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Tonedale Mill and Tone Works, Wellington, Somerset: an archaeological landscape assessment of the water management system

Nicky Smith, Fiona Small and Rebecca Pullen

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TONEDALE MILL AND TONE WORKS, WELLINGTON, SOMERSET

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SUMMARY

This report examines the water management systems associated with Tonedale Mill and Tone Works, former cloth-manufacturing mills near Wellington in Somerset. The mills were founded by Thomas Fox in around 1800 and continued to be operated by his descendants until 1999. The mills worked together as an integrated woollen textile factory, with spinning and weaving undertaken at Tonedale Mill, cloth-finishing and dyeing at Tone Works, and effluent treatment at the adjacent grease works. Ample supplies of water were needed for power and cloth-making processes. For this they exploited the River Tone and two tributaries, the Westford Stream and Rockwell Green Stream, modifying and diverting aspects of the existing watercourses. Much of the water management infrastructure remains intact, with key elements surviving as a network of culverts, channels, leats, weirs, sluices, ponds and footbridges in the wider landscape.

In 2021 and 2022, Historic England's (HE) Archaeological Investigation Team undertook desk-based research, aerial investigation, and site visits. Additional contextual research was undertaken in 2023. The work clarifies the nature, extent and importance of the water management features, charts their development and examines the interconnections between them. This information will inform HE's advice on regeneration proposals and help to underpin future site interpretation.

CONTRIBUTORS

The report was primarily researched and written by Nicky Smith, with aerial investigation and mapping contributions from Fiona Small, and was edited, augmented and brought to publication by Rebecca Pullen. Fieldwork was carried out by Nicky Smith and Johanna Roethe, and new site photography captured by James O. Davies. Sarah Newsome and Johanna Roethe provided editorial comment. Illustrations were produced by the authors unless otherwise stated.

ACKNOWLEDGEMENTS

Joanne O'Hara, Jack Johnston and Amy Kemmish of Somerset Council provided valuable support and assistance throughout the course of this study. Vanessa Ruhlig of Thread Architects generously shared her research results and showed us surviving features. Antony Firth of Fjordr kindly provided advice on investigation approaches to riverine landscapes. Kevin Wendt allowed us access to his land and shared his personal knowledge of the area. Denis Dodd, Geoff Fitton, Mary Miles and Chris Cooper of the Somerset Industrial Archaeology Society (SIAS) contributed helpful information and additional contact details. Chris Webster of the Somerset Historic Environment Record (HER) supplied copies of essential reports from the HER's collection. Staff of the Somerset Heritage Centre (SHC) provided valuable assistance during archive visits. The project also benefited from the knowledge and insights of Richard Fox.

The authors would also like to acknowledge the contribution of the late Brian Murless (1947-2022), a knowledgeable local archaeologist who spent many years tirelessly exploring and recording Somerset's industrial heritage. His accounts of the mills around Wellington and the details that he supplied to Somerset HER inform much of our current knowledge.

ARCHIVE LOCATION

Any digital archive for this project will be held by Historic England Archive, The Engine House, Fire Fly Avenue, Swindon SN2 2EH.

The investigation has been registered under OASIS Id: nmr1-502873.

DATE OF RESEARCH

Field visits, aerial mapping, new site photography and desk-based research took place between September 2021 and September 2022. Additional background research and analyses were completed in Autumn 2023, and the report was published in early 2024.

CONTACT DETAILS

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Cover image: The weir downstream (north) of the Basins with footbridge and sluices, looking north-east, April 2022 [James O. Davies © Historic England Archive, DP347731]

CONTENTS

1. INTRODUCTION

Tonedale Mill and Tone Works are highly significant places in the history of England's textile industry. They were the headquarters and main production sites of Fox Brothers & Co. Ltd (previously Were & Sons, followed by Thomas Fox & Sons) and were a woollen mill and cloth finishing works which operated together, carrying out all processes to produce finished cloth from raw fleece. Both factories were established by Thomas Fox around 1800 from existing earlier water-powered mills, and a constant water supply remained essential throughout their period of operation. The sites developed in a piecemeal fashion through the 19th and 20th centuries and continued to be run by the Fox family until their closure in 1999, outliving similar complexes. Part of Tonedale Mill continues to be the base for Fox Brothers & Co. Ltd which, though no longer linked to the Fox family, still produces a wide range of high-end cloth from the Wellington site as well as having current responsibility for the Fox Brothers archive.

The two interlinked mill complexes are located within about 0.5km of each other, on the north-west side of Wellington in Somerset, with related watercourses and water management features extending to the south and south-west of Tonedale Mill and to the east and west of Tone Works (Fig. 1). Water supply and its passage were fundamental to the factories' operation, determining their layout and location. The water supplies to Tonedale Mill and Tone Works were separate. Tone Works was sited to take its water and power from the River Tone, while Tonedale Mill was built on the site of the old flour mill, adapting and expanding the existing leat system which exploited a pair of tributaries that flowed north (the Westford and Rockwell Green Streams), before entering the main river at Tone Bridge. Tonedale Mill's extensive and complex water management system secured a reliable flow of water to the mill in the face of seasonal fluctuations in stream levels and the activities of the mills upstream. The system is generally attributed to Thomas Fox, as part of his initial establishment of the Fox family's factories between 1801 and 1803, although evidence for the precise construction dates of many of its individual features is lacking.

The buildings at both sites contain features associated with water management which extend into the wider landscape as a network of culverts, channels, weirs, sluices, ponds and footbridges. In addition to this, natural watercourses were modified and adapted to serve the increasing requirements for water as power and for numerous factory processes. Little was previously known about these water management features, associated watercourse adaptions or the history of the water management system as whole. Using a combination of desk-based research and targeted field visits, this report identifies structures associated with water management, traces their development and discusses their significance.

Several of the main building ranges at both mill sites are listed (Table 1), as is Tonedale House, built next to the factory by the Fox family in 1801. Three of the four listed factory elements are on the current Heritage at Risk (HAR) Register, all deemed to be in very bad condition with high potential risk of further rapid deterioration (Historic England 2023, 168). The nearby central conservation area focused on Wellington high street is also categorised as at risk but with relatively low vulnerability. No aspects of the wider water management features associated with the factories have current heritage designations.

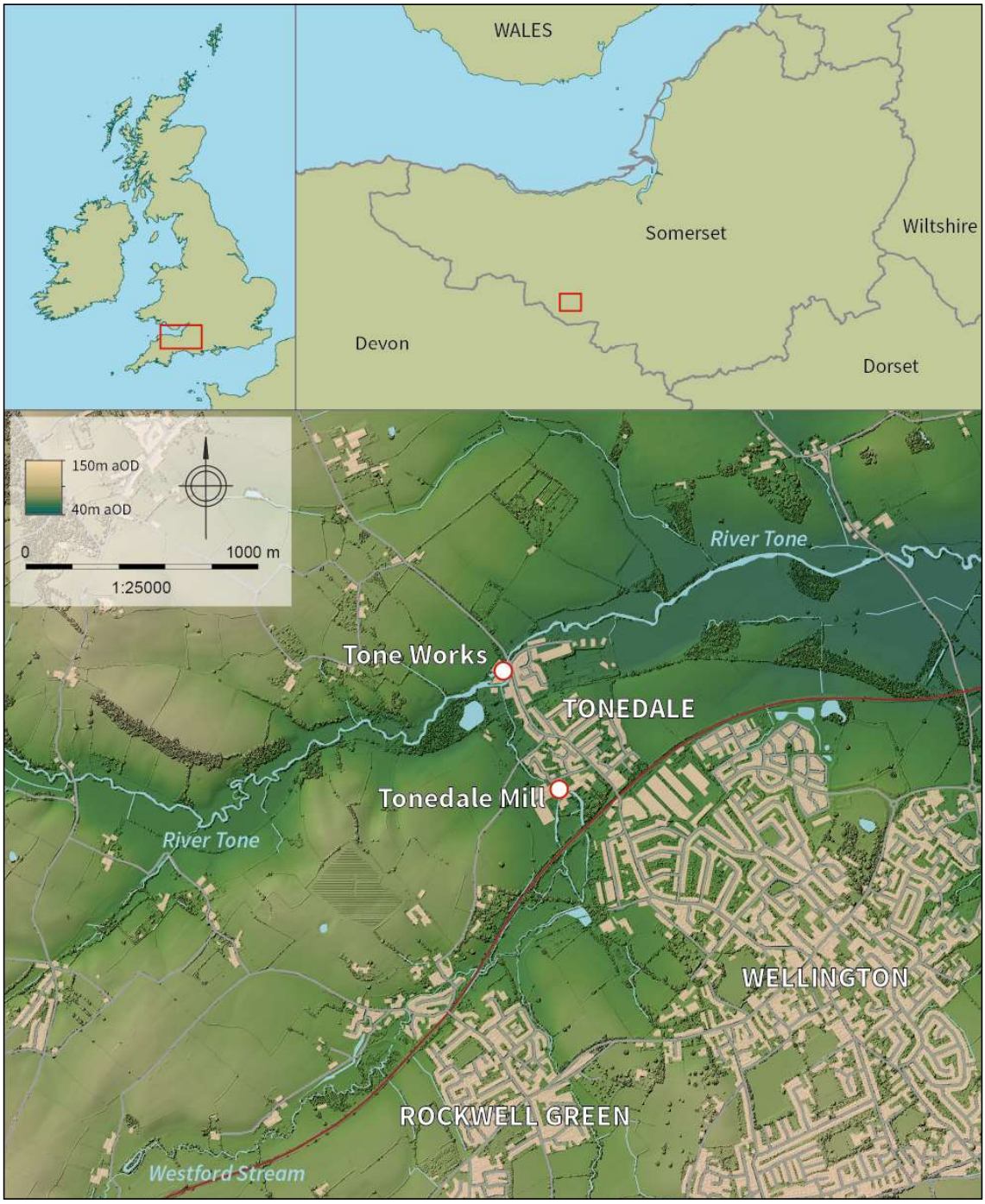

Figure 1: Location plan. [Height data (aOD = above Ordnance Datum) derived from 1m-resolution lidar DSM captured in 2022 © Historic England, source Environment Agency. Other mapping derived from Ordnance Survey open data © Crown copyright and database right 2023]

The factories and the areas connecting have recently become the focus of a major regeneration and conservation initiative by Somerset Council, supported by Historic England (HE). Part of this proposes to develop the green and blue infrastructure in Wellington and connect pedestrian and cycle routes through the town. Improvements to the mill buildings and their water management landscape will link in to the wider Wellington Place Plan which was adopted in March 2023 (Somerset West and Taunton Council 2023). The research presented here was undertaken by HE's Archaeological Investigation team at the request of HE's South West Region and was carried out in order to inform these regeneration proposals, and any subsequent related work, and to help to underpin future site interpretation.

Table 1: Listed buildings and Heritage at Risk status

NHLE no.	Listed building name	Listing grade (year assigned)	NGR (OS GB)	2023 HAR assessment
1051987	Tonedale Mills (west complex)	II* (1993)	ST 12755 21349	Priority A – immediate risk of further rapid deterioration or loss of fabric; no solution agreed
1176514	Tonedale Mills (east complex)	II* (1976)	ST 12862 21363	Priority B – immediate risk of further rapid deterioration or loss of fabric; solution agreed but not yet implemented
1271246	Cloth finishing works at Tone Mills (north range)	II* (2000)	ST 12570 21823	Priority B – immediate risk of further rapid deterioration or loss of fabric; solution agreed but not yet implemented
1059866	Cloth finishing works at Tone Mills (south range)	II (1976)	ST 12639 21786	-
1344790	Tonedale House	II (1976)	ST 12933 21363	-

1.1 Project scope and outline

This report describes the major features of the interlinked water management systems related to Tonedale Mill and Tone Works. It includes the main culverts, channels, leats, weirs, sluices and ponds, as well as footbridges providing access through this network of waterways. The multifarious minor drains, tanks, vats and pipes connected with specific buildings and items of machinery fall beyond its scope.

Also out of scope were the water management features relating to the nearby site of Westford Mills, which sat a short way upstream along the Westford Stream, located across the area that now forms the southwest side of Westford. Established

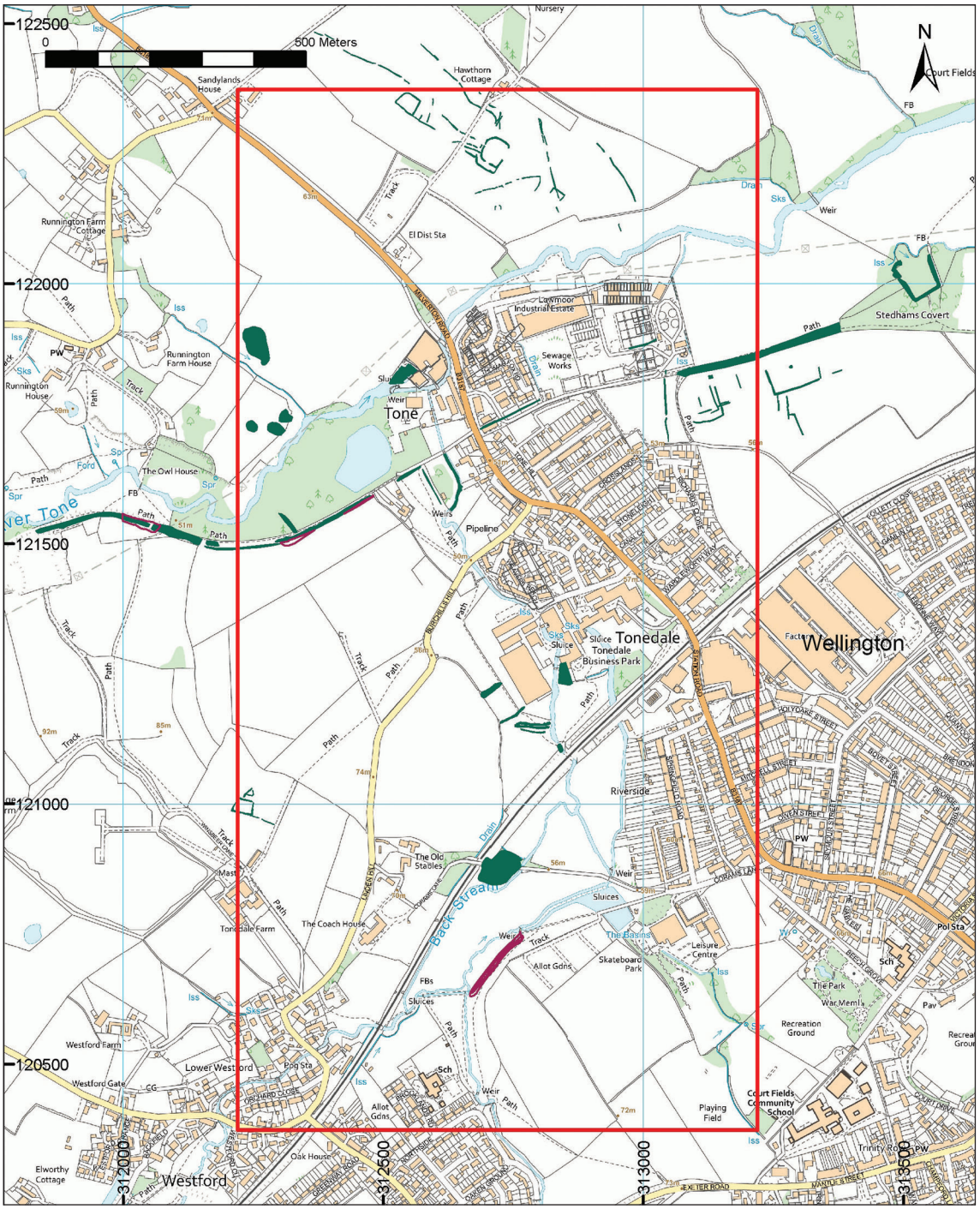

Figure 2: Aerial investigation and mapping study area. Green-filled polygons represent negative features (such as ditches and pits seen as cropmarks), red-filled polygons indicate positive features (such as upstanding earthwork banks or mounds), and black outlines are structures. [© Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900 © Historic England]

by the Elworthy family, the Westford Mills complex was another textile mill site of comparable date, incorporating a spinning mill, power-loom weaving and a large dye house. Most of its buildings were demolished in 2008 and the site redeveloped for housing (Williams 2013, 109-10).

The report has been compiled primarily through a desk-based study of published sources, grey literature reports and research notes. It draws together into a single narrative information contained in previous work which concentrated largely on the mill buildings and local history. Further information has been obtained by comparing the current layout with georeferenced extracts from historic maps. Evidence from a brief search of archival sources and from local commentators has also been included. Where known, approximate dates for the construction or alteration of individual features are discussed in the description chapters and are outlined in the gazetteer (Appendix A). Due to the difficulty in confirming precise dates for the individual elements, it has not been possible to produce a meaningful phase plan for the chronological development of the water management system. Some features remain undated, some are the product of multiple alterations and improvements at separate times, and for others we have only been able to surmise probable construction periods to the date span between certain map revisions. Future documentary investigation or discoveries may enable further refinement to the dating of some features.

Site visits were made, between September 2021 and March 2022. These involved a rapid assessment of the surviving elements of the water management systems beyond the factory complexes. No detailed recording or measured survey was undertaken during the site visits. Targeted ground photography of individual features was undertaken in April 2022 by Historic England photographer James O. Davies.

In addition to this, complementary aerial investigation and mapping of the surrounding landscape was undertaken in order to assess the development of the complex network of water courses associated with Tonedale Mill and Tone Works, as well as to provide context for the mill remains and their setting. The aerial assessment covered an area of approximately 2 square km, centred on the industrial complex (Fig. 2). All available aerial photographs and lidar data were used to identify and record features relating to the 18th to 20th-century industrial complex, as well as recording the earthwork and cropmark evidence for earlier archaeological activity within the study area. These earlier sites, along with details regarding the method and sources used in the aerial assessment, are provided in Appendix B towards the end of the report. Information gained about the mills and their water management systems have been incorporated throughout. Historic aerial photographs from the 1940s onwards and historic Ordnance Survey (OS) maps have provided a picture of the mills and their structures prior to closure.

The report is divided as follows: The first part (sections 1 and 2) contains preliminary contextual information about the project and an overview of the historical development of the mills. The middle parts describe and interpret the water management features associated with Tonedale Mill and outline the history of individual elements (sections 3 and 4), followed by the same for features connected with Tone Works (section 5), and finally for the grease works (section 6). This is followed by a section describing and discussing the network of paths and

footbridges relating to access and connection through and between the sites (section 7). The concluding parts (sections 8 and 9) consider the importance of the surviving features in their wider context, explore the issues and opportunities facing these features and make recommendations for further research and management.

A tabulated gazetteer listing the all the key water management features and related infrastructure has been provided at the end of the report as Appendix A. Feature numbers given in square brackets throughout the description sections of the main report are to aid orientation and these can be cross-referenced with the gazetteer and also with a labelled feature location map (*see* Fig. A1 within Appendix A). Any 'HER' numbers given in the text and gazetteer refer to monument numbers from Somerset Historic Environment Record (HER).

Finally, Appendix B presents the method and sources for the aerial investigation, as well as the mapping results for any pre-factory features recorded within the study area, such as cropmarks indicating prehistoric or Roman farmsteads.

1.2 Location, geology and topography

Tone Works and Tonedale Mill survive as two separate complexes of buildings situated in the valley of the River Tone north-west of Wellington town centre, at NGR ST 1258 2186 and NGR ST 1285 2135 respectively (*see* Fig. 1). Tone Works occupies a bend in the river, which flows past the factory from west to east. Its situation, on level low-lying ground (below the 45m Ordnance Datum (OD)) prone to flash flooding, was determined largely by its use of river water for power and cloth processing. Tonedale Mill is situated away from the river, 0.5km to the south, but occupies similarly level and low-lying terrain with most of its buildings set in the valley floor below 50m aOD. Water was diverted to Tonedale Mill from the Westford and Rockwell Green Streams, tributaries approaching from the south-west and south respectively. The combined watercourses of the Westford Stream and the Rockwell Green Stream continue northwards through the mill (via the 'Back Stream'), entering the River Tone immediately south of Tone Works.

