archive will be so organised as to be compatible with the other archaeological archives produced in the North West. All drawn records will be transferred to and stored in digital format, in systems which are easily accessible. The integrity of the site archive will be maintained upon completion of the archaeological works with the archive ultimately being offered for deposition with Salford Museum.

10. ACKNOWLEDGEMENTS

10.1.1 Salford Archaeology would like to thank Trinity Developments (Manchester) Ltd for commissioning the fieldwork and also Ian Millar of GMAAS for monitoring the work. The author would like to thank Julian Thorley, Richard Carter, Andy Coutes, Evon Kirby, Harrison Peters and Jenny Addis for their work on site. The figures were compiled by Sarah Mottershead and Graham Mottershead managed the project.

BIBLIOGRAPHY

Cartographic sources:

Map of Manchester and Salford, C Laurent, 1793

Map of Manchester and Salford, drawn from a survey by William Green, begun in 1787 and completed in 1794

Map of Manchester and Map of Manchester and its Environs, W Swire, 1824

A Map of Manchester and Salford, Bancks and Co, 1831

A Map of Manchester and Salford, Adshead, published 1850

Ordnance Survey 1:500 Town Plan, published 1891

Ordnance Survey 1:2500 First Edition map, surveyed 1888-91, published 1896

Ordnance Survey 1:2500 map, 1908 Edition, (surveyed 1905)

Ordnance Survey 1:1250 National Grid Map of 1948

Secondary sources:

Baines, E. 1835 *History of Cotton Manufacture in Great Britain*, London

Board of Health of Manchester 1805 *Proceedings of the Board*, Manchester

Bruton, F.A. 1909 *The Roman Fort at Manchester*, Manchester

Brennand, M. (ed)., 2007, *The Archaeology of North West England: An Archaeological Research Framework for North West England: Volume 2*, CBA North West, 9 (19), Manchester

CIfA Regulations, Standards and Guidelines, updated 2020, *Standards and Guidance for the Creation, Compilation, Transfer and Deposition of Archaeological Archives*

CIfA Regulations, Standards and Guidelines, updated 2020*, Standards and Guidance for the Collection, Documentation, Conservation and Research of Archaeological Materials*

CIfA Regulations, *Standards and Guidelines, updated 2020, Standards and Guidance for an Archaeological Excavation*

Conway, RS, MacInnes, J, and Brooke, GC, 1909 'The Roman coins of Manchester', in F.A. Bruton (ed.) *The Roman Fort at Manchester*, Manchester

Countryside Commission 1998 Countryside Character Volume 2: North West,Cheltenham

Donaghty, T.J., 1972 Liverpool and Manchester Railway Operations, 1831-45, NewtonAbbott

Farrer, J. and Brownbill, W. (eds.) 1911 *Victoria County History of Lancashire*, **4**, London

Fitzgerald, R.S. 1980 Liverpool Road Station, Manchester: An Historical and Architectural Survey, RCHM Sup Ser, **1**, Manchester

Goodrich, F 1912 *Modern Destructor Practice* London: Charles Griffin and Company Limited

Goodrich, F 1904 *Refuse Disposal and Power Production* Westminster: Archibald Constable & Co

Goodrich, F 1901 *The Economic Disposal of Towns' Refuse* London: P. S. King & Son

George, D. and Brumhead, D. 2002 'The Mersey Irwell Navigation - The Old Quay at Manchester', in R. McNeil and D. George (eds.), 22-4

GMAU 1991 *Water Street, Manchester: Excavation Report*, unpublished report

Gregory, R.A. 2007 *Roman Manchester: The University of Manchester's Excavations within the Vicus 2001-5*, Oxford

Hadfield, C. and Biddle, G. 1970 *The Canals of North West England*, *Vol 1*, Newton AbbotHylton, S. 2003 *A History of Manchester*, Chichester

Historic England, 2015, *Digital Image Capture and File Storage: Guidelines for Best Practice*

Kidd, A. 1993 *Manchester*, Manchester

Maxwell, W. H. 1898 *The Removal and Disposal of Town Refuse*, London: Sanitary Publishing

Miller, I. and Cook, O. 2019 Deansgate Square, Manchester: Archaeology Beyond the Medlock, **25**, Salford