The River Tone and its tributaries drain Exmoor, the Brendon Hills and the Quantock Hills to the north of Wellington and the Blackdown Hills to the south. The river is 33km long from its source near Raleigh's Cross in the Brendon Hills to its confluence with the River Parrett (Environment Agency 1997, 1, 3). Today the catchment, covering approximately 414km², forms part of Wessex Water's Somerset supply zone (Environment Agency 1997, 11).

The topography comprises a flat, open, landscape. The area's geological composition is Triassic Otter Sandstone and Budleigh Salterton Pebble Beds overlain by a band of alluvial clays and silts (British Geological Survey 2009; Natural England 2014, 6). The predominant soils are brown earths of the Whimple 1 association, loamy drift with a slowly permeable subsoil causing seasonal waterlogging (LandIS 2023).

The wider land-use is predominantly lowland mixed farming, with agricultural intensification along the River Tone including permanent, improved and reseeded grassland, maize and potato cultivation. Sheep and cattle grazing are also common (Environment Agency 1997, 3; Natural England 2014, 6). Within the environs of

the textile mills, footpaths interwoven with the channels (wet and dry) of the water management system are used for pedestrian access between housing estates and to local schools and places of work, as well as for leisure by the local community. The paths are well-trodden by dog walkers, and the attractive and nature-rich area around the Basins is popular for recreational visits and fishing.

1.3 Previous work

Both Tonedale Mill and Tone Works contain buildings of national importance which have been the focus of past architectural studies. Tonedale Mill's East and West complexes were listed at Grade II* in 1976 and 1993 respectively. The North Range at Tone Works (including its soft water reservoirs) was also listed at Grade II* in 2000, and the South Range at Tone Works was listed at Grade II in 1976. Nearby Tonedale House, built by and for Fox family, is also listed at Grade II (*see* Table 1 for all List Entry details).

In the 1990s, the Royal Commission on the Historical Monuments of England (RCHME) visited and recorded many of the factory buildings (Williams and Stoyel 1993; Williams et al. 1993; Williams and Jones 1998; Williams and Stoyel 1999). Following the closure of the factories in 1999, further architectural investigation and documentary study was carried out by English Heritage (Williams n.d. a-b; 2000; 2001; 2003; 2005; 2007a-c; Jessop 2007) and latterly Historic England (Roethe 2020). As with the present report, much of the previous research by English Heritage and Historic England was undertaken to establish key information on the heritage value of the sites in order to provide a basis for informing future heritage-led regeneration (Williams 2010).

In 2003 a Conservation Plan for Tonedale Mill was compiled (Woodhall Planning & Conservation 2003). A pre-development excavation was carried out at Tonedale Mill in the same year by Exeter Archaeology, after the demolition of the weaving sheds (Passmore 2003). These studies contain much information which is relevant to the history and development of the factories' water management systems, though this was not their primary area of interest. Particularly useful for this study are a report on a second waterwheel – the 'blacksmith's waterwheel' – at Tonedale Mill produced by Westcountry Access Ltd (Craven 2007), and a pre-demolition study of the history and buildings of the former grease works site east of Tone Works by AC Archaeology (Stainer 2014).

More recently, Thread Architects produced a suite of detailed plans of Tone Works as part of an analysis to determine the site's potential for sensitive regeneration, including visualisations for possible reuse schemes and sustainability models. The plans identify its individual buildings and their uses, provide detail of the surviving machinery, chart the development of the factory's power system and waterways, and identify the routes and rights of way linking the site with surrounding green spaces (Fear 2020; Thread Architects 2021).

In July 2021, a void survey of Tone Works was undertaken using Ground Penetrating Radar (GPR) in all areas sufficiently clear from debris and obstructions. This work identified many of the underfloor channels through the factory as surviving beneath the extant buildings, including the assumed line of the headrace

and tailrace serving the waterwheel (Anthony Brookes Surveys Ltd 2021) (*see* section 5.3).

In November 2022, a short documentary film about the watercourses to the north-west of Wellington was published online via YouTube (McCluskey 2022). The film – *Stream Power: The Waters that Made Wellington* – explores the waterways in the context of their place in the Fox Brothers' textile mills and dye works and their importance in the history of the town. It includes interviews with Richard Fox, Ben Fox and Julian Fox, discussion of the history of the water power system and how it worked, video footage of the Wellington waterways, leats, weirs, sluice gates ('fenders') and footbridges today, as well as archive images and animated maps.

March 2023 saw the adoption of the Wellington Place Plan (Somerset West and Taunton Council 2023). It aims to enhance the local environment and boost prospects for the area through a suite of community and heritage-led regeneration initiatives, including improvements to the Tonedale and Tone Works mill buildings at and their water management landscape.

At present, the topic of watermill landscapes and water management systems is poorly represented in thematic studies and few focused syntheses exist. A recent review produced by Historic England provides the most useful account of the current understanding of watermill landscapes, although a bigger targeted study would be welcomed (Alexander and Edgeworth 2018). As well as covering their nature, the threats they are under, and how we might aspire to better record and manage them, the review also provides a useful glossary of feature types and terminology, and a precis of existing research which readers of this report may find useful.

2. HISTORICAL BACKGROUND

2.1 Early landscape history

Modification of rivers and streams has a long history, since watercourses provided the only source of inanimate power prior to the introduction of steam engines. From the medieval period onwards, the River Tone and its tributaries supported numerous watermills, including flour mills, fulling mills and sawmills. Their presence near Wellington was facilitated by the fact that the section of the river north of the town was unnavigable.

As early as 1086, two watermills recorded by the Domesday Survey existed on Bishop Giso's Wellington estate (Giso, or Gisa, was Bishop of Wells from 1060 to 1088), although the exact whereabouts of the watermills is not known (Elworthy 1892, 225-6; Gathercole 2003, 17). In the 13th century the woollen textile industry developed in the north and west of England to take best advantage of waterpower for fulling (thickening and cleaning woven cloth by matting the surface using large wooden hammers) (Getzler 2006, 18). It is claimed that spinning and handloom weaving were brought to Wellington in the following century (Thorne 1972, 26). By 1327, the Lay Subsidy lists tenants of the manor, among whom were individuals bearing names appended with 'atte Were' and 'atte mill', indicating the existence of water management features. A William Pyers also rented 'the clothe house' by 1547 (Elworthy 1892, 236, 249-50). The Bishop's fulling mill on the Tone is mentioned in 1503 and, though its location is not certain, the area north and west of Wellington is flagged as most likely (Gathercole 2003, 17). Hagen and Fox (2000, 3) note that the Were family had been active in serge-making in the area since about 1650, but records suggest that their involvement probably began even earlier. An early documentary record of the Were family making woollen cloth in Wellington dates from Elizabeth I's reign (1558-1603), when a deed mentions John Were of Pinksmoor Mills, a serge-maker who used the mill for fulling and dyeing cloth (Thorne 1972, 26; Fox 1914, 2).

Tonedale Mill and Tone Works were situated within a landscape already characterised by carefully managed and heavily used watercourses. By 1700 there were between 10,000 and 20,000 watermills in Britain and, in the 16th and 17th centuries, there was extensive building of dams, weirs and leats for water supply and hydropower to support them (Getzler 2006, 22).

Water-powered medieval fulling mills were important precursors to water-driven mechanised textile production (Getzler 2006, 22). The steady power of the waterwheel was especially suited to woollen manufacture, and, in 1771-2, the first large-scale application of waterpower for spinning was made by Richard Arkwright and his partners at Cromford in Derbyshire (Getzler 2006, 25). The potential to re-use existing infrastructure and the rights to water attached to early mills were important factors in siting early industrial complexes (Getzler 2006, 19). In conditions of competition for hydro resources, industrialists were forced to devote much effort and money to purchasing ancient corn mills as well as fresh mill sites in order to acquire the appendant water rights ready for conversion to industrial uses (Getzler 2006, 25).

Wellington in the late-18th century, with its existing cloth industry and watermills, was a prime location for developing water-powered cloth production. The town was also strategically well situated to carry trade to and through coastal ports to the north and south, with an established route of transport along the Milverton Road, turnpiked by the Wivelscombe Turnpike Trust in 1786 and 1806. By the early-19th century, the Westford Stream powered six watermills (HER 32538, 53536, 43722, 43753, 43535 and 43754) immediately upstream from Tonedale Mill. Most were woollen mills, one being Pinksmoor Mill (the current Pinksmoor Farm) where serge-maker John Were had lived in the reign of Elizabeth I. Harpford Mills (HER 43275), which operated for fulling and corn grinding, was similarly situated upstream from Tone Works.

2.2 Development of the mills

The business sites at Tonedale Mill and Tone Works developed from a serge-making enterprise established in the 18th century by Thomas Fox's mother's family, the Were family (the Were family having been involved in local textile-making since the 16th or 17th century, as discussed above). Serge is a strong woollen fabric, that was commonly used to make coats, jackets and military uniforms. In 1772, Thomas Fox was made a partner in the firm, then presided over by his maternal grandfather (Hagen and Fox 2000, 2). In 1792 he became the sole proprietor and reinvented the company by introducing factory production methods which resulted in the firm's exapansion into a major national and international concern. While the company was best known for producing coarse serge, from the 1780s they were also making large quantities of fine undyed 'long ells' (long lengths) of serge which went to the East India Company for export (Fox 1879b, 18, 25; Humphreys 1889, 215) and, in 1805 in a bid to diversify production Thomas Fox perfected a new line of fine soft woollen cloth he called 'Flanel' (Jessop 2007, 1-2).

From 1803 his sons helped to run the business, with Thomas Fox junior being made partner in 1809 (Jessop 2007, 2). In 1811, Were & Sons became 'Thomas Fox & Sons' (Hagen and Fox 2000, 3). Following his death, in April 1821, the business was carried on by his sons and in 1826 the company was renamed 'Fox Brothers' (Thorne 1972, 28). In 1849 this became 'Fox Brothers & Co' – by which time many of the partners were from the next generation of Fox brothers (Fox 1879b, 23) – before becoming a limited company of the same name in 1896 (Hagen and Fox 2000, 3).

The business, along with its buildings and water management infrastructure, continued to expand throughout the 19th century (Fig. 3). During the Boer War (1899-1902), the company made khaki cloth for military uniforms, receiving an order for 1.5 million yards, to be made at a rate of 4,000 yards a week to meet the War Office need for new inconspicuous uniforms. They also became well known for producing puttees, cloth bindings worn on soldiers' lower legs for weather protection and to prevent debris and mud entering short boots. They supplied 70,000 pairs a week to the army in the 1914-18 war (Thorne 1972, 29-30).

The factories continued to develop into the 1960s, when farmland and buildings owned by the company were sold to release funds enabling them to modernise

the machinery. Shuttleless looms, which could run up to two and a half times faster than the previous looms were installed, along with new twisting frames and automatic winding machines. These measures reduced the number of employees to below 1,000 (Hagen and Fox 2000, 36-7).

Figure 3: Extract from the 6-inch OS map of 1888 showing the full study area, with the waterways helpfully coloured in blue. Not reproduced at scale. [Somerset. Sheet LXXVIII. NE. Surveyed: 1887, Published: 1888. Reproduced with the permission of the National Library of Scotland]

Both factories were developed from earlier water-powered mills and a constant water supply continued to be essential throughout their period of operation. Waterwheels powered line shafting to drive machinery and water was also needed for processes such as washing, milling, scouring and dyeing. Water continued to be used as a power source after steam engines were installed in the factories and it remained essential for cloth processing and steam generation. Indeed, the first steam engine at Tonedale – a 15 horsepower Watt beam engine installed around 1840 – was, according to Charles Fox, only used as a reserve engine for times of drought and was moved to Tone Works in 1868 (Fox 1879b, 23).

A multitude of features, designed and constructed to regulate the flow of water and divert it to where it was needed in the mills, still survives within the factory complexes and forms part of their surrounding landscape. Natural watercourses were modified and leats, ponds, weirs, sluices and culverts were constructed. The water systems became increasingly complex during the second half of the 19th century following the introduction of steam power and a water softening plant. Pipework, underground tanks and boilers were installed. Pipes carried steam from boilers to engines, while further pipes discharged waste water. Effluent was directed to a grease recovery plant (a refinery, hereafter referred to as the grease works) and ultimately flowed into the River Tone east of Tone Works.

The factory sites themselves developed in a piecemeal fashion through the 19th and 20th centuries and continued to be run by the Fox family until their closure in 1999. In the late 1980s and early 1990s a flood alleviation scheme was implemented to prevent flooding at Westford (section 3.2.3). This impacted a number of the water management features (weirs and sluices) clustered in the Westford Stream to Rockwell Green area of the watercourses that eventually feed Tonedale Mill (Taunton Dean Borough Council n.d.).

3. TONEDALE MILL

Feature numbers given in square brackets throughout the descriptions in this section are to aid orientation and refer to the gazetteer (Appendix A) and labelled feature location map (*see* Fig. A1) presented towards the end of this report.

Building block numbers mentioned in this section refer to a plan created as part of the culmination of the extensive research undertaken by Mike Williams and others through the 1990s and 2000s (2013, 115) (Fig. 4). The building and room functions shown on that plan are in part based on the more detailed building numbering and naming given in an insurance plan of Tonedale Mill from the 1950s, held amongst the Fox Brothers & Co. Archive (a version of that plan can be viewed in Williams 2003, 2).

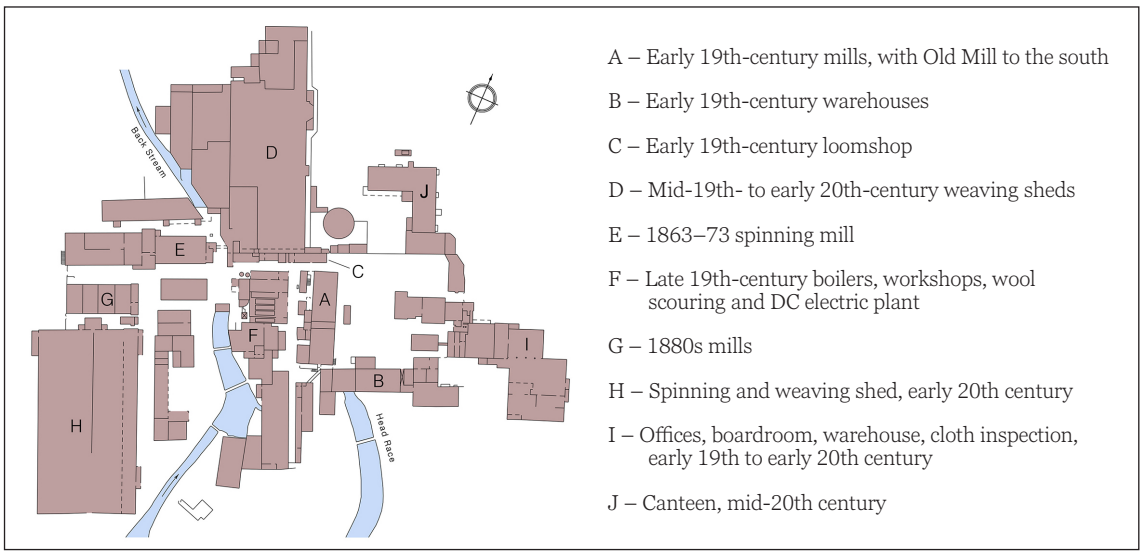

Figure 4: Plan of Tonedale Mill, showing the main building groups [source: Williams 2013, 115 © Historic England]

3.1 Origins and development

On taking charge of his family's serge-making business at the close of the 18th century, Thomas Fox was faced with newly emerging industrial methods of textile production and so he began work to bring the firm up to date. He first introduced horse-driven machinery at the Were family premises in Wellington, but soon realised the greater potential of waterpower (R. Fox in McCluskey 2022). Fox purchased Coldharbour Mill (Devon), followed by the Town Mills, a flour mill belonging to Wellington Manor, for conversion into textile mills (Thorne 1972, 28). A memorandum book records the Town Mills' re-lease in 1799 from George Hutchings (Jessop 2007, 23). Conversion of the building had started by autumn 1801 and the mill was renamed 'Tonedale Mill' ('Town' and 'Tone' having been interchangeable names, indeed the OS 1-inch map versions use both 'Town' and 'Tewin' in place of Tone). The work is likely to have been extensive and essentially involved construction of a new mill (Williams et al. 1993, 2). Elm timber was used for the building and the roof was covered with Wivelscombe slate (Fox 1879a, 9). Clay was dug from behind Thomas Fox's house (later the Victoria Arms) in North

Street, Wellington, to make bricks used in the building (Thorne 1972, 28). In March 1803 the textile mill was ready to begin operating (Fox 1933, 95).

In August 1821, a few months after Thomas Fox's death, this mill was destroyed by fire. Thomas Fox's sons consulted Brunel's architect on the best way to rebuild and make the replacement buildings fire resistant (Hagen and Fox 2000, 37). The walls of the original mill were retained, the wooden upper storeys removed. Fireproof floors were inserted, a fireproof staircase and fireproof roof added. The mill was also enlarged and was operating again by 1823 (Hagen and Fox 2000, 16). This fireproof mill (HER 46330) (*see* Fig. 4, southern part of building A) is now part of a complex forming the west side of a yard and is listed at Grade II* (NHLE 1176514). It is currently on Historic England's Heritage at Risk Register (Heritage at Risk 2022).

In addition to his purchase of the Town Mills, Thomas Fox set about expanding his local landholding, enabling him to control its water supply. In 1801-3, he bought 'Mons Meadow' (Jessop 2007, 23), the whereabouts of which remains unknown. In 1803 he purchased 73 acres of land in the Wellington Landside manor from Robert Were (SHC DD/SF/2/57/39), and in 1805 he obtained Harpford Mills and Hammins Cottage (SHC DD/SF/2/36/114). Around this time, he also acquired land at Landcocks (now Linden) and bought up many water rights (Thorne 1973, 71). By 1839, when the Wellington tithe survey was produced, the Fox family (the Fox Brothers, Henry Fox, Edward Fox, Charles Fox, or Sarah Fox and trustees) owned all the land surrounding Tonedale Mill and the watercourses immediately upstream, with the exception of one field – 'Hutchings Mead' – immediately south-west of the mill, which was held by Thomas Elworthy of Westford Mill (Fig. 5). By 1888 this field too had been acquired by the company, since it formed part of Tonedale Mill. The Fox family's ownership also extended to the meadows south of Linden House and beyond. The 1839 tithe apportionment for Wellington records that land bordering the watercourses closer to Westford was predominantly owned by John Bird and the Elworthys (Thomas and William), owners of Westford Mills (SHC D/D/rt/A/367), though the Foxes also held land there.

As the business grew, additional buildings were built around the mill of 1823. The family home, Tonedale House (HER 46329; NHLE 1344790, listed at Grade II), was erected to its south-east by 1807 and, with additional buildings, this formed the south side of a yard. An eleven-bay winder mill (*see* Fig. 4, northern part of building A) powered by the earlier mill's waterwheel was constructed immediately to the north in the early- to mid-19th century. Between 1852 and 1854, a weaving shed was built further north of these buildings. This was doubled in size by 1878 (Fox 1879a, 13).

The first steam engine, a Watt beam engine of 15-horsepower, was installed in around 1840, but it was only used to supplement the waterwheel in times of drought; in 1868 it was moved to Tone Works (Fox 1879a, 13, 29). A pair of oscillating marine engines was also purchased and supplied with steam from underground boilers (Fox 1879a, 13).

Later mills at Tonedale were steam powered. They included a spinning mill, referred to as 'No 2 Factory', constructed west of the Back Stream in 1863 and 'No 3 Factory', built in 1873 (*see* Fig. 4, building E) (Fox 1879a, 14; Fox 1879b, 25). In 1887-8 two further spinning mills (*see* Fig. 4, building G and the building south

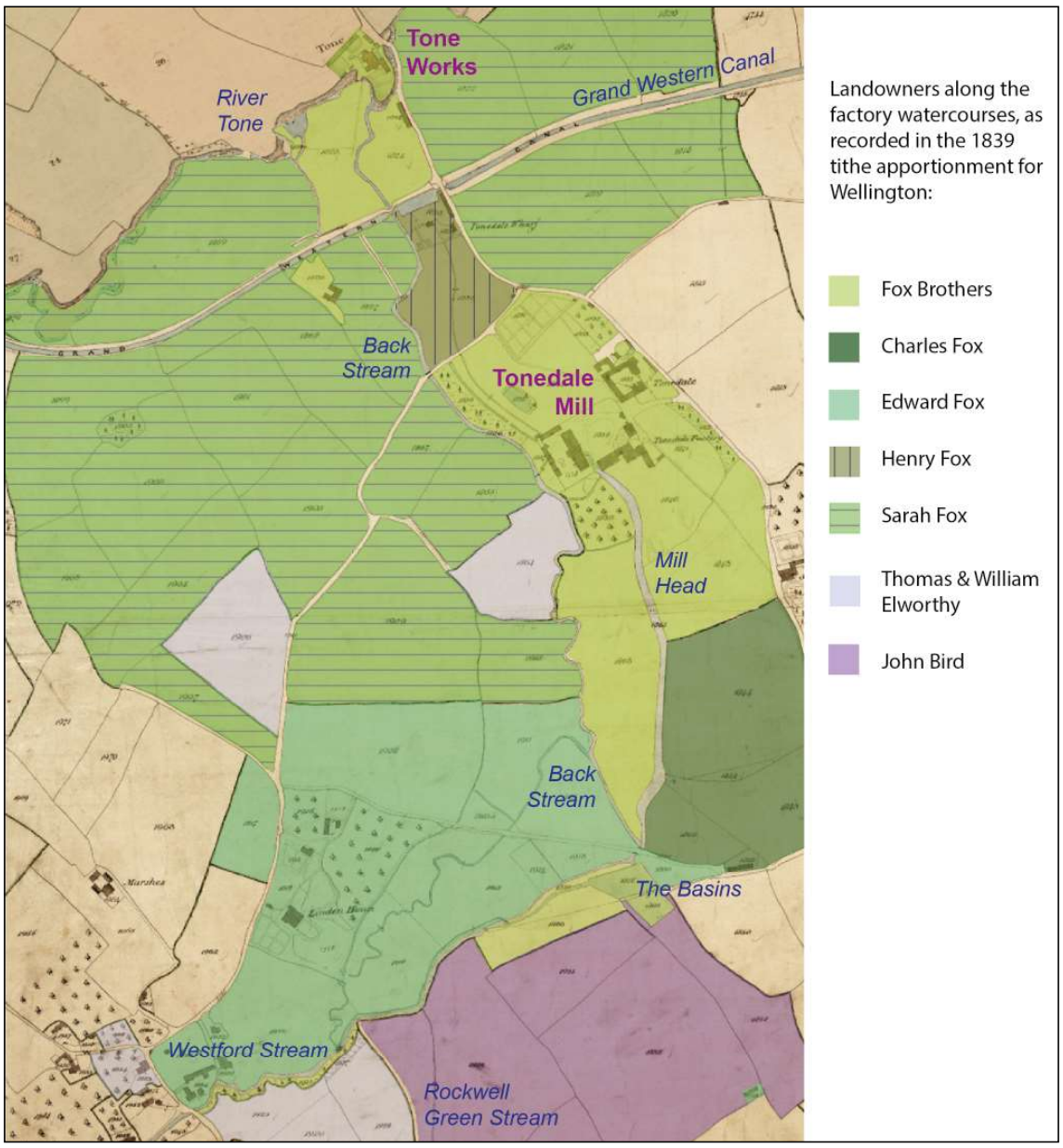

Figure 5: Extract from Wellington tithe map of 1839, coloured to indicate land ownership along the watercourses, as recorded on the tithe apportionment, and showing the extensive holdings of the Fox Brothers company and members of the Fox family in green. [SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust]

of the east end of building E) were erected parallel with the south sides of the 1863 and 1873 mills. Other additions west of the 1823 fireproof mill included water- and steam-powered workshops (*see* Fig. 4, centre of building F) which were built prior to 1888. The steam power system was developed further in the 1890s, when new boilers were installed, older ones re-sited and an electricity generating plant and fire station added (Roethe 2020, 6). In 1904 the waterwheel was scrapped and replaced with a turbine (Williams et al. 1993, 12).

In addition to providing power, water was used at Tonedale Mill for processing raw fleece. Production stages carried out included preparatory scouring to remove dirt

and grease, washing and dyeing (Woodhall Planning & Conservation 2003, 9). A 15-bay north-light shed (*see* Fig. 4, south end of building F) of a similar date to the workshops (see above) was used for scouring and dyeing raw wool (Williams 2003, 8). By 1927-8, soft water for wool scouring was being piped to the mill from the water-softening plant at Tone Works (Fox 1933, 51; Jessop 2007, 16).

3.2 Water supply to Tonedale Mill

The Ordnance Survey (OS) 1-inch drawings for Wellington, published in 1802 and surveyed prior to the completion of Thomas Fox's work on the mill, provide the earliest map evidence for the watercourses at Tonedale (Fig. 6). The Westford Stream and Rockwell Green Stream are shown converging south of 'Tone Mill', however, the amount of detail they include is limited by their depiction scale. No leat leading to the mill is shown, nor any tailrace exiting from it.

Figure 6: Extract from OS 1-inch map (1809-1820) showing 'Tone Mill' and watercourses leading northwards to it. Note this map version is an official OS revision of the original, modified to include the route of the Grand Western Canal. Not reproduced at scale. [© and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2023). Licence numbers 000394 and TP0024]

The existing water supply was evidently inadequate or not reliable enough to meet the greater needs of the new Tonedale Mill. Consequently, water rights were bought up and work started to improve the watercourses (Thorne 1972, 28). Teams of men were engaged to dig a new watercourse bringing water from the Westford Stream to the mill, which was completed in Spring 1803 (Fox 1933, 93). Approximately halfway along its course and 0.5km south of the mill, the Basins (or 'Basons' in transcripts of R. L. Thorne) [37] were excavated by hand in 1801-1803 on either

side of a pre-existing footpath that ran through the field close to Corams Lane (Thorne 1973, 71; Hagen and Fox 2000, 26). These two large ponds served as back-up reservoirs ensuring that an adequate and constant supply of water was available for the mill, even in times of drought. Their water level was maintained using weirs and sluices. During summer months, water was ponded up overnight in order to give a stronger daytime flow, thereby more closely matching the winter flow and meaning that factory production could remain more consistent throughout the year. A tailrace was also dug to carry water away from the mill (R. Fox being interviewed on film: McCluskey 2022).

Subtle variation in ground elevation was of great importance to the system and each channel was carefully constructed with the correct gradient to ensure a steady flow of water. In 1801, Thomas Fox asked Henry Leake for a plan and estimate for the cost of constructing the mill's waterwheel and gear. He noted that Leake's theodolite would not be needed because the watercourse (presumably the Mill Head) had been '...carefully levelled by another person who only differs about ½ Inch from Josiah' (Williams 2007a), Josiah probably being a previous surveyor. The Mill Head and tailrace leading to and from Tonedale Mill are each approximately half a mile long, so designed to provide an adequate gradient for water to flow well across the relatively level topography.

The basic layout of channels and water control features visible today results from this early-19th century work, although modifications were made during Thomas Fox's lifetime and later. On 2 March 1803, he commented: 'I now wish to widen and deepen the head of water up thro [sic] the meadow in order to ensure a larger supply of water' (Fox 1933, 95). Further improvements may have been needed in 1821, when competition for water from Westford Mills resulted in a dispute between Thomas Fox and its owner Thomas Elworthy. Water was scarce and was perhaps being penned at Westford (information from Geoff Fitton, SIAS), suggesting that the mill was being worked intermittently, allowing its millpond to be replenished.

The Wellington tithe survey of 1839 – an original copy of which is held at SHC –provides the first large-scale map of the water system (Fig. 7). Although it does not mark any weirs or sluices, the configuration of channels indicates that most of the structures surviving today, or precursors to them, were already in place. The fully-fledged water management system was surveyed as part of the 1:500 scale OS Town Plan of 1888. This shows its weirs, sluices and channels in remarkable detail (for good examples see Figs 10, 17, 22 and 26).

3.2.1 Upstream of the Basins

Water from the Westford Stream was diverted into two channels. One of these [19] was a canalised continuation of the stream itself. The other, a narrow channel [22] running parallel to its northern side – as seen on the 1839 tithe map –, is not shown on later maps. The narrow channel's eastern end crossed a further channel [27] close to where the locally named 'Waterfall Weir' [25] is situated and entered the Basins feeder leat [26], presumably supplying water at a higher level. By the late-19th century the narrow channel [22] was replaced by a new leat further south [10] (see below), the layout shown on the tithe map otherwise closely resembles that which survives today (Figs. 8 and 9).

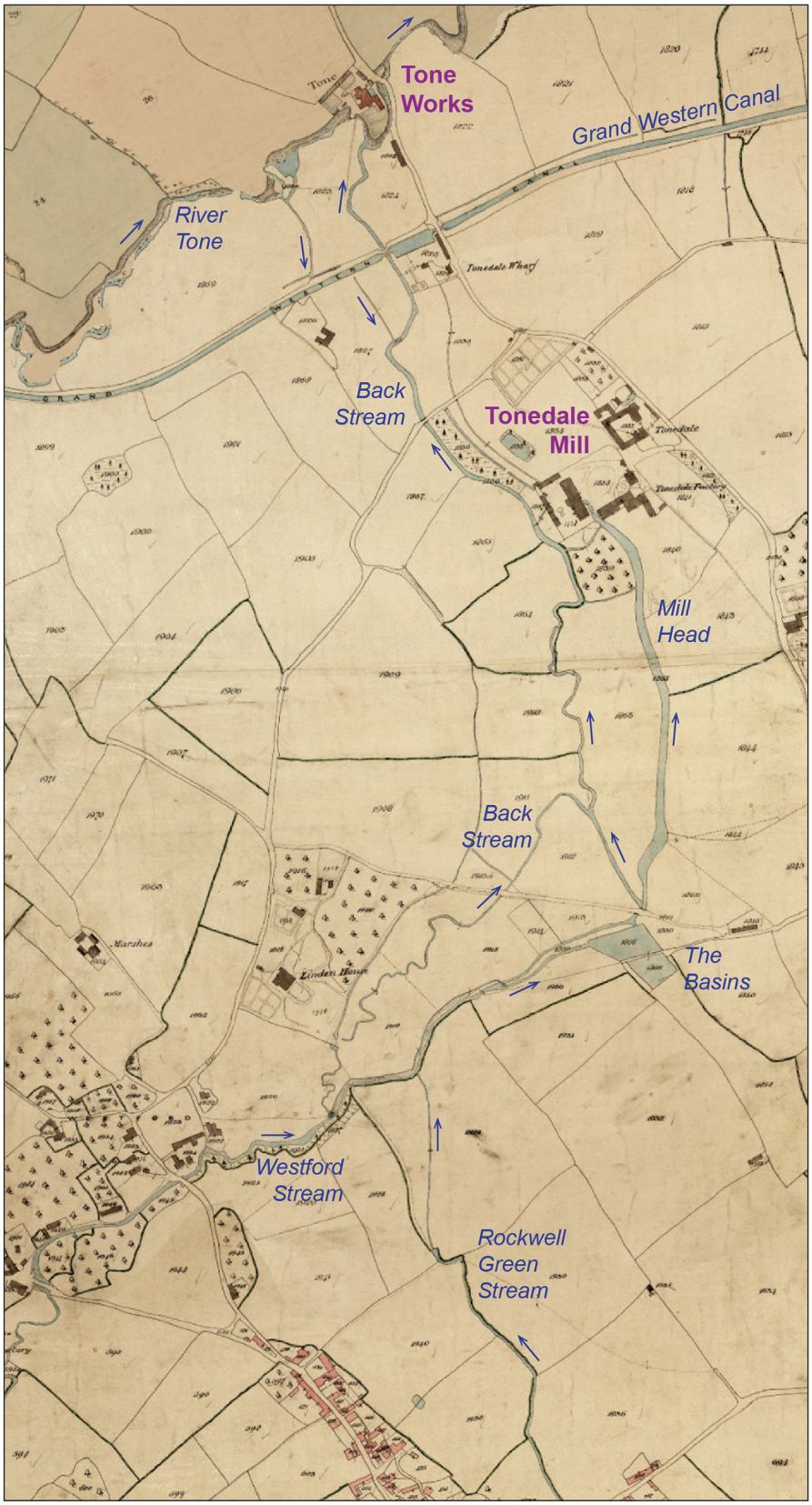

Figure 7: Extract from the 1839 Wellington tithe map, annotated with the names of the main watercourses serving Tonedale Mill and Tone Works, and showing the Grand Western Canal with its wharf and basin crossing between the two industrial complexes. Not reproduced at scale. [SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust]

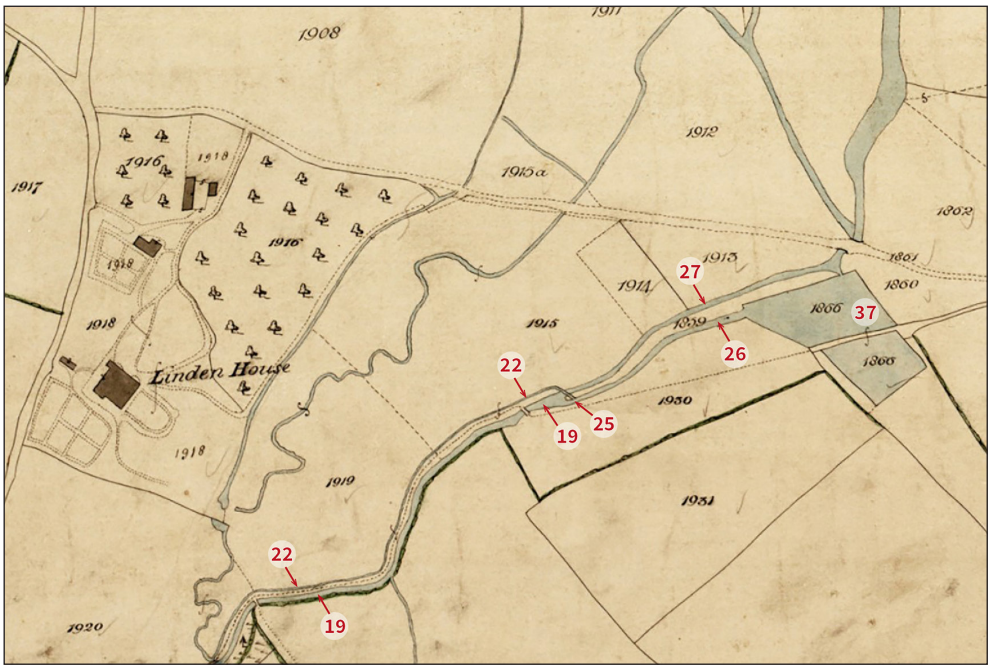

Figure 8: Extract from the 1839 Wellington tithe map, showing watercourses from the Westford Stream to the Basins, including the parallel channels [19 and 22] between the Westford Stream and the Waterfall Weir [25]. Not reproduced at scale. [SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust]

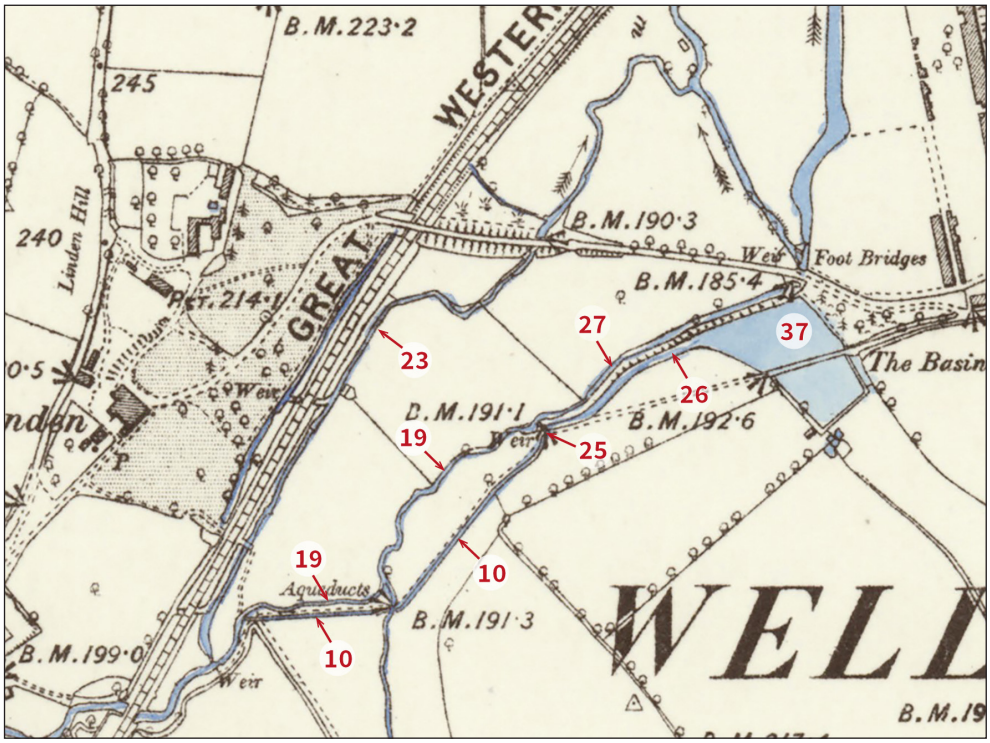

Figure 9: Extract from the 6-inch OS map of 1888, showing watercourses from the Westford Stream to the Basins. Note the new Railway Back Stream [23] replacing the former meandering course of the Back Stream following the arrival of the Great Western Railway, the new leat [10] to the Waterfall Weir [25], created between 1839 and 1888, and the lack of depiction of channel [22] which [10] replaced. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

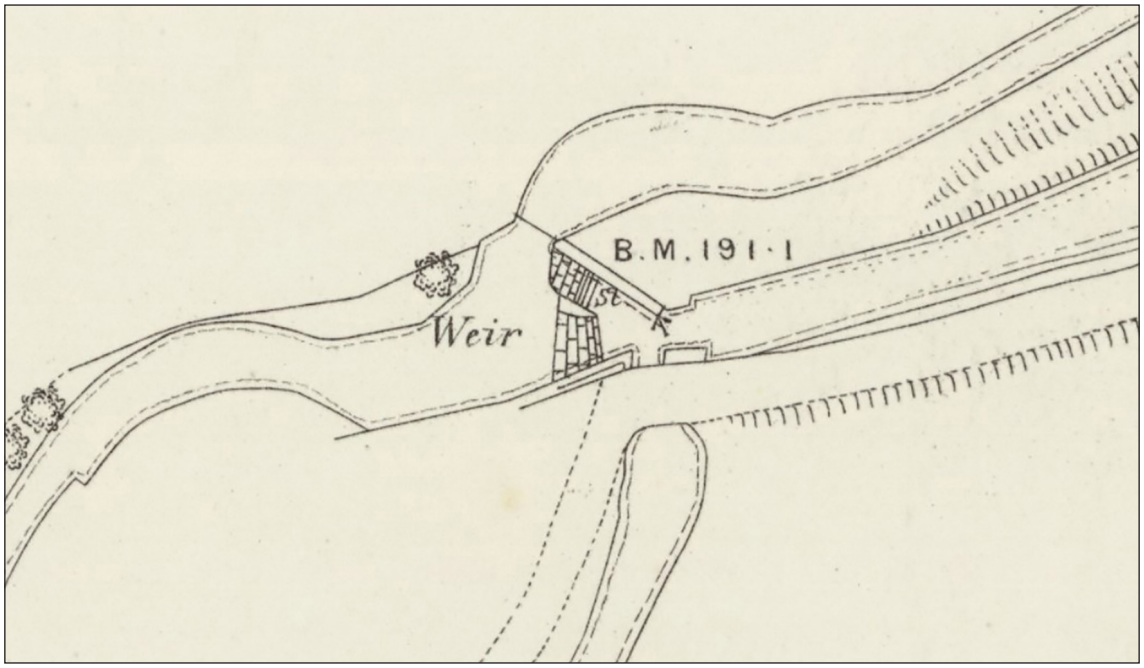

Figure 10: The Waterfall Weir [25] depicted on the OS 1:500 Town Plan of 1888. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Figure 11: The Waterfall Weir [25], looking east, April 2022 [James O. Davies © Historic England Archive, DP347739]

After approximately 100m, the canalised section of the Westford Stream [10] joined the Rockwell Green Stream and both continued to the Waterfall Weir [25]. The Waterfall Weir, situated upstream to the west of the Basins, is depicted on the OS Town Plan of 1888 as it is today, although its sluice boards and mechanisms have since been removed (Figs 10 and 11). The 'waterfall' served as an overflow, allowing surplus water from the Basins' feeder leat [26] to pass into the channel carrying the diminished Westford and Rockwell Green Streams below, ensuring the ponds were filled but did not flood. Thorne (1973, 71) suggests that this weir and leat scheme for the Basins started working around 1820, although elsewhere Thorne (1972, 28) and a recent interview with Richard Fox (McCluskey 2022) both suggest that the Basins themselves, if not the rest, were created at the very start of the 1800s. From the weir the combined streams [27] continued north-eastwards, parallel and north of the Basins' feeder leat [26]. Why there is an overflow at the Waterfall Weir rather than in the Basins themselves has been questioned by Richard Fox, who believes that the weir's purpose was to protect the Basins from silting up by allowing silt-laden water to be diverted away when the stream was in spate (R. Fox in McCluskey 2022).