Ministry of Housing, Communities and Local Government, 2018 (revised July 2021), National Planning Policy Framework

Newman, R. and McNeil, R. 2007 The Post-medieval Period Research Assessment, in M Brennand (ed) *The Archaeology of North West England: An Archaeological Research Framework for North West England: Volume 1*, CBA North West, **9** (19), Manchester, 165-221

Parkinson-Bailey, J.J. 2000 *Manchester: An Architectural History*, Manchester

Pre-Construct Archaeology 2002 An Archaeological Excavation at Quay Street/Lower Byrom Street, Manchester, unpublished report

Salford Archaeology 2016 Archaeological Post-excavation Assessment Report: Owen Street Castlefield, Manchester, unpublished report

Sillitoe, P. 1988 The Castlefield Canal Basin 1763-1805: A Chronology of Development, unpublished dissertation

Tucker, D 1977 Refuse Destructors and Their use for Generating Electricity: A Centuries Development, *Industrial Archaeology Review*, 2:1, 5-27

Tupling, G.H. 1962 Medieval and Early Modern Manchester, in C.F. Carter (ed.) *Manchester and its Region: A Survey Prepared for The British Association*, Manchester,115-130

UMAU, 2001 Land at Bridgewater Viaduct, Manchester, unpublished report

UMAU, 2002 Liverpool Road, Manchester: Archaeological Excavation, unpublishedreport

Wild, C. 2018 'Tracks Across the Irwell: From the Liverpool & Manchester Railway to theOrdsall Chord', *Industrial Archaeology Review*, 40:2, 74-87, DOI: 10.1080/03090728.2018.1507166

Online Sources:

British Geology Viewer: *www.bgs.ac.uk/map-viewers/geology-of-britain-viewer*

Archaeological Research Framework for North West England: https://researchframeworks.org/nwrf/

APPENDIX 1: CONTEXT INDEX

Context	Description
001	Flue on west side of chimney
002	Flue on west side of chimney, south-west of 001
003	Wall to rear of western flues
004	Slope down to flue 001 and dividing wall
005	Chimney
006	Concave flue west of chimney
007	Concave flue east of chimney
008	Wall on south side of chimney, surrounding outlet 028
009	Flue to east starting below 007 leading to 010 and 011 truncated by modern pipe 029
010	Flue east of chimney, heading to boiler setting
011	Flue east of chimney associated with flue 010 and brickwork 012
012	Brickwork between 010 and 011
013	Wall of boiler house
014	Brick base on the north-west side of engine bed
015	Engine bed
016	Square base, encasing chimney 005
017	Cobbled floor abutted 016
018	Engine bed
019	Brick floor cut by concrete 022
020	Brick floor/ base of industrial oven
021	Wall
022	Concrete floor surface poured over flagstones and granite setts
023	Wall
024	Floor

025	Engine bed
026	Stone wall
027	Construction rubble
028	Flue to south
029	Pipe cutting 007 and 006
030	Skin on north side of 016
031	Stone/brick surface adjacent to 014
032	Flue
033	Roof/covering of flue
034	Orange/brown made cut by 014, 015 and 025
035	York stone and cut stone surface
036	Flagstones and iron manhole covering steam pipe
037	Granite sett surface

APPENDIX 2: FINDS REPORT

Introduction

A small artefactual assemblage was recovered from the evaluation (no finds were recorded from the excavations) at Trinity Island (Plot D), Water Street, Manchester. Some 173 objects, weighing 5996g, were collected from three contexts in Trenches 1 and 2. The assemblage comprises finds from various material categories and is dominated by 19th-century and later ceramics, clay tobacco pipes and metalwork. The assemblage has a narrow date range with most of the material dating from the 19th to 20th centuries, although there are a few fragments that probably date to the 18th century. A description of each class of artefact group is provided in the following sections. The finds report aims to describe and quantify the material evidence recovered, along with some chronological interpretation, relating it as far as possible to other known finds from the same site or area, in line with Chartered Institute for Archaeologists (CIfA) guidelines (2022).

Methodology

The examination of the artefactual assemblage was carried out by the guidelines set out by the CIfA Standard and guidance for the collection, documentation, conservation and research of archaeological materials (2014). The pottery was examined with reference to A Standard for Pottery Studies in Archaeology (Barclay *et al* 2016). Reference has also been made to Medieval and Post-Medieval Research Agendas drafted by the North West Region Research Framework (2022).