In 1843, shortly after the tithe map was surveyed, the Bristol and Exeter Railway was constructed, cutting across the landscape south of Tonedale Mill. Railway bridges carried the railway line over the Westford Stream, the Back Stream and the Mill Head. The meandering southern part of the Back Stream interfered with the track, so it was diverted into a new straight channel, named the 'Railway Back Stream' [23], cut beside the railway (*see* Fig. 9).

It may have been at this time that the Basins' supply leat was altered to its present layout, a change which occurred at some stage between 1839 and 1888. The narrow channel [22] on the tithe map was replaced by a new leat [10] south of the stream (as mentioned above). A sluice [9] at its entrance could be opened to allow water to be sent along the channel when the Basins were filling. Alternatively, when the Basins were emptying, water could be directed to flow through the parallel continuation of the Westford Stream [19], which had a double sluice [17] at its entrance. The new leat [10] had to cross the Rockwell Green Stream but, according to local sources, Thomas Fox did not have the legal right to stop the flow of water from the Rockwell Green Stream. This problem was solved by sinking an old ship's boiler to carry the leat beneath it (Thorne 1973, 71). The leat [10] passes through the boiler or 'siphon' [13] and re-emerges on the other side of the Rockwell Green Stream. It then rejoins the original system at the Waterfall Weir [25], thus by-passing a loop in the meandering course of the Rockwell Green Stream (Fig. 12).

When the tithe apportionment was compiled, 'Watermanshill', the field through which most of the new leat (or channel) was cut, was the property of John Bird. The western end of the leat, which lay on the Fox family's land, is brick lined, while remainder is not (pers. comm. R. Fox). The significance of this is uncertain, since many of the watercourses traversing the Fox family land also appear to be earthen channels.

A watercourse [19] which serves as a continuation of the Westford Stream joins the Rockwell Green Stream immediately north of the siphon [13], at which point the embedded remains of a concrete sluice gate [20] were noted during field examination in January 2022 (Fig. 13). This sluice would have controlled the flow

Figure 12: Leat [10], which leads to the Waterfall Weir, looking south-west away from the weir, January 2022 [Nicky Smith © Historic England]

Figure 13: The buried remains of a sluice gate [20] on the Westford Stream at its confluence with the Rockwell Green Stream, January 2022 [Johanna Roethe © Historic England]

of water from the watercourse into the Rockwell Green Stream, allowing it to be contained when stream levels were low. Feature 19 survives as a dry channel today, following flood alleviation work upstream (*see* 3.2.3 below). Today a reduced flow of water enters the siphon from a brick channel taken off a modern sluice [4] on the Rockwell Green Stream (Taunton Deane Borough Council 2006; McCluskey 2022).

3.2.2 The Basins to Tonedale Mill

The Basins are situated at the head of a small re-entrant valley below the 60m contour (Fig. 14). An outlet sluice [36] in their northern side released water from the ponds into the Mill Head [39], via channel [27] around 2.5m below (Figs 15 and 16). The sluice has been much altered and most of its gate lifting mechanism has been removed, leaving the hatch (known locally as a 'fender') shut (*see* Fig 16). Two people may have manned it in summer, regulating the flow to maximise power to the mill below (R. Fox in McCluskey 2022). The outflow enters channel [27] immediately north of the Basins.

Below the Basins' outlet is a complex weir [30] with two further sluices [28 and 33] (Figs 17 and 18). These controlled the level of water in the Mill Head. Surplus water could be diverted, via an overflow channel [31], which turns sharply northwards to join the Back Stream (the natural continuation of the Railway Back Stream) further north-west. As with the features connected to it, this channel was extant by 1839 and probably formed part of Thomas Fox's initial system.

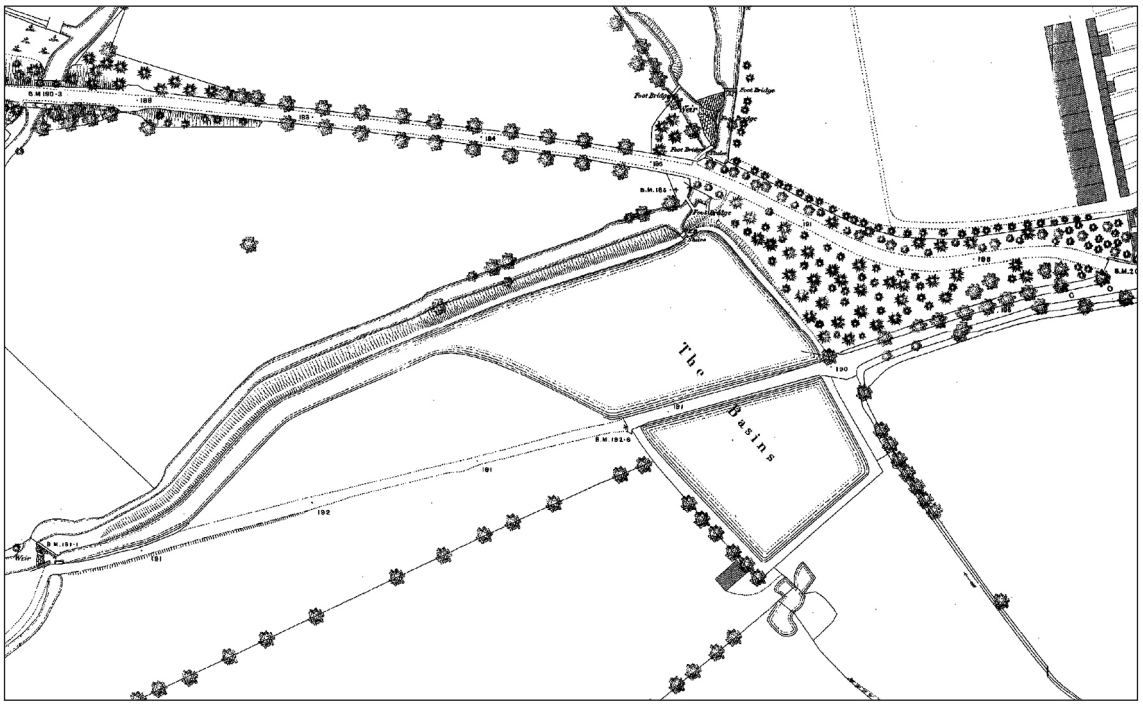

Figure 14: The Basins [37] depicted on an extract from the OS 1:500 Town Plan of 1888. Not reproduced at scale. [© and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2023). Licence numbers 000394 and TP0024]

Figure 15: General view of the northern water basin [37], looking west, April 2022 [James O. Davies © Historic England Archive, DP347733]

Figure 16: Outflow sluice [36] in the northern water basin, looking south-west, April 2022 [James O. Davies © Historic England Archive, DP347736]

Figure 17: The weir below the Basins [30] shown on the OS 1:500 Town Plan 1888. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Figure 18: The weir below the Basins [30], with sluice [28] and footbridge [29] in the foreground, looking east, April 2022 [James O. Davies © Historic England Archive, DP347730]

3.2.3 Westford flood alleviation scheme

From 1888 onwards, the water system supplying Tonedale Mill saw only minor alterations, such as straightening of bends or widening or narrowing of watercourses, until the late 20th century. A flood alleviation scheme of the late 1980s and early 1990s was then implemented to prevent flooding at Westford (Taunton Dean Borough Council n.d.). The scheme involved construction of an earthen dam across the Westford Stream at Westford, creating a reservoir to contain floodwater. Further downstream and east of the railway line, the Westford Stream's channel was enlarged and a concrete weir [8] was erected across it, diverting all water northwards into a new cut [16] leading to the Railway Back Stream [23] (Fig. 19). It has been said that the new concrete structure was originally intended to incorporate a sluice to control the flow of water to the Basins, but there were insufficient funds for its completion (R. Fox in McCluskey 2022). However, plans of the weir as it was proposed in 1986 show no sluice (Fig. 20). This work made the channel carrying the Westford Stream and the leat to the siphon [19 and 10] redundant. Sluice boards and their lifting mechanisms no longer survive on the dry watercourses, but the brick-lined channels still have slots [9 and 17] where they were formerly situated (Fig. 21).

Figure 19: Concrete weir [8] built as part of flood alleviation work in the 1990s, looking north-east, April 2022 [James O. Davies © Historic England Archive, DP347750]

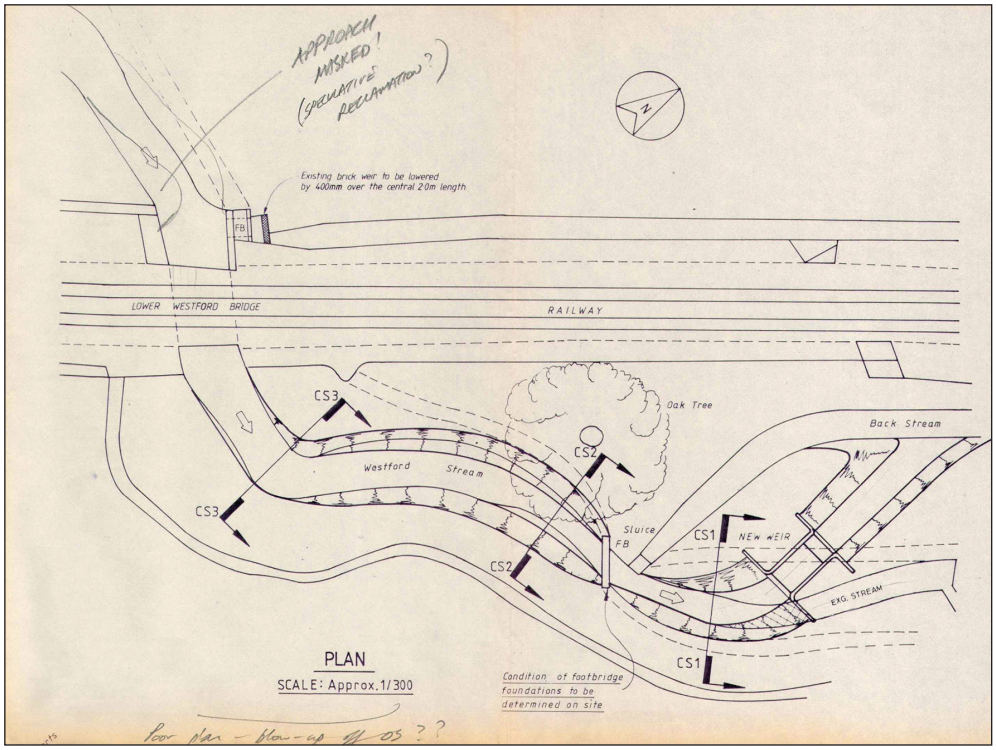

Figure 20: Plan of the concrete weir [8] as proposed in September 1986 by Watson Hawksley Consulting Engineers for Taunton Deane Borough Council as part of the Westford Flood Alleviation Scheme. Not reproduced at scale. [Extract from Watson Hawksley drawing no. W113 01/O/G/Y01, reproduced with permission of the Environment Agency, under the Open Government Licence: http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/]

Figure 21: Dry channels [10 (right) and 19 (left)] following the flood alleviation work, looking east, April 2022 [James O. Davies © Historic England Archive, DP347755]

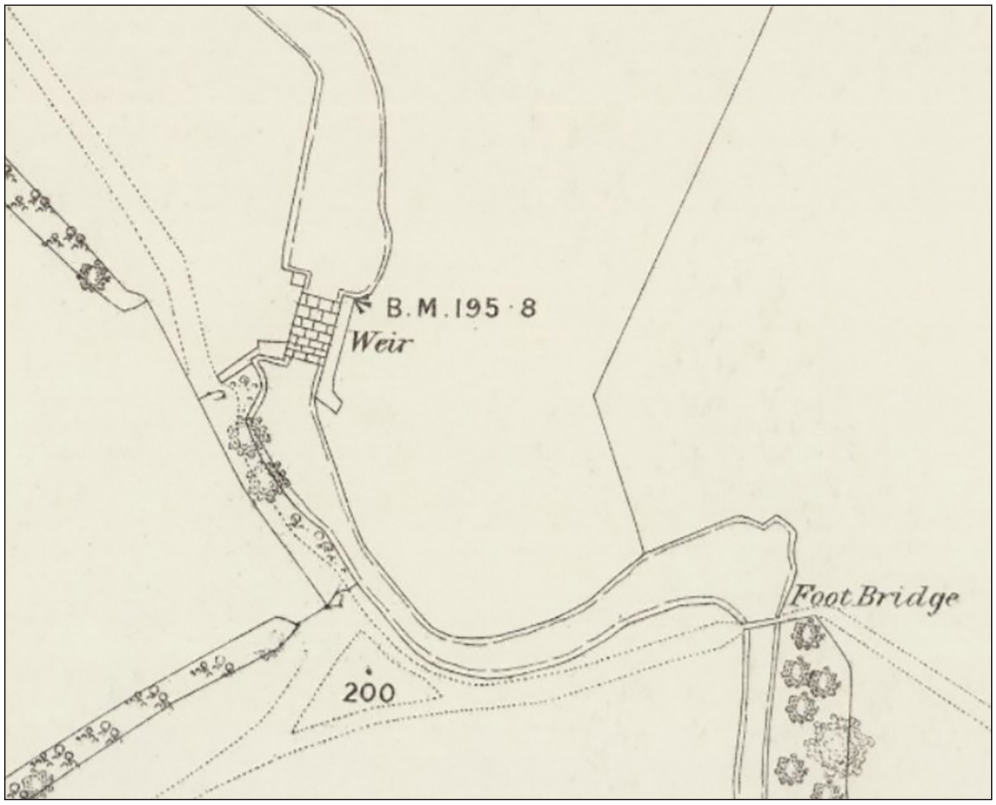

Figure 22: The weir at Oaken Ground [3], as shown on the OS 1:500 Town Plan 1888. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Figure 23: The weir at Oaken Ground [3], looking east, March 2022 [Nicky Smith © Historic England]

Further south, at Oaken Ground, a weir [3] is situated on a sharp double bend in the Rockwell Green Stream. This weir was depicted in detail on the OS Town Plan (1888) (Fig. 22), and the Wellington tithe map shows a head of water at the same location indicating that a weir was already in place here by 1839. Its purpose is uncertain. It may pre-date the Fox Brothers' system, but it has been substantially rebuilt to include a notched concrete section at its head, probably as part of the flood alleviation work, from which water flows down over three broad steps (Fig. 23).

3.3 Water management at Tonedale Mill

The Wellington tithe map shows the open channel of the Mill Head [39], wider than the other watercourses, approaching Tonedale Mill from the south and turning sharply to enter the mill's eastern side (Fig. 24). The tailrace channel exited the wheel pit at a lower level; it is shown on the tithe map re-emerging as an open channel [54] at the north-western corner of the building complex and continuing as far as Burchills Hill, from which point it was culverted. Two cross channels to the south of the mill [51 and 53] connect the Mill Head with the Back Stream [40].

As the factory developed the watercourses shown on the tithe map appear to have been retained and culverted beneath new buildings (Fig. 25). The OS 1:500 Town Plan of 1888 shows detail of the southern cross-channel [53], including a sluice with a footbridge, three weirs across it and its eastern end culverted by this date (Fig. 26). Its most obvious function would have been as an overflow channel for the Mill Head, but it also appears to have been landscaped for aesthetic purposes since it skirts part of the southern boundary of the large garden at the rear (south) of Tonedale House. The Mill Head [39], ponded along the western side of the main part of the garden, also doubled up as an ornamental feature (Figs 27 and 28).

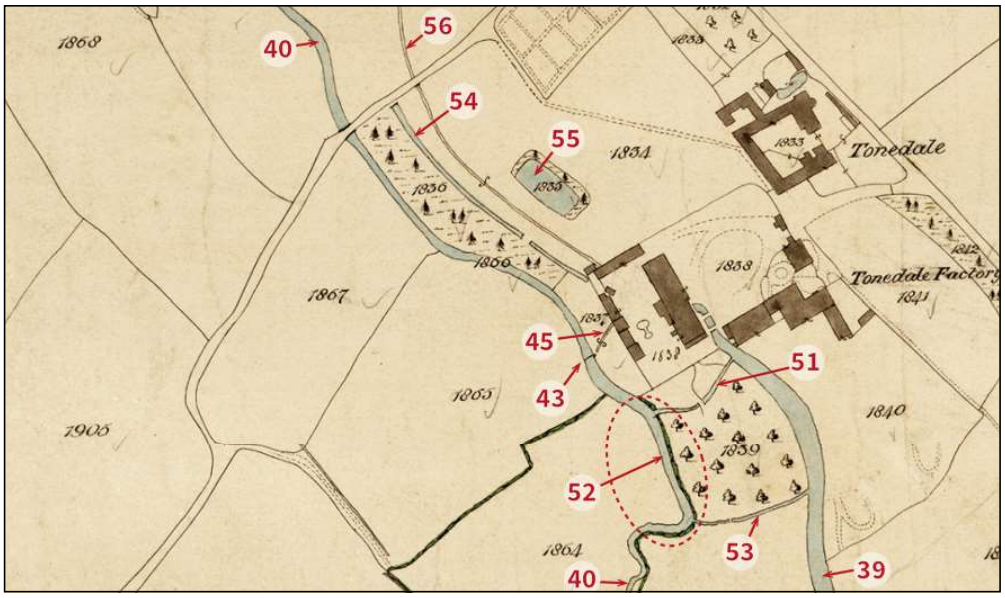

Figure 24: Extract from the 1839 Wellington tithe map, showing Tonedale Mill and its watercourse connections. Not reproduced at scale. [SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust]

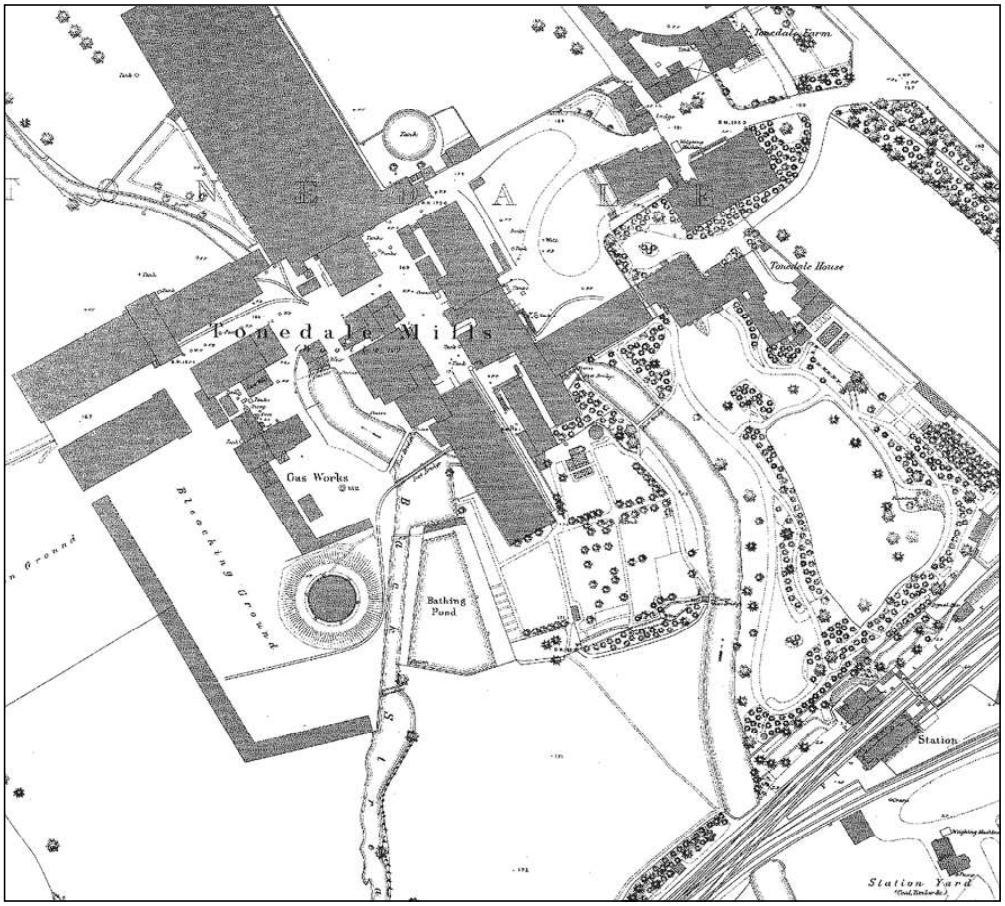

Figure 25: Extract from the OS 1:500 Town Plan of 1888, showing Tonedale Mill following expansion, with the Back Stream (bottom left) and Mill Head (bottom right) flowing into and through the factory from the south, and the trapezoidal bathing pool [41] situated in the former stream bend. Not reproduced at scale. [© and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2023). Licence numbers 000394 and TP0024]