The finds recovered from the excavation comprised various categories of material including; Industrial period ceramics, clay tobacco pipe, glass, metalwork, industrial residues, ceramic building materials and organics such as leather, bone and shell. For quantification and full contents of the assemblage, see Table x1.

All categories of finds were examined in full, with observations supplemented by the finds records generated during the course of the fieldwork. The finds were categorised according to type and class and have been entered into a database to prepare a preliminary catalogue. The finds were then given a unique accession number (SF No.) and digitally photographed. Full details of all recovered material reside within the project archive held at Salford Archaeology.

Overview

Material	Number of contexts/areas	Object count	Weight (g)	% of total assemblage (object count/weight)	Date range
Pottery	3	78	3306	44%/55%	1700-1950
Clay tobacco pipe	1	49	271	18%/5%	1790-1930
Glass	1	18	142	7%/2%	1800-1950
Metal	1	10	1045	4%/17%	1550-1950
leather	1	8	713	3%/12%	1800-1900
Ceramic Building material	1	2	229	1%/4%	1840-1950
Organics	2	3	25	1%/<1%	Not closely datable
Industrial, stone and building material	2	5	251	2%/4%	1800-1950
Miscellaneous	2	3	14	1%/<1%	1800-1950
totals		176	5996		

Table A1: all material recovered

Contexts with finds

Trench/Context	Object count	Weight (g)	% by object count	% by weight
Trench 1/107	46	1937	26	32
Trench 1/110	8	152	5	3
Trench 2/211	115	3195	65	53
Unstratified	7	712	4	12
Totals	176	5996		

Table A2: quantification of finds by context

All finds from the site were recovered during the evaluation from Trenches 1 and 2B. Trench 1 was positioned to investigate the footprint of a late 18th-century dye works / mid-19th-century chemical works. No remains or this early phase (Phase 1) of activity were identified, instead Trench 1, which was located along the northwest limit of the open area excavation area (see Figure 2), which revealed the remains of flue [001]/[103]. It was from the rubble infill [107] within the flue that a substantial number of finds were recovered (see table A2 for quantification). An area immediately to the southeast of engine bed [108] had been infilled with deposit [110], from which a small number of finds were recovered.

Trench 2B lay to the southeast of the open-area excavation. A single 12-course high wall constructed of handmade brick [210] was exposed in the southwest-facing section of the trench. A black silty layer [211], was associated with this structure and produced the largest quantity of finds.

Rubble infill [107] was dominated by metal and glass objects, with under a quarter of the finds represented by pottery. Ware types represented include plain white earthenwares, Industrial slipware, brown stoneware and transfer printed earthenware. The small quantity and diverse range preclude any definitive dating, although the blue, black and white banded Industrial slipware body sherd generally date to the second half of the 19th century (Carpentier and Rickard 2001, 132), and there is some evidence to suggest that plainer pottery was a facet of non-elite table wares in the early 20th century (Griffin and Casella 2010, 105).

Deposit [110] produced only eight objects, comprising plain white earthenware and a spout from a Brown-glazed earthenware teapot, a rubber washer and a single, possible avian, long bone. Like that from context [107], there was little in the way of definitive dating evidence. Both deposits [110] and [107] contained pottery that displayed evidence of post-depositional burning.

In Trench 2, deposit [211] produced 65% of the finds (by object count, 53% by weight) from the excavations. Well over half of the finds from this deposit was made up of pottery, whilst the presence of nine Clay tobacco pipe bowls presented some degree of closer dating of the assemblage. A group of nine decorated bowls likely date to the first half of the 19th century (plate A1). Bore diameters of some 40 stem fragments suggest a broad late 18th to 19th-century date.

Amongst the pottery, there is some evidence that the material from deposit [211] may be slightly earlier than that recovered from Trench 1. An unglazed pancheon rim in Dark glazed coarse ware is likely to be 18th century in date. Painted wares included a painted pearlware jug, with a possible Chinese house motif, which may date from as early as *c.* 1775-1810 (Maryland Archaeological Conservation Lab 2002 and 2015a), whilst the remainder, mostly comprising chamber pots and flatwares date from *c.* 1800-1860 (Plate A2).