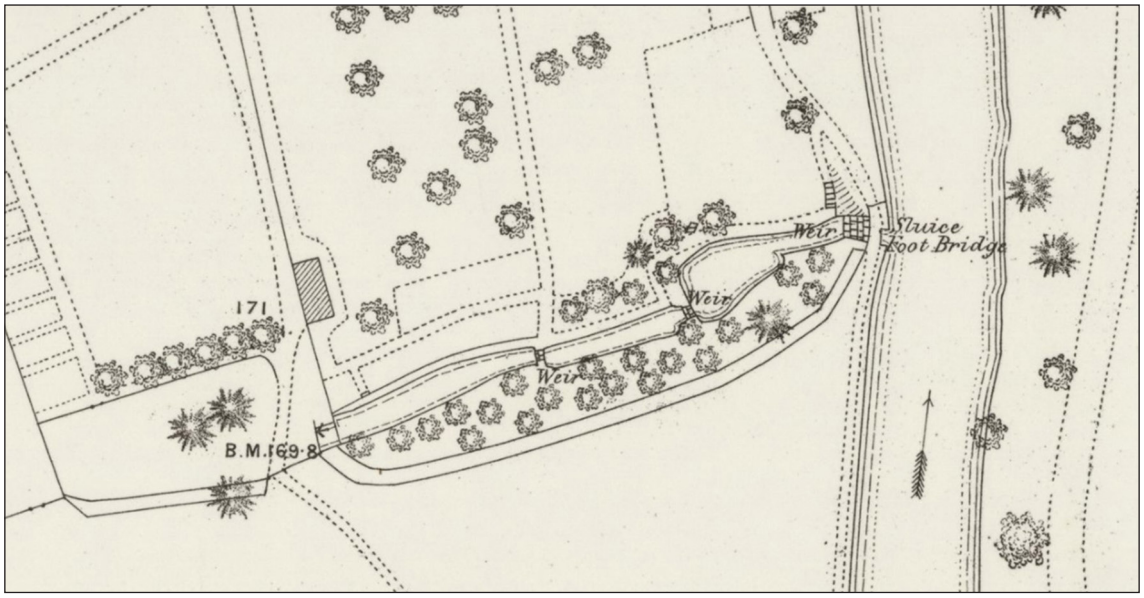

Figure 26: Detail of the southern cross-channel [53] at Tonedale Mill, shown on the OS 1:500 Town Plan of 1888. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Figure 27: Tonedale Mill in 1973, with north at the top. The course of the Back Stream (left/west) and Mill Head (right/east) can be seen flowing from the south up into the mill complex. Note the purposefully widened stretch of the Mill Head as it passes through the large garden on the south side of Tonedale House. [OS/73039_006 29-MAR-1973 © Crown copyright. Historic England (OS Photography)]

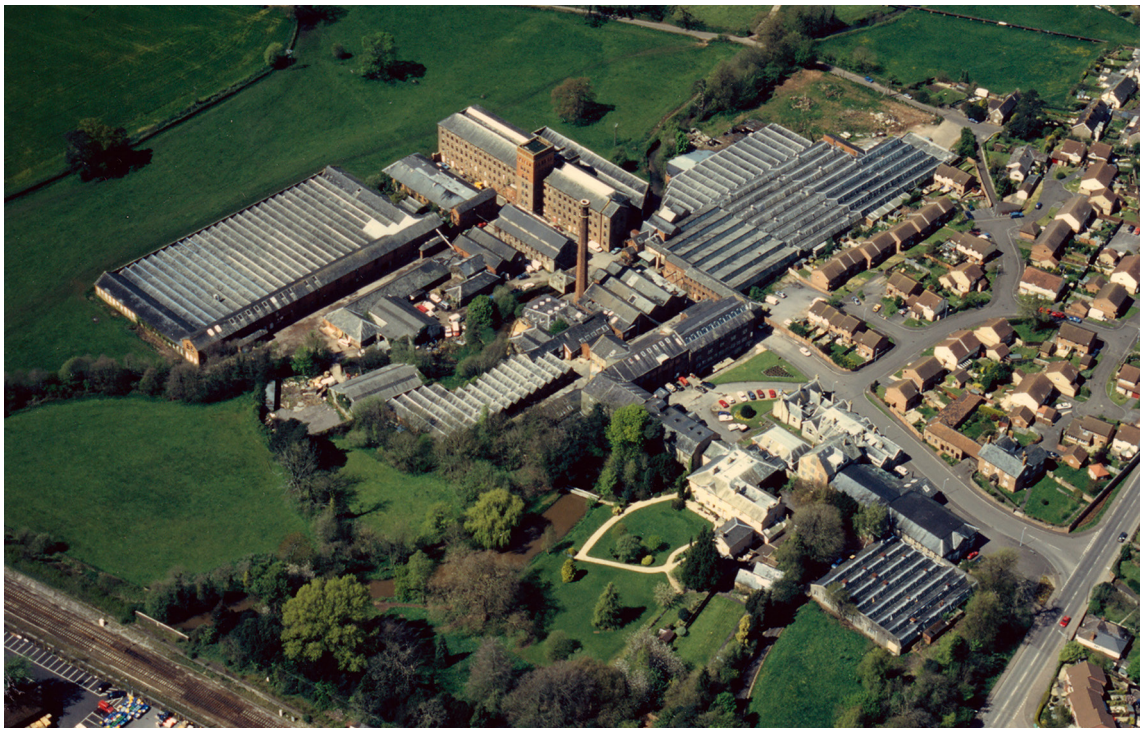

Figure 28: Tonedale Mill in 1998, looking north-west, with Tonedale House and garden in the foreground, seen with the Mill Head running along the west edge of the plot. [NMR 15890_26 27-APR-1998 © Crown copyright. Historic England Archive]

The northern cross-channel [51] was retained beneath buildings and corresponds with 'culvert B' in the report on the blacksmith's waterwheel (Craven 2007, 4) (*see* Fig. 35). An outlet into the Back Stream coincides precisely with its exit point on the georeferenced tithe map (Fig. 29). This channel probably served as an overflow for discharging water from the Mill Head into the Back Stream, but it may have had additional uses, perhaps providing water for processes or boosting the flow in the Back Stream which powered the blacksmith's waterwheel (see below). The channel drops steeply as it enters the east side of the mill (*see* Fig. 4, beneath the south-west end of building B), raising the possibility that there could have been an additional waterwheel.

By 1888 the main open channel of the Mill Head had been culverted where it enters the factory. It passes beneath a later building (*see* Fig. 4, building B) and continues below a yard to its north. Here it turns westwards and enters the mill, falling some 8m in the wheel chamber or pit. The culvert appears to follow the same course as the open channel shown on the tithe map (Williams et al. 1993, 2).

Until the addition of steam power both Thomas Fox's mill and its successor, the 1823 fireproof mill, were powered from the same waterwheel pit [47]. The wheel pit has been described and illustrated in detail in previous studies from which the information below has been taken (Williams and Stoyel 1993, 4; Williams et al. 1993, 4-5, 8-12) (Figs 30 and 31). Its east, west and south sides were believed to date from the mill of 1801-3. Blocked openings of two splayed windows indicated that they were external walls before stair towers were added. A blocked archway in the west half of the south wall was possibly the site of an original shaft bearing with the drive to the mill taken directly from the waterwheel shaft. A mounting block,

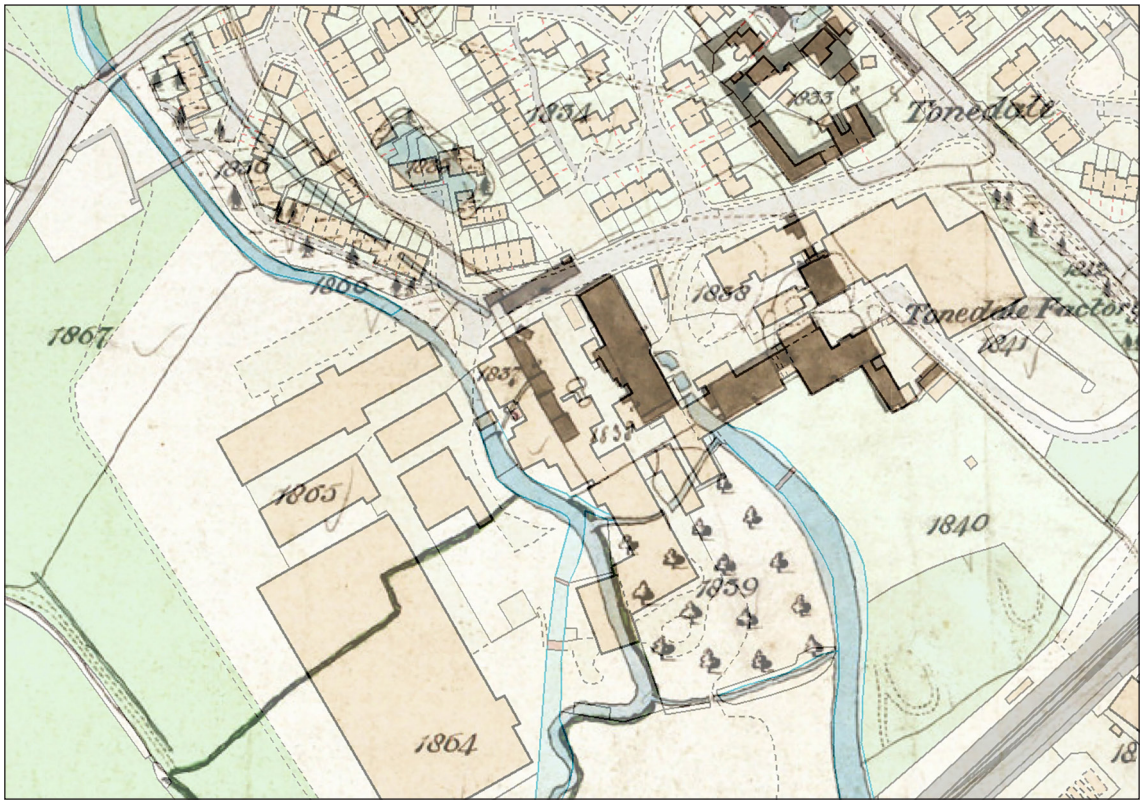

Figure 29: Earlier routes of water features through Tonedale Mill, illustrated by overlaying the 1839 Wellington tithe map on the modern OS Mastermap data. Cross-channel [51] can be seen connecting the two main watercourses immediately south of the early factory buildings. The former distinct bend in the Back Stream [52] (bottom centre) had been straightened by 1888, and most of the other features were culverted as the site developed and expanded. Not reproduced at scale. [Background mapping © Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900 © Historic England | overlay source: SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust]

probably for a pinion driven by a ring gear on the wheel, was situated in the north-east corner. Power was transmitted to the upper floors via an upright shaft (not in situ) in the north stair tower. Most of the other surviving internal features related to later modifications (Williams et al. 1993, 5).

The waterwheel, which had been removed, had been of high breastshot type (water entering the upper part of the wheel and its falling force rotating the wheel anticlockwise) (Williams et al. 1993, 8). It was estimated to have been 9.5m (30ft) in diameter and 3.5m wide, larger than the wheel chamber with its western end extending through an arched opening. The position of its eastern end was indicated by a curved ashlar apron located about 3m from the end of the chamber. Above this, a bolted cast-iron trough carried the headrace, the edges of its sides embellished with an embossed rib suggesting an early-19th century date. This large waterwheel would probably have been a replacement for an earlier wooden waterwheel. Iron wheels became more common from the mid-19th century, allowing further optimisation of the power potential at different sites (Tann 2012, 95). In the 1990s, the wheel chamber still contained water, its flow blocked by rack and pinion sluice gates at the back of the trough (Williams et al. 1993, 8). The water exited the wheel pit through an arch in the west side, flowing out at a lower level and entering the culverted tailrace (*see* Fig. 30).

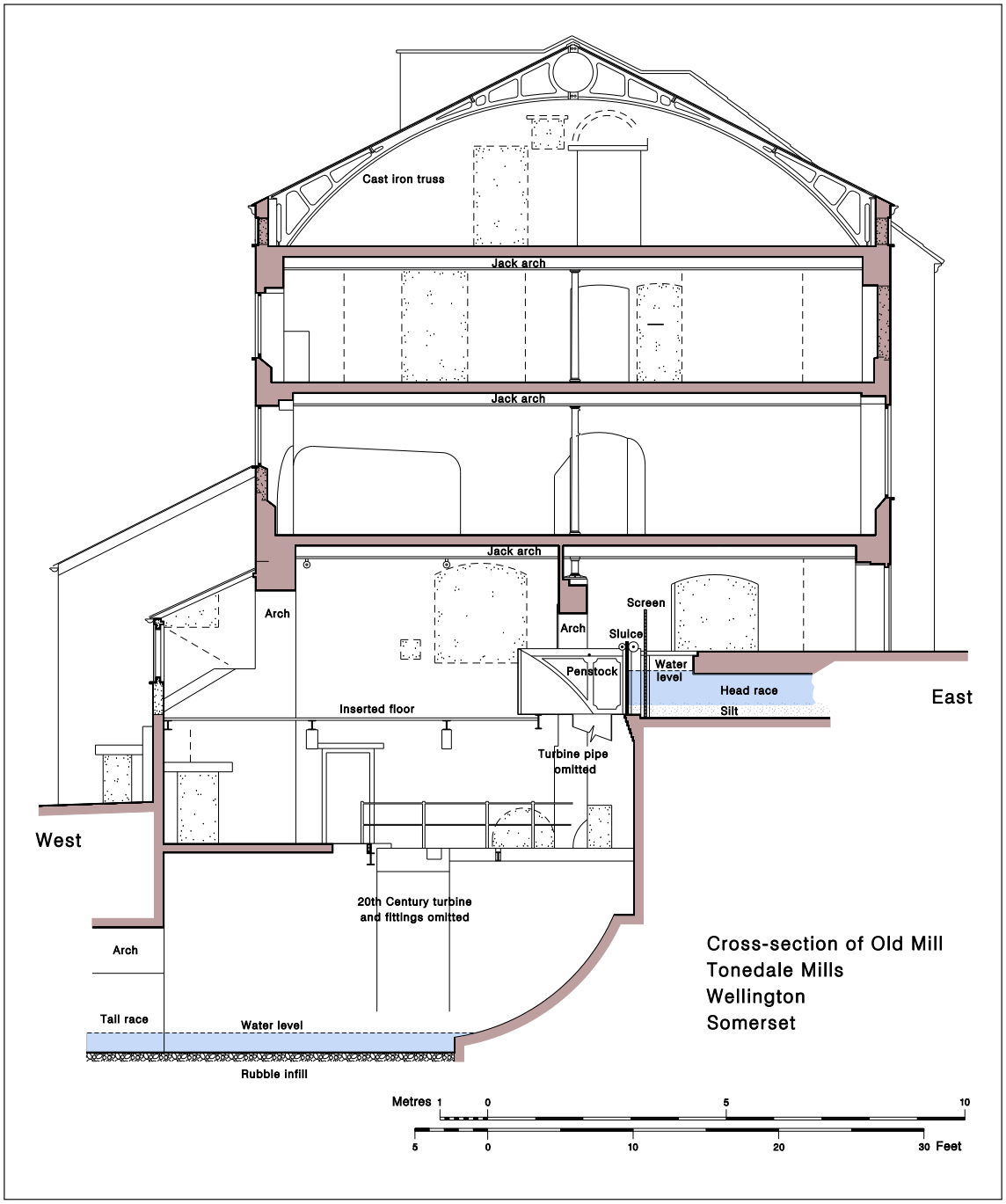

Figure 30: A section drawing through the 1823 fireproof mill at Tonedale and its waterwheel pit [47], produced as part of English Heritage's architectural survey and investigation of the mill buildings in the early 1990s. Portions of curved floor in the waterwheel pit (bottom right) and above in the penstock give an indication of the large-diameter wheel that was housed here prior to replacement with a turbine. [© Historic England]

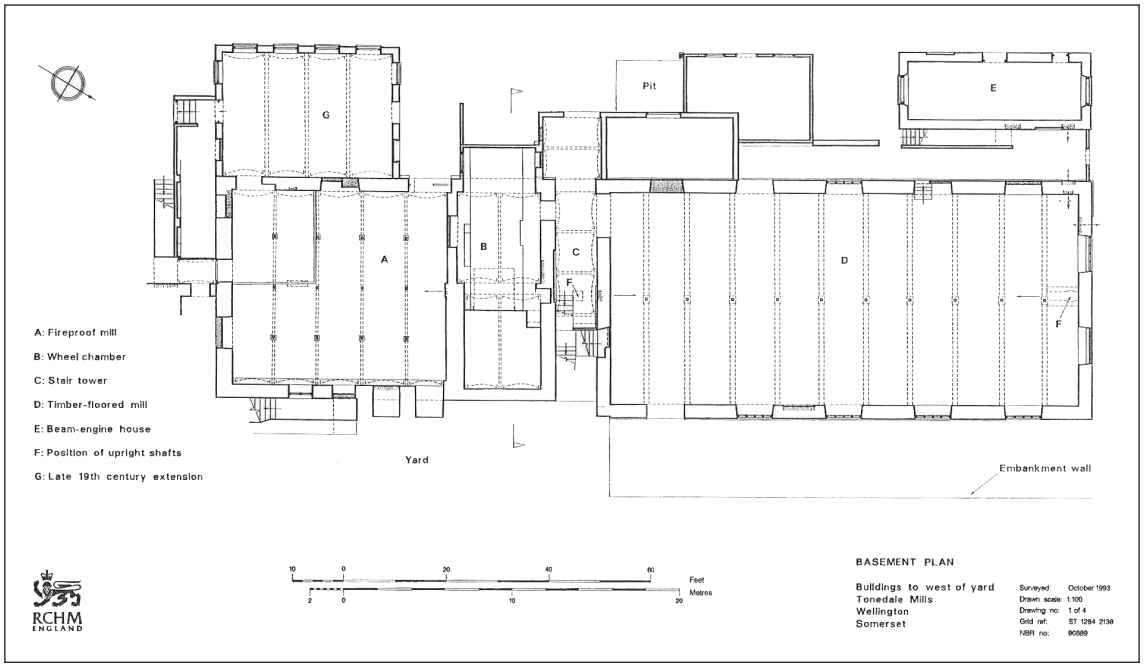

Figure 31: A plan of mill buildings to the west of the yard at Tonedale mill, including the 1823 fireproof mill 'A' and its adjacent waterwheel pit 'B' [47], produced as part of English Heritage's architectural survey and investigation of the mill buildings in the early 1990s. [© Historic England]

Since the waterwheel remained in place until 1904 it seems likely that the mill was intended to be driven by a combination of water and steam power for some time after the detached engine house was added (Fox 1933, 28; Williams et al. 1993, 11). It was then replaced by a small inward-flow reaction turbine which was used to generate DC-electricity for lighting. The iron trough that had fed the wheel was modified by the addition of a square bottom section with a penstock tube to supply the turbine. The turbine machinery is no longer in situ, but its supporting beams, the penstock and draught tubes were still in place in the 1990s (Williams et al. 1993, 12). When electricity was first used to power machinery at Tonedale Mill is not clear, but a gas plant was set up in 1908 apparently for the production of electricity for machinery (Roethe 2020, 10). At some point in the 20th century DC-power was also being transmitted to Tone Works from generators at Tonedale Mill using overhead lines (Williams 2007c).

After passing through the wheel chamber, the culverted tailrace flowed at a lower level and re-emerged as the westernmost of two channels [54] shown exiting the mill complex's northern boundary on the 1839 tithe map (*see* Figs. 24 and 29). A small building straddled its projected course a short distance south-east of this exit point and followed its alignment, indicating that it used the watercourse. The function of the building is not known, but the OS 1:500 Town Plan shows that it was replaced with new buildings before 1887 (*see* Fig. 25). Both channels [54 and 56] were likely to have been culverted when large weaving sheds were built at the northern edge of the factory complex in the late-19th century.

The eastern channel [56], which ran roughly parallel with the tailrace [54], was interpreted by Brian Murless of Somerset Industrial Archaeology Society (SIAS) as a feeder channel for the Grand Western Canal (Passmore 2003, 2). In December

2002, archaeological excavation of the site of the demolished weaving shed, loom shop and engine house by Exeter Archaeology unearthed and recorded the channel's remains passing through a wall via a brick arch. It had a curved roof of red brick and a line of limestone blocks at its base, which was interpreted as possibly the side of the earlier open watercourse (Passmore 2003, 4). It had been truncated by a brick-lined and arched transmission shaft and replaced by a smaller rebuild slightly east of the original culvert, avoiding the position of new machine bases (Passmore 2003, 6). The culvert was believed to have been constructed when the weaving shed was built, possibly representing the culverting of the tailrace (Passmore 2003, 8). Georeferencing of the tithe map and the 2002 excavation plan on to the current OS Master-mapping, however, shows it to be the watercourse [56] to the east of the tailrace [54].

The Back Stream [40] is the only other major watercourse flowing into and through Tonedale Mill (Figs 32, 33 and 34). It follows its approximate natural course through the factory, though canalised. The tithe map shows it in 1839, prior to the mill's expansion, when it passed to the west of the small building complex (*see* Figs 7, 24 and 29). From a weir [43] on the Back Stream a small channel [45] flowed into the westernmost mill building, entering the building where a weir and sluices are shown on late-19th century maps (*see* Figs 24 and 25). These buildings were later used for wool scouring, drying, steam plant and maintenance facilities. The stream was thus being used either for power, processes or both by this date. By 1888 the factory buildings had been extended and the Back Stream was partially culverted, flowing beneath a yard and the eastern end of the mills built in 1863-73 (*see* Fig. 29).

Figure 32: The centre of Tonedale Mill in 1993, looking north-east, with the Back Stream visible entering the mill complex, west (in front) of the chimney. [NMR 4893_22 22-JUN-1993 © Crown copyright. Historic England Archive]

Figure 33: Tonedale Mill in 2003 following closure, looking north-west, with the Back Stream visible entering the mill complex (centre foreground). The northern part of the mill has been demolished and the site cleared for development. [NMR 23057_11 16-APR-2003 © Crown copyright. Historic England Archive]

By the late-19th century water was diverted into a further culvert [49] to power the blacksmith's waterwheel [44] (Fig. 35). The OS 1:500 Town Plan (1888) shows a series of sluices on the north-eastern side of the Back Stream (all near buildings containing steam plant and facilities for maintenance, scouring and drying). The southern sluice was the entry portal to the culvert supplying the blacksmith's waterwheel, while the others probably diverted water used for cloth-making processes.

The blacksmith's waterwheel is situated west of the main waterwheel, in the centre of what is now an open yard but formerly situated in a building (*see* Fig. 4, centre of building F). It provided power for workshops built in 1839-1889 over the site of an earlier north-south range (Roethe 2020, 16). The wheel pit still contains a waterwheel, which is believed to be that described as 'the small wheel and governor' acquired in 1887 (Roethe 2020, 17). The wheel pit and waterwheel have been examined and recorded in earlier reports by Westcountry Access Ltd and Historic England, from which the information below has been taken (Craven 2007; Roethe 2020).

Figure 34: Tonedale Mills in 2020 in a derelict state, looking north, with new housing constructed on the northern part of the mill site which had been cleared in the early 2000s. [NMR 33912_029 16-SEP-2020 © Crown copyright. Historic England Archive]

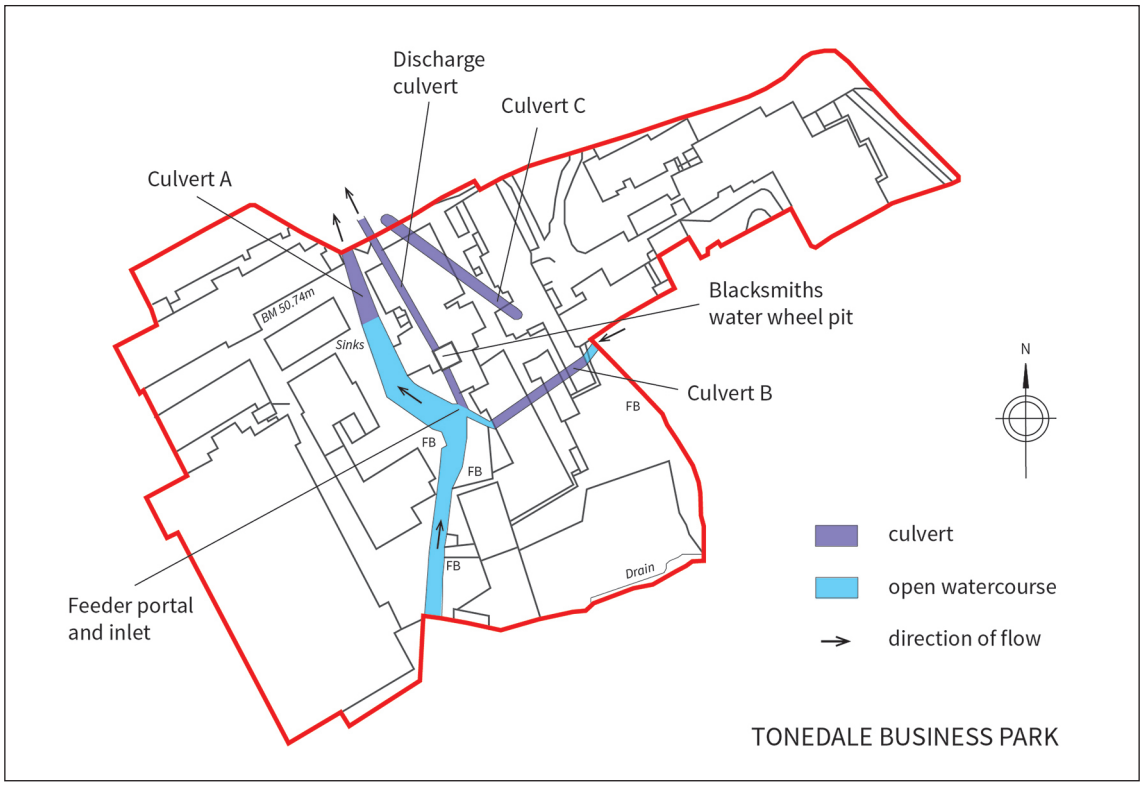

Figure 35: A plan of the mill complex at Tonedale, produced by Westcountry Access Ltd in 2007 as part of a condition inspection, showing the blacksmith's waterwheel pit [44] and its culverts [46 and 49] [after Craven 2007, 4, redrawn by Historic England]

The wheel pit is aligned north-west to south-east, corresponding with the layout of the buildings. It is lined with a mixture of stone and brick and appears to have been roofed (Craven 2007, 10). When examined by Westcountry Access Ltd in November 2006 and April 2007, it was clogged with vegetation and debris, but still contained the cast iron framework of a wide undershot waterwheel with a ring gear and a square axle (Craven 2007, 3-4, 13; Roethe 2020, 16-18). By 2019, a cast iron launder (or penstock) survived with parts of a sluice mechanism, drive shafting and bearings (Roethe 2020, 18). A smaller pit or pinion wheel inside the wheel chamber and a geared axle east of the wheel chamber related to the first stage of power transmission to adjacent workshops (Roethe 2020, 18). In 1916 the wheel was described as a '10 horsepower waterwheel with gearings and fixings', by which date the workshops were powered by several steam engines, though it is not known whether there was a combined steam and water-power system. The waterwheel was not 'written off' until 1937 (Roethe 2020, 17).

A stone- and brick-lined culvert [49], smaller than other culverts in the mill, leads to the penstock in the south side of the wheel chamber from under the centre of building F on Figure 4 (Craven 2007, 10; Roethe 2020, 18). It begins at a portal in the retaining wall in the north bank of the Back Stream 20m north-west of the discharge portal of the culvert [51] from the Mill Head to the Back Stream. The portal once had the same dimensions as the culvert but had been partially bricked up and a 4-inch clay pipe inserted restricting its flow.

Water exited the wheel pit through a large culvert [46] and continued its downstream course under the western side of the boiler house complex (Craven 2007, 4). By 2007 vegetation and debris had blocked the flow downstream and only limited examination of the discharge culvert was possible due to oil contamination and its low ceiling height. The culvert's route was tentatively mapped, in a direction 330 degrees from magnetic north, continuing under the west side of the boiler house complex. It had stone side walls topped by a brick arch roof and was in fair condition and structurally sound. Its roof dipped and returned to a level plane 4m from the upstream portal. It was believed to join up with the mill's main tailrace beyond a mid-culvert chamber (Craven 2007, 18-19).

Upstream from the blacksmith's waterwheel, changes were made to the Back Stream at some point between 1839 and 1888 (*see* Fig. 29). A sharp bend was removed to accommodate a bathing pool [41] (*see* Fig. 25), a valuable amenity for the Fox Brothers' workers, prior to the availability of domestic baths and showers. A probable reference to the pool occurs on 19 June 1877, when the company received a request to allow the 'bathing place' to be used by the residents of the town 'at hours not wanted by our people' (Williams n.d. b). Similar bathing facilities were provided by the Elworthy family in their mill pond at Westford Mill. The 1:2500 OS map sequence shows that the bathing pool at Tonedale Mill was filled in at some stage between 1930 and 1964. Its site was covered by a woollen waste store (Hagen and Fox 2000, 37). The pool may have doubled up as a storage pond, perhaps a back-up supply for the blacksmith's waterwheel.

4. TONEDALE MILL TO TONE WORKS

Feature numbers given in square-brackets throughout the descriptions in this section are to aid orientation and refer to the gazetteer (Appendix A) and labelled feature location map (Fig. A1) presented at the end of this report.

The 1839 Wellington tithe map shows Tonedale Mill's tailrace [54] leading northwards for approximately 150m and then ending abruptly on the southern side of Burchill's Hill, where it presumably entered a culvert (Fig. 36). Its projected course northwards passed through 'Tonedale Three Corner Close', a pasture field in the possession of Henry Fox. The reason for it being taken underground here was presumably to enhance its gradient and so improve the flow of water away from the mill. If the course of the open part of the channel shown on the map is projected directly northwards it leads to a prominent spur visible on the east side of the Back Stream, which may have been where the tailrace entered the Back Stream.

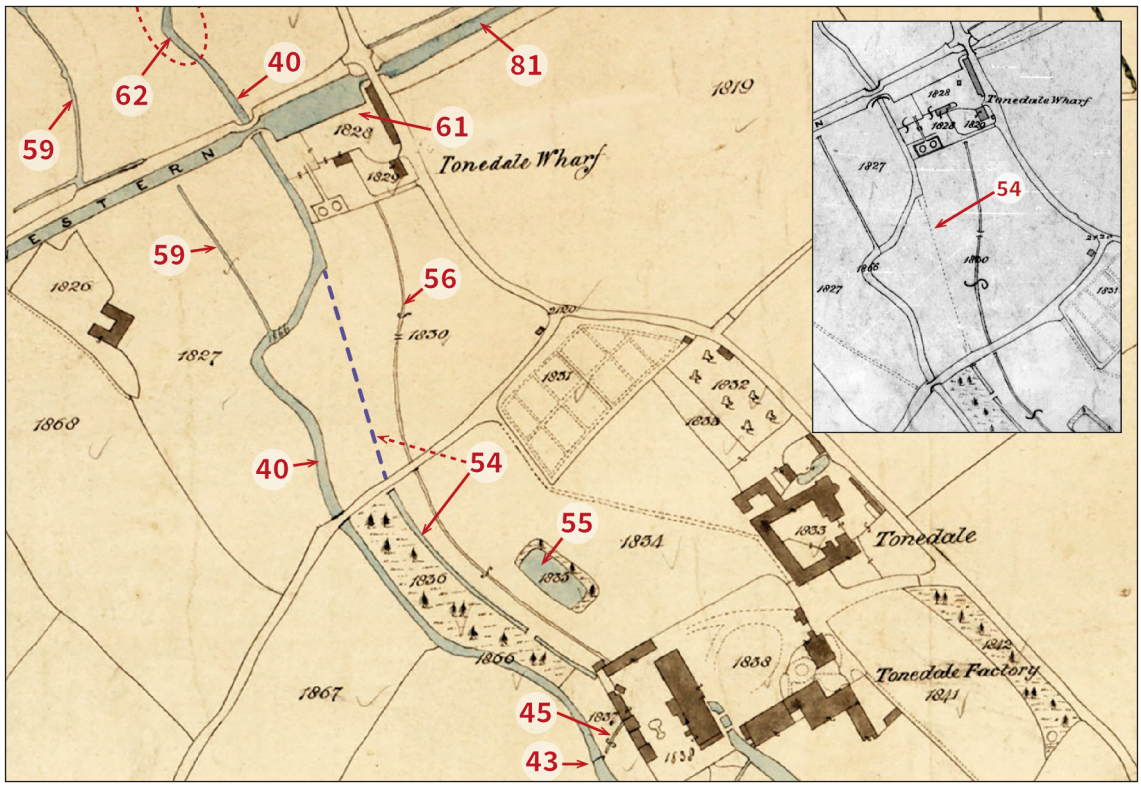

Figure 36: Extract from the Wellington tithe map of 1839. The postulated continued course of the tailrace [54] has been added as a dashed blue line and can be seen depicted on an alternative copy of the tithe map, shown as an inset. Parallel to its east is the narrow channel [56] from Tonedale Mill to the wharf and former pond [55], and to the west the Back Stream [40]. Not reproduced at scale. [main map SHC D/D/rt/M/367, accessed via the 'Know Your Place' website, reproduced with kind permission of the South West Heritage Trust; inset map © Crown copyright images reproduced courtesy of The National Archives]

4.1 The Grand Western Canal

In 1792 proposals were put forward for the construction of a canal connecting Bristol and Exmouth. Its planned route from the River Exe at Topsham to the River Tone at Taunton was surveyed by John Rennie in 1794. The proposed canal

promised to link the Bristol Channel and the English Channel by cutting out the lengthy and dangerous trip around Lands' End and providing a means to transport bulky goods and materials such as iron, timber, cheese, wool, limestone and coal. It would also distribute quicklime manufactured at canal-side limekilns, which up until this time relied on slow overland transportation by cart (Hadfield 1985, 95-8; Harris 1996, 11-30). The route and purpose were approved by Act of Parliament on 24 March 1796. Built in two main construction stages, the Grand Western Canal (HER 44126) eventually achieved a connection between Tiverton and Taunton but, despite its original ambitions, the two seaways were never joined up (Harris 1996).

Thomas Fox and other mill owners were apprehensive that the water they used to power their mills would be diverted into the canal. However, the 1796 Act of Parliament safeguarded mill owners' interests on the Rivers Tone and Culm, allowing them to appoint an engineer to work with the canal engineer in surveying and fixing marks above which surplus water could be diverted into the canal (Fox 1958, 78; Harris 1996, 25-30). The canal's construction was delayed by the French Revolutionary Wars (1792-1802), but in the early 19th century interest revived and in 1810 it was resolved to commence work, although the period that followed was hampered by pauses, disagreements and modifications to the plan (Harris 1996, 31-8). In 1829-30, James Green resurveyed its route and proposed a 'tub boat canal' (Harris 1996, 64-110). Tub boats were small and manoeuvrable, enabling canals to be smaller and cheaper. In 1838 the canal was completed – as far as it ever would be – and opened, passing immediately south of Tone Works on its course between Tiverton and Taunton (Harris 1996, 110-12).

The positioning of the canal [81] was convenient for the Fox Brothers, offering the potential for it to be used to transport raw materials and goods to and from the factories. A wharf [61] (HER 39873) – 'Tonedale Wharf' – owned by Henry Fox, shown on the 1839 Wellington tithe map and listed in the tithe apportionment, provided the mills with immediate access to the canal (*see* Fig. 36). Henry Fox later proposed to form a small basin at right angles to the canal and a deed of covenant with the Grand Western Canal Company was signed on 31 December 1842. Plans by Henry Smith showed the intended wharf and an agreement was made 'in consideration of trade to be carried on' (DHC 2062B/0/T/81 canal title deeds). It is not known whether these plans ever became a reality but, by 1860, the Fox Brothers were using the canal to transport ammoniacal liquor from Taunton Gas Works. The liquor was pumped into barges fitted with tanks, which drew up alongside the company's distillery at the wharf. It was distilled to produce ammonia, with the addition of quicklime and the application of heat. For some years this was the company's only detergent for cleaning woollens before milling and the process continued until the closure of the canal following its sale to the railway company in 1863 (Fox 1879a, 16; Fox 1879b, 28-29).

The canal was quickly superseded by the Bristol and Exeter Railway, which opened in this stretch in 1843. There followed a period of twenty years of competition between the canal and railway networks, but it was an unequal fight and in 1863 the railway company purchased the canal. By 1867 they had closed the Somerset section to all traffic (Green's tub boat section from Lowdells to Taunton), including the stretch that passed through Tonedale Wharf, leaving the railway alone to serve the main haulage needs of the textile mills of Fox Brothers and the surrounding area (Hadfield 1985, 111-115).

Figure 37: Extract from the coloured 1888 OS 25-inch map showing that while some sections of the Grand Western Canal remained in water, it had already been infilled between Tone Works and Tonedale Mill. Tonedale Wharf is no longer labelled, but the wharf cottages remain. Note also the dotted line of the parish boundary. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Ordnance Survey map editions from 1888 show that much of the canal's course past the factories was already filled in by this date and that Tonedale Wharf was no longer extant (Fig. 37). A bridge carrying the Milverton Road over the canal was demolished in 1869 (HER 39870) and an aqueduct (HER 39872) taking the canal over the Back Stream has been taken down and replaced with a later structure. However, the canal's former route through Tone and Wellington survives fossilised in the line of the field boundaries and as a series of paths, including the West Dean Way long distance footpath. The traces of a stretch of the canal can be seen as a slight earthwork extending east-north-east along the present field boundary between the sewage treatment works at Tone and the corner of Stedhams Covert further east (*see* Fig. B4).

The short lifespan of the canal limited its usefulness to the Fox Brothers and, prior to the construction of the railway, most of the company's transport of wool and cloth appears to have been by road. The Milverton Road (now also the B3167), passing next to Tone Works, was the primary route of transport to and from the factories. Turnpiked by the Wivelscombe Turnpike Trust in 1786 and 1806, its completion enabled finished cloth to be loaded onto waggons and driven south-west to Topsham for sea transport to London (HER 26235; Fox Brothers & Co Ltd 1947, 4; Fox 1958, 17). For transporting to northern England, goods were shipped from Bridgewater to Liverpool, and for America and the West Indies they were shipped from Falmouth (Fox Brothers & Co Ltd 1947, 4).