Transfer printed earthenwares, mostly blue and white with Chinese or willow pattern motifs have a long duration and were produced throughout the 19th century and beyond. However, amongst this ware type was part of a polygonal flaring bowl, with a “Romantic views” motif common between *c.* 1815-40, a fragment of flatware with continuous repeating designs dating to *c.* 1842-58 (Maryland Archaeological Conservation Lab 2002 and 2015b) and a Flow blue

hollow ware vessel with a Chinoiserie landscape motif dates from *c.* 1845-1860 (Plate A3). A late Rockingham type ware, perhaps dates to the middle to late 19th century.

These more closely datable wares and fabric are tempered by those produced over a long period and which changed little, such as the stoneware ink bottles. Also in this category are two slip-trailed decorated dishes, bearing much simpler decorative motifs than those that typify late 17th- to early 18th-century vessels (Plate A4). They have a broad 18th- to 19th-century date, with some examples dating the very end of the 19th century (Barker and Crompton 2007, 127-164). There are likewise examples of open sponge decorated ware, typically produced from 1860-1935 (Maryland Archaeological Conservation Lab 2002 and 2015c). Lustre ware jug fragments also have a fairly long production life, spanning c 1810-1860 (Maryland Archaeological Conservation Lab 2002 and 2015d), although reproduction of this type of ware continued into the 20th century (Lewis 1985, 165). Industrial slipware was produced over a long period, although it has been suggested that the use of brown and white slip noted on two of the vessels is more typical of the mid to late 19th century (Maryland Archaeological Conservation Lab 2002 and 2015e).

The pottery

Seventy-eight sherds of pottery, weighing 3306g, were retrieved from three deposits in Trenches 1 and 2 located at the northern end of Plot D. The pottery was in good condition, unabraded, with some relatively large pieces, although the diversity of wares and from only three contexts and the lack of joining sherds would suggest some degree of post-depositional disturbance. The pottery dates from the 18th to the mid-20th century, with the majority probably dating to the 19th and early 20th centuries.

Ware type	Contexts	Object count	Weight (g)	Date range*
Brown-glazed earthenware (eg. teapots)		1	47	1800-1950
Dark glazed coarse ware		1	153	1700-1800
Glazed red earthenware fine (Lustre ware)		2	31	1810-1840
Mottled ware (Rockingham glaze)		1	32	1770-1900
Pearlware		2	121	1775-1860
Self-coloured earthenware (general)		1	49	1800-1900
Industrial slipware		4	108	1850-1939
Decorated slip-coated ware		3	218	1800-1900
Stoneware (British brown)		9	637	1800-1900
Transfer printed earthenware		35	1160	1783-1950
White earthenware		10	309	1800-1950

Spongeware		2	150	1860-1935
Painted earthenware		5	219	1785-1870
Cobalt coloured ware		2	72	1840-1860
Totals		78	3306	

* based on wares recovered from the site

Table A3: Types and quantification of pottery recovered during the excavation

The earliest pottery is likely to be a sherd from a Dark glazed coarse ware pancheon, with an unglazed rim, as this characteristic is more typical of 18th-century dark glazed wares. It has been noted that coarsewares, particularly heavy-duty storage and cooking vessels, because of their sturdy construction and durability, often survive longer as complete vessels (Pearce 2000). Other early pottery includes Pearlware and transfer printed wares. A Pearlware jug fragment with painted cobalt blue painted Chinese house type decoration, was probably manufactured between *c.* 1785 – 1810 (Maryland Archaeological Conservation Lab 2002 and 2015a). Dating to the early decades of the 19th century is a rim sherd from a chamber pot decorated with cobalt blue leaves, with another chamber pot painted with chrome colours (Plate A2), whilst a saucer with scalloped rim and polychrome painted floral pattern and a polygonal flaring bowl, decorated with transfer printed 'Romantic views' dates to *c.* 1815-40. Much of the remaining pottery comprises factory-produced white wares, plain and decorated dating to the second half of the 19th century and later. A more unusual type was part of a relief moulded jug in a blue fabric, possibly a type of stoneware, with similar if better-executed designs being manufactured in Hanley, Staffordshire in *c.* 1860-80 (Potteries Museum & Art Gallery). A Rockingham-type glazed jug handle may date from as early as *c.* 1770, however, in this instance, it is likely to be from a vessel mass produced in the mid to late 19th century (Maryland Archaeological Conservation Lab 2002 and 2015f).