The Grand Western Canal's construction does not appear to have had any major effect on the mills' water management systems. A small channel [59], shown on

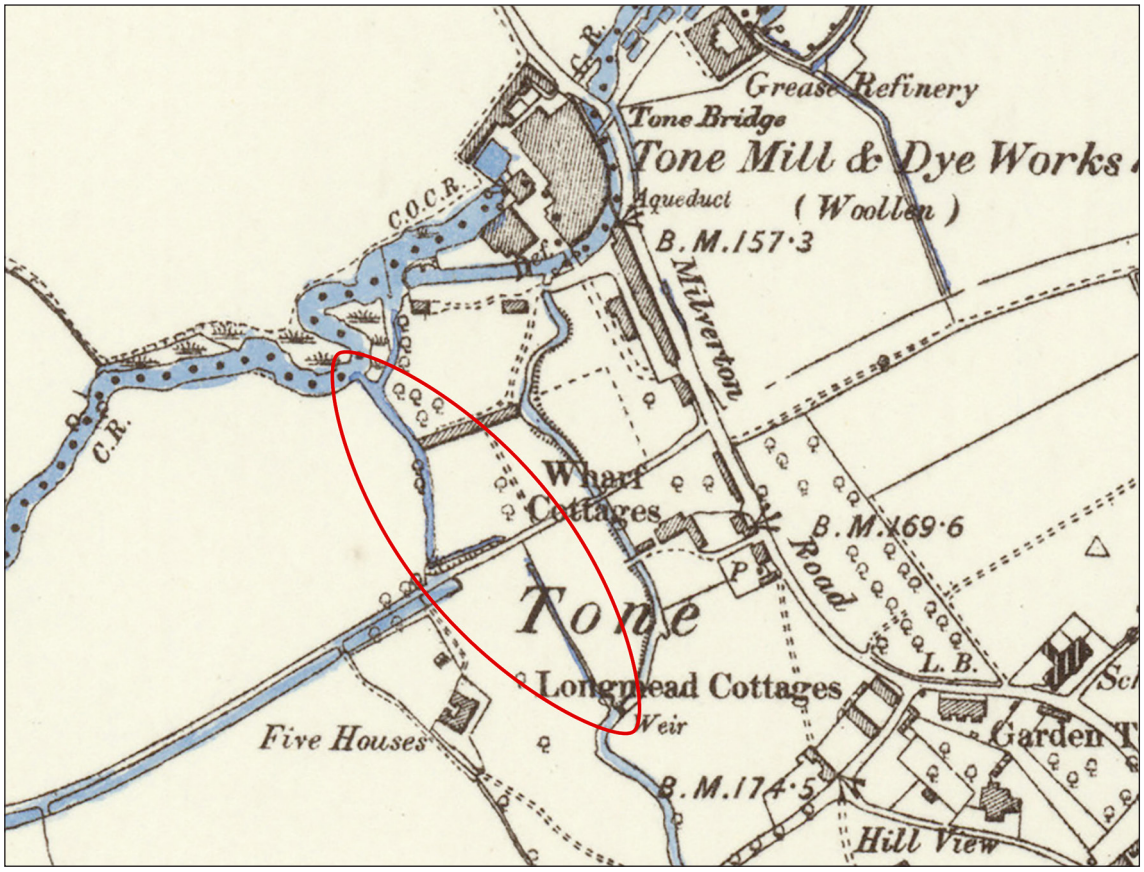

Figure 38: Channel [59] leading south-east from the River Tone to the Grand Western Canal [81] and continuing south to a weir [57] on the Back Stream. Depicted on the 1888 OS 6-inch map, highlighted here by the red oval. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

the tithe map flowing south-east from the River Tone, making a dog-leg east to pass under the canal, and continuing south to a weir [57] on the Back Stream, was possibly a feeder channel connected with the canal by a sluice [58] (Fig. 38, and *see* Fig. 36). This channel was still extant on the OS 25-inch map of 1904, but it had been filled in or culverted by the subsequent edition in 1930.

Downstream from the feeder weir [57], the Back Stream continued northwards to pass under the Grand Western Canal, entering the River Tone downriver (a little way east) of the main weir for Tone Works [65]. At some stage between the 1904 and 1930 (OS 25-inch map editions) its meandering course south of Tone Works was straightened and lined with stone blocks. It discharges directly into the river with no control features apparent at its junction.

5. TONE WORKS

Feature numbers given in square brackets throughout the descriptions in this section are to aid orientation and refer to the gazetteer (Appendix A) and labelled feature location map (*see* Fig. A1) presented at the end of this report.

Building numbers mentioned in this section refer to a plan created as part of the extensive research undertaken by Mike Williams (Figure 40) (Williams 2007b13, 115). In turn, that plan benefited from the more detailed building numbering given in an insurance plan of Tone Works from the 1950s, held amongst the Fox Brothers & Co. Archive, and which has a wider coverage to include the adjacent grease works (a version of that plan can be viewed in Williams 2007b, 12).

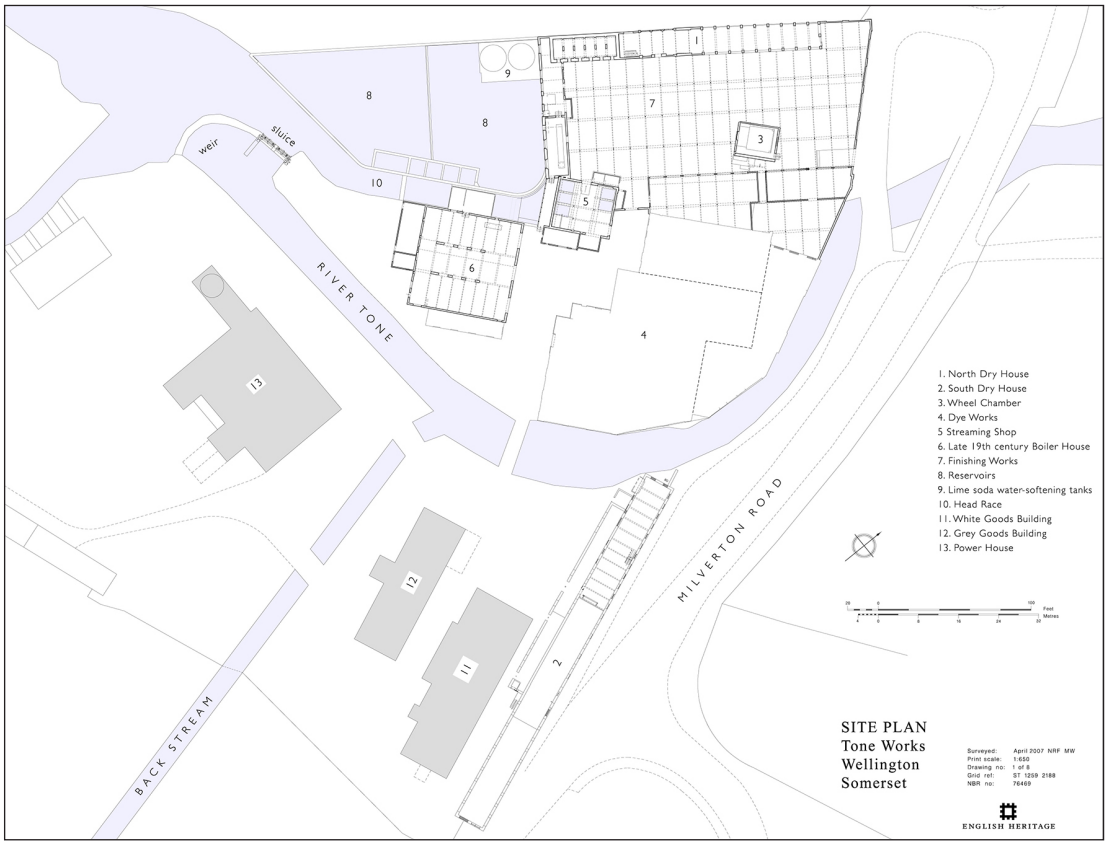

Figure 39: Plan of Tone Works showing the main buildings and their functions. Not reproduced at scale. [source Williams 2007b, 12 © Historic England]

5.1 Origins and development

Tone Works was developed by Thomas Fox from the Were family's existing fulling mill. This fulling mill appears to have been rebuilt from a mill leased to the family in 1750 (Jessop 2007, 1, 6: letter from Bruce Watkin to Mike Williams). Conveyances from as early as the 17th-century record a parcel of land including 'Tone Meadow' (immediately south of Tone Works) with 'a water or grist mill newly erected' in 1627 (SHC DD/X/CK/11), but 'decayed' in 1663, 1668 and 1741 (SHC DD/X/CK/12; SHC DD/X/CK/14; SHC DD/X/CK/24). Tone Meadow was also leased to Robert and Thomas Were in 1750, indicating that the same grist mill became the company's fulling mill.

In 1752, when work on the new fulling mill was underway, millwright John Fowler of Hatch Beauchamp visited Thomas Were and noted that:

> 'the Watter fall is from head to foot but 16 inches and from the Top of ye Mump (marked on Joseph Belletts side) to ye water was when Simon Farrant measured it - 3 feet and 8 inches – and belive it will be Needfull to make the Ware Cross the River but 2 feet only under ye Top of ye marked oller mump – that will make ye Watter head 1 foot 8 inches and ye 16 inches before 1-4'...Total 3 feet fall' (Memorandum book of Thomas Were, 1737 onwards, NRA 30948/23 (v), p136, transcribed in Jessop 2007, 6).

The head of water described was significantly less than it is today.

A reset stone in one of the late 19th-century gables of the Dye Works (*see* Fig. 39, building 4) reads 'Thomas & Eliza[th] Were and Sons' followed by the date 1754, which may relate to the 18th-century fulling mill building (Williams 2007b, 6). Construction continued in subsequent years, since in 1759 and 1765 more oak and elm timber was purchased for work on the mill, again directed by John Fowler. Parts included a fender post, the wheel cistern, the mill head and tail and three oak pieces each 9ft long for waterwheel arms (Jessop 2007, 7). The early fulling mill does not survive, but its most likely position is thought to have been on a leat near the surviving waterwheel pit [72] (Williams 2016, 121).

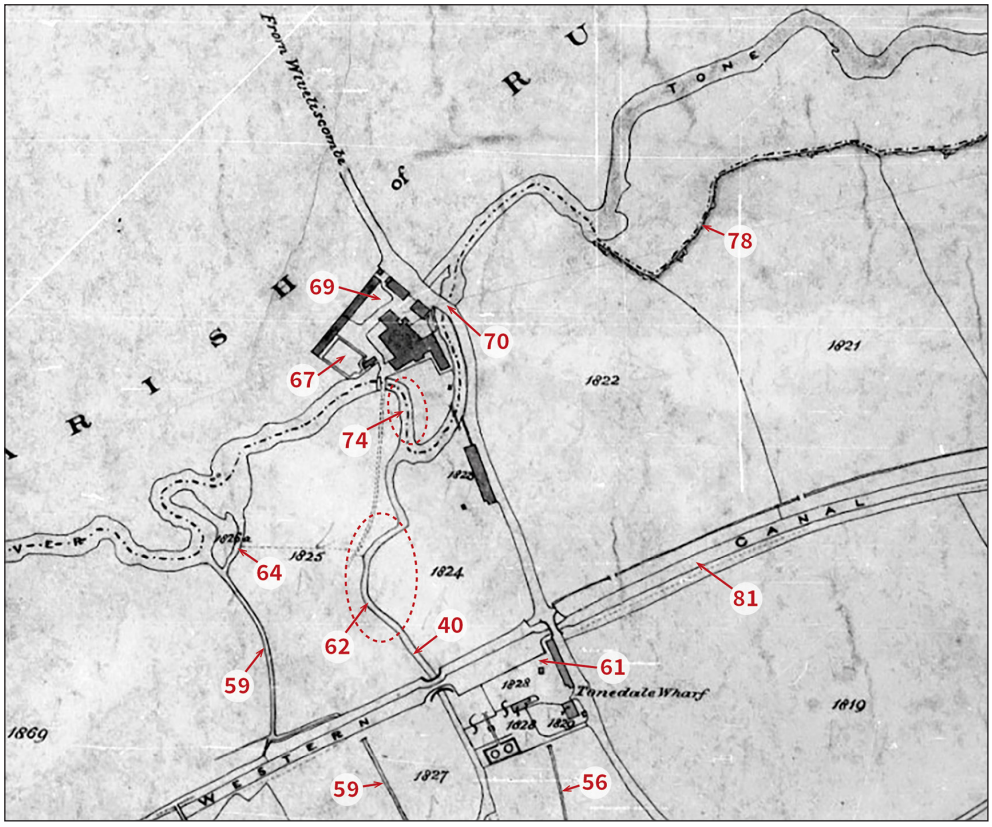

Figure 40: Tone Works depicted on the Wellington tithe map of 1839, with the small island in the river a short way upstream to the south-west [64]. Note the large sub-rectangular tank at the west edge of the complex [67]. The parish boundary is shown (dot-dash) following the meanders of the River Tone before deviating away from the river further east to follow a minor watercourse [78]. Not reproduced at scale. [© Crown copyright images reproduced courtesy of The National Archives]

By 1839, when the Wellington and Runnington tithe surveys were produced, the Fox family held much of the land to the south of Tone Works, as well as meadow fields along the south banks of the River Tone immediately upstream and downstream of the factory and flanking the Grand Western Canal (SHC D/D/rt/A/367 and D/D/rt/A/43).

5.2 Water supply to Tone Works

As the major cloth-finishing site for the Fox Brothers' operation, Tone Works required a large amount of water for processes as well as for power. It was intentionally sited within a distinctive bend on the River Tone at Tone Bridge and was powered by water taken directly from the river. The relatively substantial watercourse of the river appears to have provided an adequate supply of water without need for extensive work upstream.

The upstream configuration of channels (west of Tone Works) has only been altered in relatively recent times. Nineteenth-century maps show that there was previously a sharp bend in the river that contained a small island [64] (Figs 40 and 41), which was probably the 'small island in the River Tone' acquired by the Were family in 1760 (Jessop 2007, 23). It survived until at least 1992, following which this stretch of the river was straightened (Fig. 42). The area has since been levelled (information

Figure 41: Tone Works depicted on the 6-inch OS map of 1888. The small island in the river to the west survives [64], but the meander through the factory has been replaced by the distinct east-west cut channel [63] controlled by a weir [65], which increased the land available for building and may also have reduced localised flooding. The earlier route of the river is still marked by the parish boundary (dotted line). Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

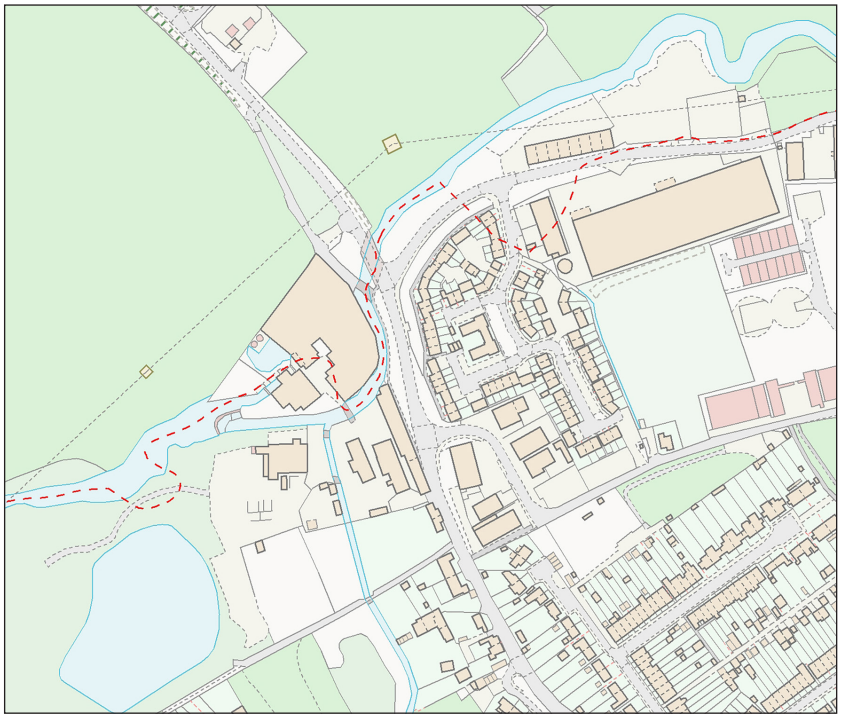

Figure 42: Tone Works depicted on the modern OS MasterMap. Note the straightened course of the River Tone to the west of the factory which has removed the former island, and the straightened channel of the Back Stream to the south. Milverton Road has been widened and rerouted slightly to the east, leaving the old Tone Bridge redundant [70]. Not reproduced at scale. [© Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900]

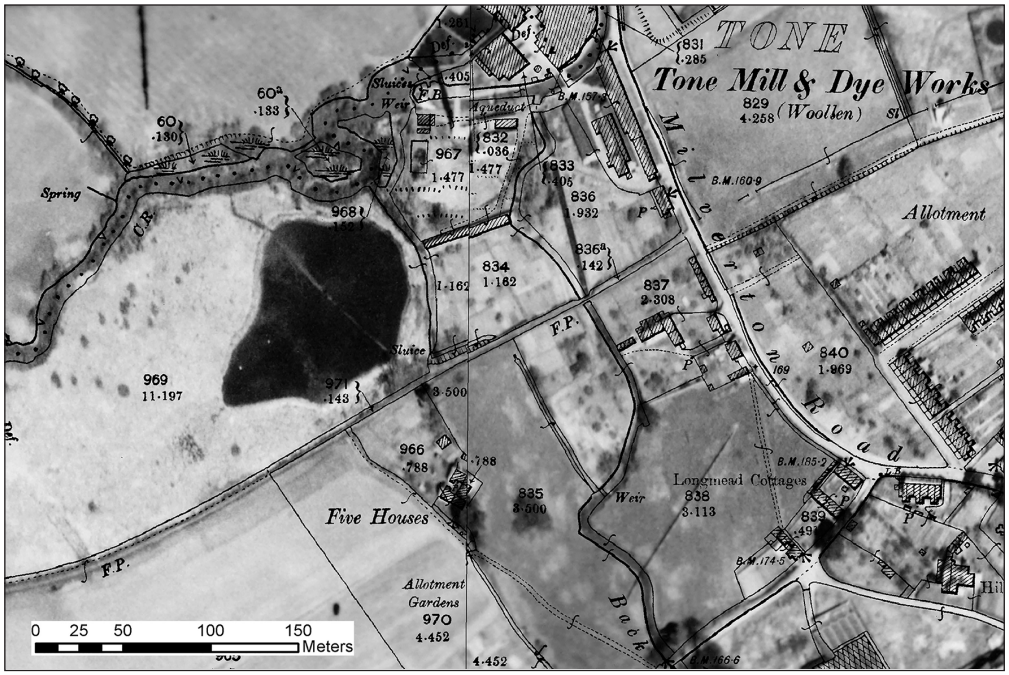

Figure 43: The 1904 25-inch OS map overlaid on a 1947 RAF vertical aerial photograph of Tone Works showing the River Tone to the north-west, watercourses to the south-west of the mill and the large pond [80]. The line of the former Grand Western Canal cuts NE-SW through the centre of the image. Not reproduced at scale. [Extract of RAF/CPE/UK/1974 1077 11-APR-1947, Historic England Archive (RAF Photography) | Ordnance Survey overlay map © and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2023). Licence numbers 000394 and TP0024]

Figure 44: Tone Works in 2007, looking north with the main mill site overgrown and derelict. [HEA 24720_029 18-SEP-2007 © Crown copyright. Historic England Archive]

from Mr K Wendt, site visit 31/1/2022) and no traces of the island or river bend are visible today. However, the river's former course is still traced by the Wellington and Runnington parish boundary (*see* Figs 37, 40, 41, 42 and 50).

Close to this, between the former canal and the river, directly west of Tone Works, aerial photographs and historic OS maps from the early to mid-20th century indicate the ground had become increasingly waterlogged and a large pond appeared in the 1940s [80] (Fig. 43, and *see* Fig. 42). It is not entirely clear if this is constructed or natural, perhaps resulting from water displaced by the diversion or infilling of nearby watercourses. A field visit undertaken in late January 2022, found it to now be more amorphous in shape than the OS depiction, with conjoined areas of boggy ground. This area has become increasingly overgrown with reeds and surrounded by trees through the last two decades. This pattern of vegetation encroachment was also seen around the main complex (Fig. 44).