Amongst the coarse wares were five complete brown stoneware ink bottles of various sizes, 19th century in date but also still manufactured in the early 20th century (Askey 1981, 135; Green 1999, 169). Unusually amongst Manchester pottery assemblages were two examples of late slip decorated dishes, with a single wavy slip trail line on an everted rim and bowl/dish with a nonagonal-shaped slip trailed motif on the base. Both fragments were red-bodied with a brown iron-rich glaze contrasting with white clay slip which fires pale yellow/cream colour. Such pots were produced over a long period from the mid-18th century until the end of the 19th. It is possible that they were products of non-industrial manufacturers that existed at the time, such as potteries that operated around Halifax, West Yorkshire (Lawrence 1974, 183- 189).

The assemblage comprises, for what is the most part, typical late 18th-19th-century domestic pottery. It comprises table wares such as teapots, jugs bowls and plates, as well as coarse wares, which were fewer in number. Ink bottles may be suggestive of both commercial or domestic usage. There is some indication that the assemblage from Trench 2B may date from the later 18th to the mid-19th century and may be associated with earlier (Phase 1) activity. The later material from trench was likely to be material destined for the refuse destructor.

Clay tobacco pipes

Forty-nine clay tobacco pipe fragments, weighing 271g, were recovered during the excavations, all of which were from layer [211]. This comprised nine bowls or fragments of, and 40 stem fragments. Seven bowls with spurs, and no makers marks date to the early 19th century. A bowl with spur and leaf pattern was one of the most common decorative motifs in the 19th century (Davey 1985, 76). Another decorated example, with an acorn design and spur, dates to the period *c.* 1860-1930 (Plate A1).

Stem bores were between 4/64 and 5/64 inches (1.6mm to 2mm) indicating a late 18th to 19th-century date. Two examples of yellow-glazed cut mouthpieces were also recovered. Cut mouthpieces were used for almost all clay tobacco pipes dating from before *c.* 1840 but is also commonly found on pipes after that date (Higgins 2017, 6.5-6.6).

Ceramic Building material

Two fragments of salt-glazed sewer pipe were recovered from rubble infill [107]. Salt-glazed sewer pipes were first manufactured by Henry Doulton at his pottery in Lambeth, London in the mid-19th century becoming the material of choice for drainage due to being impermeable, tough and above all cheap (Green 1999, 46-7; McComish 2015, 49).

Glass

Some 18 fragments of glass were recorded during the excavations, all of which were recovered from rubble infill [107]. The glass comprised glass production waste, vessel glass and window glass. Vessel glass, nine fragments of which were recorded, was all nondiagnostic and comprised pale green and colourless fragments. Window glass, which was all colourless and had thicknesses of 2.75mm, 3mm, 3.1mm and 7.9mm, was likely to be cast plate glass, manufactured in Britain from the later 18th century. This technique utilised molten glass, which was ladled from the furnace onto an iron casting table and then rolled into large flat sheets, subsequently being ground and polished on both sides (Paynter and Dungworth 2018, 36). A

single fragment of glass production waste, or glass melted during the waste destruction was recovered from rubble infill [107].

Metalwork (iron, copper and lead)

In total 12 metal fragments and complete objects were found in rubble infill [107], weighing 1532g. They comprised eight iron objects and two of copper alloy and two of lead. Identifiable iron objects comprised a 20mm diameter square-headed bolt with a hexagonal nut at the opposite end, two joining fragments of a heavily corroded pipe, with an internal diameter of 8mm, a small rod with one end bent over, a round sectioned nail head with bent shank and nondiagnostic object too corroded to identify. Copper alloy objects comprised two round-headed, square section nails measuring 39.5mm long. The objects of lead consisted of a lead foil bottle cap, possible from a wine bottle and a piece of lead melt.

Leather

Eight leather objects were found during the excavations, comprising two near-complete shoes and a small fragment with stitching holes. The two leather shoes were both recovered unstratified and both were intended for the left foot. Shoe 1 consisted of parts of the upper and an almost complete sole. The surviving elements of the upper comprised a piece with five eye holes strengthened by metal eyelets and decorative perforations or 'broguing', the tongue which also exhibited brogue decoration, and two unidentified parts. The sole, which measured 260mm x 85mm wide was constructed from two pieces at the front and three pieces at the rear, which may be a variation on the full-double construction which contains two thicknesses of leather spanning across the entire foot. The sole was completed by the attachment of 18 studs. The heel comprised four lifts was attached to the sole with iron nails and finished with nine studs. The combination of studs and brogue decoration suggests that this was a golf shoe (Plate A5).

Shoe 2 was near complete and measured 284mm long x 106mm wide. It comprised uppers and quarters with separate heel stiffener or backstay and toe cap or tip. The five eye holes, again strengthened by metal eyelets and are attached in the ‘Derby’ style, that is over the vamp. The sole (11.5mm thick), is composed of mid-sole and partial remains of tread sole which has been repaired with a man-made replacement, whilst the heel (height: 16.9mm) is formed of three lifts and possible replacement man-made heel (Veres 2005; Goubitz et al 2001, 301). The presence of the shoes is likely to reflect the items that escaped being incinerated within the waste destructor. A leather fragment from rubble infill [107] with two rows of stitch holes along one edge could not be identified as a particular form or artefact.

Animal bones

A single burnt animal bone was found in deposit [110]. It was hollow in section and was presumably avian in origin. The animal bone has no analytical value.

Organics

Two marine mollusc shells were recovered from layer [211]. These comprised an oyster and a cockle shell. The marine shell has analytical value.

Industrial, stone and building material

Three objects were recorded in this category. They comprised two samples of tar from rubble infill [107] which were disposed of due to hydrocarbon contamination. A third object found in deposit [110] was a flanged rubber washer or nozzle, which may have been connected to a pipe of some description.

Miscellaneous

Three objects have been included in this category, which comprised a horn double-loop buckle frame and pen from rubble infill [107] and an annular plastic object from layer [211]. The pinless horn double-loop buckle frame was perhaps a slider or similar object used for clothing such as braces for holding up trousers (Plate A6). From the same context was a fountain pen barrel. Although the barrel survived, the nib from the pen did not. The barrel was likely made of celluloid or vulcanised rubber, with the former enabling production in a much wider range of colours and designs (Nishimura 1997-2022). Lastly, was an injection moulded green transparent plastic, annular object of unknown use. This object was intrusive within layer [211].

Discussion

The finds assemblage from layer [211] in Trench 2, which is associated with a wall [210] constructed from handmade bricks, was likely to belong to Phase 1 activity on the site. The association of the finds that are tentatively assigned to the late 18th to mid-19th century with the handmade brick wall may, therefore, represent structures associated with the mid-19th century Chemical works.

Those finds from Trench 1, infill [107] and deposit [110], which date from the second half of the 19th and early 20th century are likely to been intended for disposal within Manchester Corporation's Cleansing Yard. It is therefore no surprise that deposits [110] and [107] both contained pottery that displayed evidence of post-depositional burning.

Plate A1: Clay tobacco pipe bowls from layer [211]

Plate A2: Painted chamber pots from layer [211]

Plate A3: flow blue

Plate A3: Flow blue hollow ware vessel from layer [211]

Plate A4: Slip-trailed decorated dish fragments from [211]

Plate A5: Unstratified golf shoe

Plate A6: Belt buckle/slider from deposit [107]

References

Askey, D., Stoneware Bottles, from Bellarmines to Ginger Beer Bottles, 1500-1949, Brighton

Barclay, A., Knight, D., Booth, P., Evans, J., Brown, D. H., and Wood, I., 2016 A Standard for Pottery Studies in Archaeology, Prehistoric Ceramics Research Group, Study Group for Roman Pottery and Medieval Pottery Research Group

Barker, D., and Crompton, S., 2007 Slipware in the collection of the Potteries Museum and Art Gallery, London

Chartered Institute for Archaeologists (CIfA), 2014 Standard and guidance for the collection, documentation, conservation and research of archaeological materials, Reading

CIfA, 2022 Toolkit for Specialist Reporting; Available at: https://www.archaeologists.net/reporting-toolkit; Accessed on 29/07/2022

Davey, P., 1985 ‘Clay pipes from Norton Priory’, in Davey, P., (Ed) The Archaeology of the Clay Tobacco Pipe IX, Parts i and ii: More Pipes from the Midlands and Southern England, BAR British Series, 146 (i), Oxford, 157-236

Goubitz, O., van Driel-Murray, C., Groenman-Van Waateringe, W., 2001 Stepping Through Time: Archaeological Footwear from Prehistoric Times Until 1800, Zwolle

Green, C., 1999 John Dwight's Fulham Pottery: Excavations 1971-79, London

Griffin, D., and Casella, E. C., 2010, '"We lived well at Hagg": Foodways and Social Belonging in Working-Class Rural Cheshire’, in Symonds, J., (Ed) Table Settings: The Material culture and Context of Dining, AD 1700-1900, Oxford, 101-111

Higgins, D., 2017 Guidelines for the Recovery and Processing of Clay Tobacco Pipes from Archaeological Projects, Historic England

Hunter, R., 2001 Ceramics in America, Hanover, New Hampshire and London

Lawrence, H., 1974 Yorkshire Pots and Potteries, Newton Abbot

Lewis, G, 1985 (third edition) A Collector's History of English Pottery, Woodbridge

Maryland Archaeological Conservation Lab 2002 and 2015a, Underglazed Painted Earthenwares; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/PaintedWares/index-paintedwares.htm; accessed on 19/08/2022

Maryland Archaeological Conservation Lab, 2002 and 2015b, Printed Underglaze Earthenware; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/Printed%20Earthenwares/index-PrintedEarthenwares.htm; accessed on 12/09/2022

Maryland Archaeological Conservation Lab, 2002 and 2015c, Sponge Decorated Wares; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/SpongedWares/index-spongedwares.htm; accessed on 12/09/2022

Maryland Archaeological Conservation Lab, 2002 and 2015d, Luster Wares; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/LusterDecoratedWares/index-Lusterware.html; accessed on 12/09/2022

Maryland Archaeological Conservation Lab, 2002 and 2015e, Yellow Ware; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/Less%20Commonly%20Found/YellowWare/index-YellowWare.html; accessed on 12/09/2022

Maryland Archaeological Conservation Lab 2002 and 2015f, Rockingham Ware; available at: https://apps.jefpat.maryland.gov/diagnostic/Post-Colonial%20Ceramics/Less%20Commonly%20Found/Rockingham/index-Rockingham.html; accessed on 19/08/2022

McComish, J. M., 2015 York Archaeological Trust: A Guide to Ceramic Building Materials, An Insight Report, York

Miller, G. L., and Hunter, R., 2001 'How Creamware got the Blues: The origins of Chia glaze and Pearlware', in Hunter, R., Ceramics in America, Hanover, New Hampshire and London, 135-161

Moore W, R, G., 1980 Northamptonshire Clay Tobacco-Pipes and Pipemakers, Northampton

Nishimura, D., 1997-2022 'What is celluloid?'; available at: https://www.vintagepens.com/FAQmfr/celluloid.shtml; accessed on 24/08/2022

Paynter, S., and Dungworth, D., 2018 Archaeological Evidence for Glassworking: Guidelines for Recovering, Analysing and Interpreting Evidence, Swindon

Pearce, J., 2000 A late 18th-century inn clearance assemblage from Uxbridge, Middlesex, Post-Medieval Archaeology, 34, 144-186

Pollock, E., c 1910, Central Clay Pipe Works, Manchester

Rickard, J., and Carpentier, J., 2001 'Slip decoration in the Age of industrialisation, in Hunter, R., (Ed) Ceramics in America, Hanover New Hampshire, 115-134

Veres, M., 2005 Introduction to the Analysis of Archaeological Footwear, Australasian Historical Archaeology, 23, 89-96

APPENDIX 3: FIGURES

Figure 1: Site location

Figure 2: Excavation and Trench location

Figure 3: Trenches 1 and 2A

Figure 4: Trenches 2B and 3

Figure 5: Trenches 4A and 5

Figure 6: Trench 4B

Figure 7: Trench 6

Figure 8: Excavation Plan

Figure 9: Excavation Results superimposed onto the 1:500 Town Plan of 1891

Figure 10: Excavation Results superimposed onto the 1:2500 County Series Map of 1908

Figure 11: Excavation Results superimposed onto the 1:1250 National Grid Map of 1948