5.3 Water Management at Tone Works

The Wellington tithe map of 1839 shows Tone Works straddling the neck of a tight bend in the River Tone; water was diverted into the mill on the upstream side via the headrace [73] and flowed through the mill complex, while the river passed to the south of the factory (*see* Fig. 40) (Williams 2007b, 7). Today, the headrace culvert turns sharply north-north-west after the Streaming Shop (*see* Fig 39, building 5, and GPR survey reproduced in Fig. 52) and then turns east-north-east into a straight section which enters the wheel chamber [72] (*see* Fig. 39, building 3). The reason for its circuitous route is not certain, but it may have been determined by the early-19th century building layout (Williams 2007b, 40).

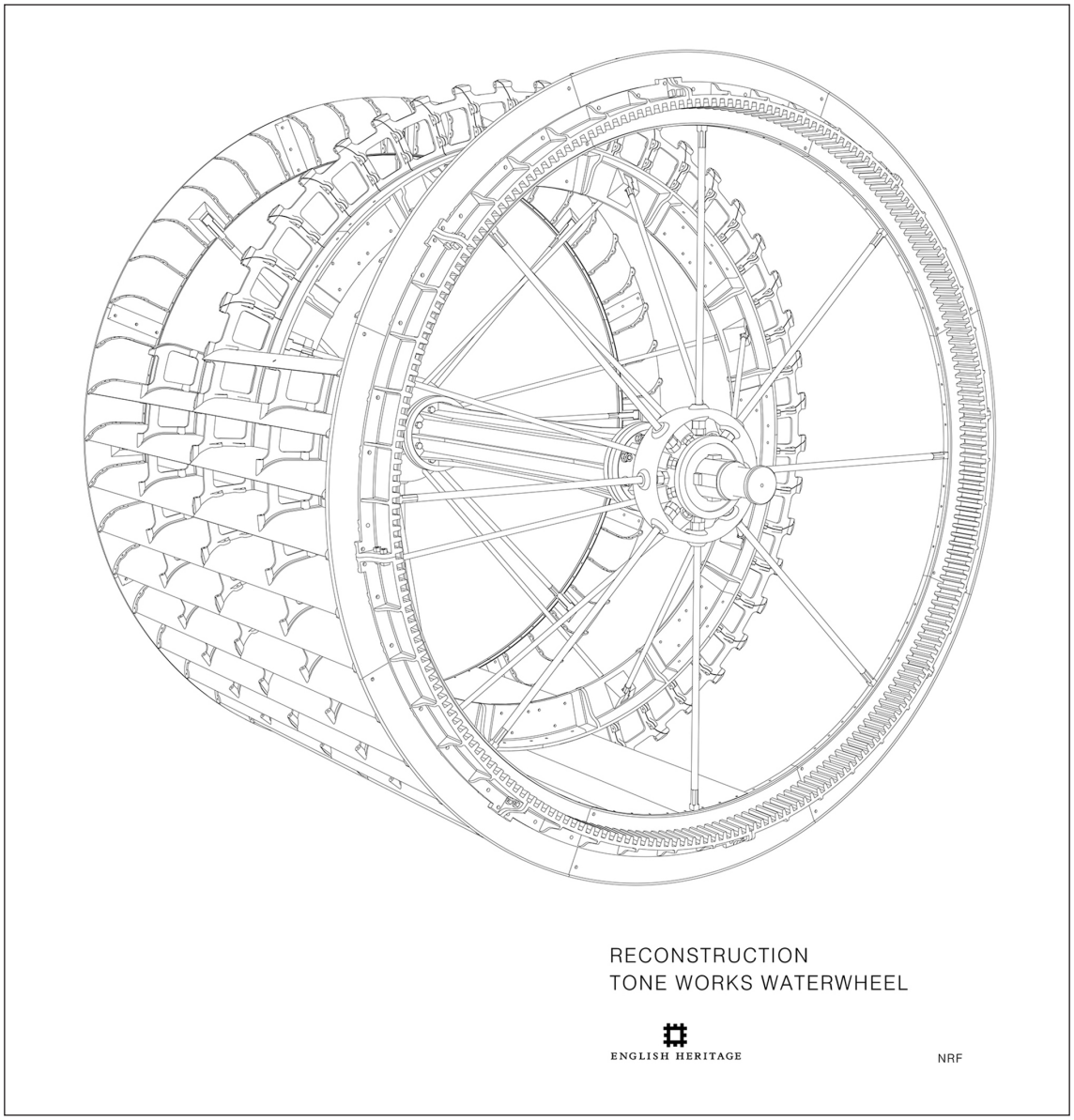

Figure 45: Reconstruction drawing of the waterwheel [72] at Tone Works, produced as part of English Heritage's architectural survey and investigation of the mill buildings in the early 1990s. [© Historic England]

The waterwheel, 'a rude structure mostly of wood', is reported to have 'worked visibly in [an open chamber at] the centre of the millhouse turning two or three pairs of stocks on either side' prior to about 1848, after which time a substantial stone wheel house structure was erected to cover it (Fox 1879a, 15; Fox 1879b, 27). This contained a wide iron breastshot suspension wheel, the shaft and shrouds of which were still attached when it was examined by the RCHME and English Heritage in 1995 and 2000 (Williams 2001, 11) (Figs 45 and 46).

The early 19th-century wheel house is shown on the 1839 tithe map, orientated at a slight angle to the walls of the other buildings but sharing a common alignment with the head and tailraces (*see* Fig. 40). The wheel chamber or pit [72], preserved inside the later 1890s Finishing Works, appears to be the remains of the wheel pit

Figure 46: The waterwheel and pit [72] at Tone Works, photographed in October 1995 [Peter Williams © Crown copyright. Historic England, AA96/00684]

housed in this former external wheel house, and has been identified as the factory's most significant water-power feature (Williams 2007b, 25-26; Williams 2016, 126). Its remains were recorded in detail during investigation of the buildings, from which the description below has been compiled (Williams 2007b, 36-44; Williams 2016; Williams n.d. a).

The wheel pit is rectangular, with ashlar breastwork at its east end and projecting piers in its sides to support the ends of the wheel shaft. The east and west end walls are probably of the early 19th century, and both have lower segmental-headed brick arches which span the entry and exit openings of the headrace and tailrace (Figs 47 and 48). The north and south side walls are late-19th century replacements.

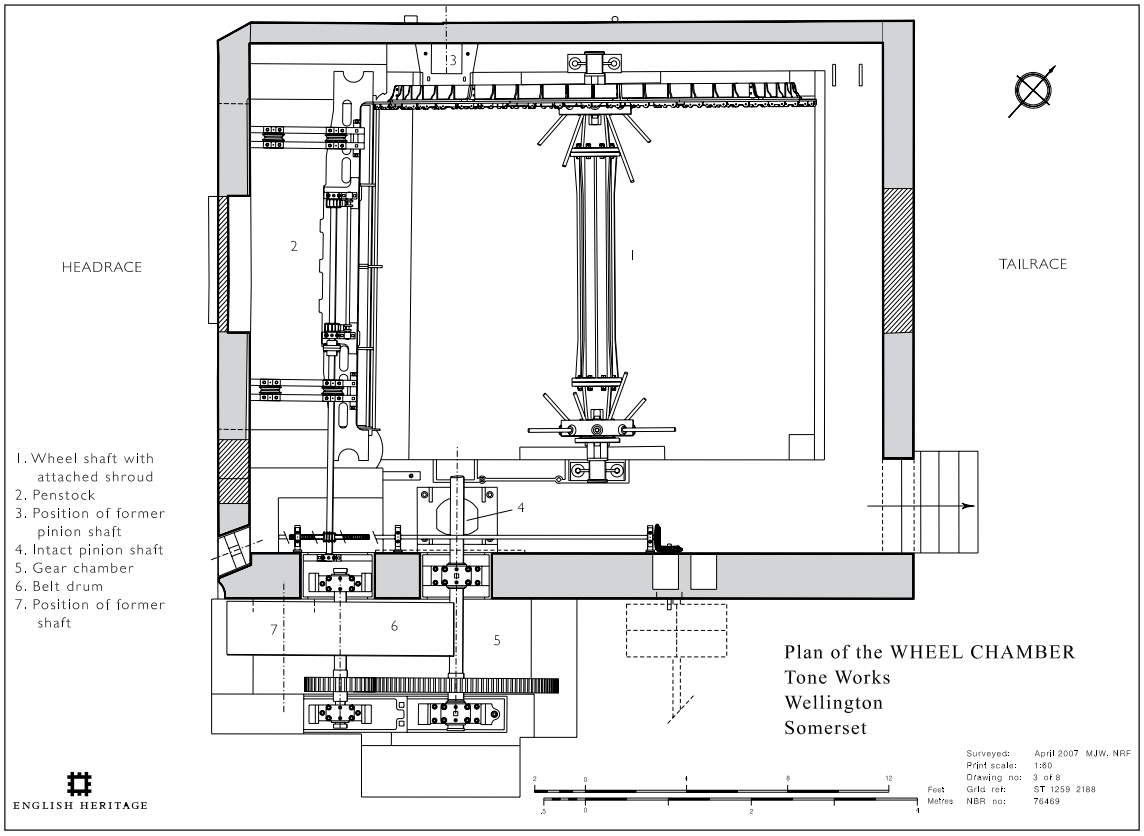

Figure 47: A plan of the wheel pit [72] at Tone Works, produced as part of English Heritage's architectural survey and investigation of the mill buildings in the mid-2000s.. [© Historic England]

Figure 48: The wheel pit [72], photographed in October 1995. [Peter Williams © Crown copyright. Historic England, AA96/00682]

Figure 49: The weir at Tone Works [65], built in 1871, photographed in October 1995 [Peter Williams © Crown copyright. Historic England, AA96/00646]

The first steam engine at Tone Works was brought from Tonedale Mill in 1868. It was used for the same purpose as it had been at Tonedale Mill, to supplement the power of the waterwheel in times of drought and, in 1877, it was replaced with a horizontal engine (Fox 1879a, 13, 29). The waterwheel was modified to drive line shafting in combination with steam power. The south side of the wheel pit was rebuilt in about 1893-5 to support a belt-drive power transmission for the Finishing Shed (Williams 2007b, 36, 46). On top of the breastwork was a cast iron penstock with an iron sluice operated by a rack and pinion mechanism to control the flow of water to the wheel (Williams n.d. a). This system was believed to mostly date from the completion of the Finishing Works in 1895. The position of the pinion shaft suggested that the wheel drove line shafting in buildings added to the north of the wheel pit in the late-19th century (*see* Fig. 39, building 3). A later gearbox control mechanism had also been added to the east, probably electric powered (Williams 2007b, 40). Electricity was probably installed initially for lighting, but a powerhouse was built later providing a third source of power for the line shafting.

The most significant alteration to the watercourses at Tone Works was carried out in 1871, when part of the bend in the river where the factory stands was removed to alleviate flooding. The western side of the bend close to the factory was replaced by a new east-west straight cut to its south [63], which re-joined the river near its confluence with the Back Stream (compare Figs 40 and 41). The work was recorded in the company's accounts, which state that £915:14:09 was spent on 'A new cut at Tone Works' (Jessop 2007, 6). The new arrangement shows clearly on maps from the 1888 OS editions onwards, but the original course remains fossilised in the line of the parish boundary (*see* Figs 41 and 42). This layout, which survives today, did not radically alter the supply to the waterwheel. A new weir [65] diverted the main flow of the river into the cut while the remaining part of the old river channel continued as the headrace, newly lined with brick retaining walls (Fig. 49). The entrance to the headrace does not have a sluice today, though its sides

have grooved concrete posts for the insertion of stop boards (Williams 2007b, 39). The new configuration allowed the addition of a boiler house on the southern side of the headrace and the Streaming Shop (*see* Fig 39, building 5) straddling the headrace on its entry to the factory. Two large tanks shown on the tithe map [67 and 69] remained, one linked to the north-western side of the Streaming Shop; their purpose was probably to store effluent.

The weir of 1871 would have replaced an earlier 'ware' nearby, mentioned in 1752 (Jessop 2007, 6). It is stone-built, to a curved plan composed of four angled straight sections crossed by a wooden footbridge (now in disrepair). Water drops some 2m from its ridge and then passes over two lower steps. Its eastern end has a large double by-pass sluice of red brick. This is believed to be contemporary with the rest of the weir and served as an overflow to allow flood water to be diverted to the south of the factory. The sluice has a central brick pier with a pair of cast-iron rack and pinion shutters to either side. These were originally controlled by separate hand wheels on pedestals at the ends of the sluices, but later a gearbox mechanism was added to the east, probably electrically powered. This was in working condition when examined by English Heritage (Williams 2007b, 39-40). No sluice gates survive, but the sides have grooved concrete posts for the insertion of stop boards. Construction of the weir did not significantly raise the head of water and its main purpose was to improve the site's flood defences (Williams 2007b, 39).

Natural dyes used by the company in the late-19th century could not be chemically fixed, so rinsing cloth in water was important to remove surplus dye. This was done in the Streaming Shop, where cloth pieces were put into metal baskets and lowered directly into the water. A channel from a sluice adjacent to the south and east walls was used to dilute the effluent and direct it into a tank beneath the south-east corner of the Finishing Works (Williams 2007c, interview with Michael Fox 2007; Williams 2007b, 40). In 1888 the two large tanks [67 and 69] shown on the tithe map remained, with sluices and smaller tanks north-west of the Streaming Shop (Fig 50, and *see* Fig 40).

In 1892-5, cloth-finishing processes were re-organised and housed in a new Finishing Works (*see* Fig 39, building 7), a large north-light shed built with a raised floor to alleviate flooding. Wet and dry processes were separated, wet processes occupying the northern part of the building. After dyeing, cloth went to scouring machines where it was passed through a liquor of hot water mixed with soap and then squeezed between heavy wooden rollers to remove oil, fluff and surplus dye. Milling was another process carried out in the Finishing Works. It matted the surface and shrank the damp cloth. After milling, cloth was tentered (stretched between tenterhooks on a framework so that it dried without shrinkage) in the North Dry House (building 1 on Fig. 39), which replaced open-air tentering grounds. These had previously covered nearly the whole area from the cottages called 'Five Houses' to the Tone gas holder, the upper part being abandoned when the canal was constructed (Fox 1879a, 4; Fox 1879b, 28).

The construction of the 1890s Finishing Works was associated with an overhaul of the power scheme. A new detached boiler house was built, serving as a centralised plant from which steam was piped to engines powering the building's line shafting and hot water was piped to machines (Williams 2007b, 26). However, the machinery could still be driven by the waterwheel which could be disconnected by a friction clutch (patented in 1887) and water power continued to be used in combination with steam power across the factory (Williams 2007b, 14, 25-7).

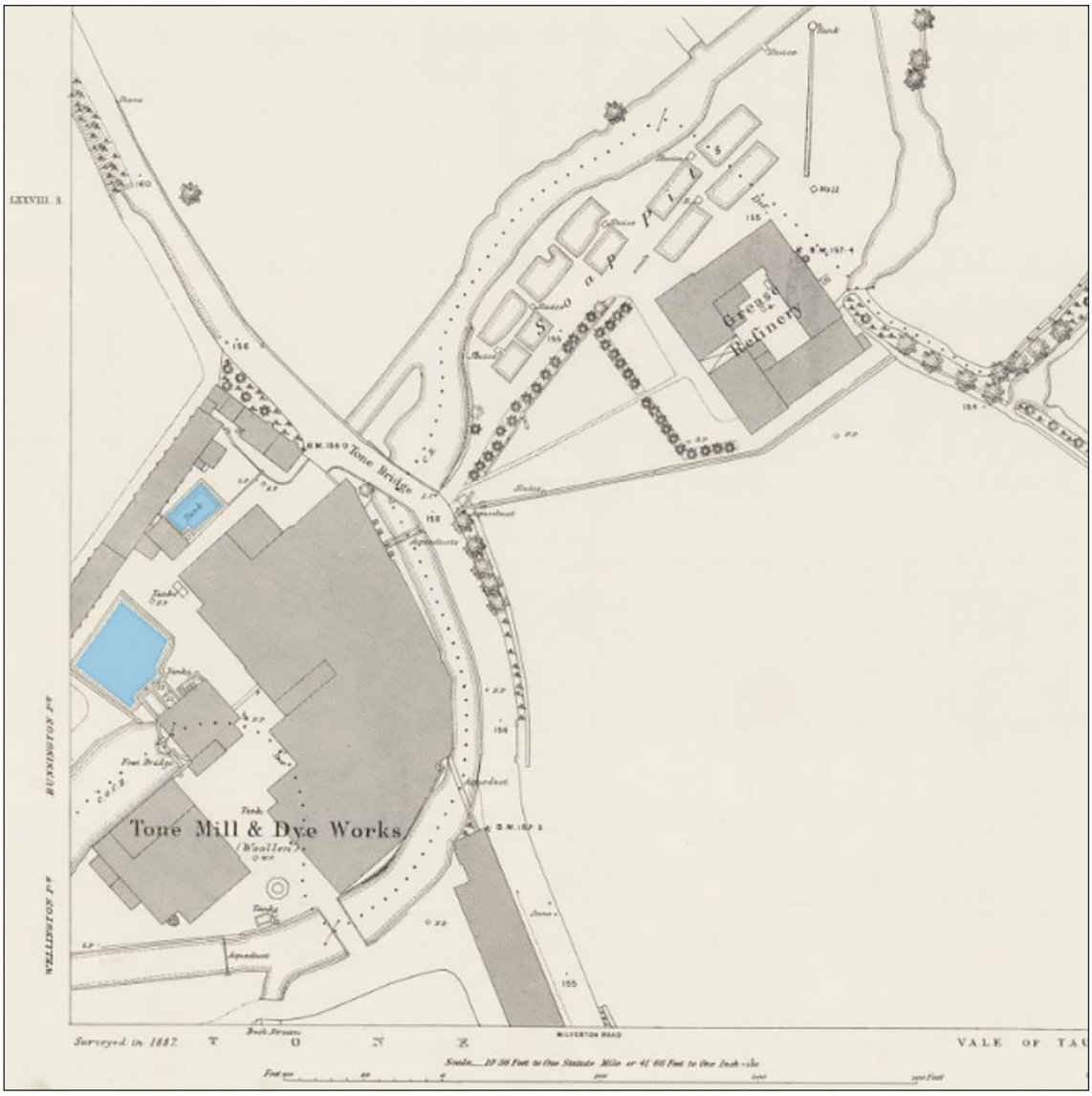

Figure 50: Water tank [67] and smaller tank [69] at Tone Works, highlighted in blue, and the grease works with its soap pits, shown on the OS 1:500 Town Plan of 1888. Note that the dotted line of the parish boundary follows the earlier course of the river where it used to bend tightly before it was modified to reduce flooding and increase land for building. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Contemporary with the Finishing Works was the reservoir(s) [71], immediately to the west of the building (feature 8 on Fig. 39). The company's ledger lists £958:08:04 spent on the 'new reservoir' at Tone in 1892 and a further £259:05:08 in 1893 (Jessop 2007, 6). The reservoir settled and filtered river water to produce the soft water needed for cloth-finishing and boilers. It was enclosed by walls and divided in two by a central low wall, the upstream side filled directly from the river via a sluice and the downstream side storing treated soft water (Williams 2016, 123) (Fig. 51). Water used in steam engines needed to be soft to prevent limescale, while processing water had to be the correct hardness, pressure and temperature for the soap in the scouring machines to work properly (Williams 2007c). Water in the soft water reservoir was kept slightly higher to avoid leakage and contamination

Figure 51: The headrace at Tone Works [73] (foreground), with the soft water reservoir of the early 1890s [71] and the pair of concrete lime soda water softening towers dating from 1914 beyond, looking north-east, October 1995 [Peter Williams © Crown copyright. Historic England, AA96/00645]

from the hard water reservoir. When the river water was dirty, such as in times of flooding, clean water was pumped to the reservoir from an old mill pond to the west of the site (Williams 2007c). The whereabouts of this is not certain.

In 1914, two concrete towers – lime soda water softeners – were built on a platform in the north-eastern corner of the soft water reservoir (Fig. 51). The purchase and installation of this water-softening plant at a cost of £2134:09:01 is recorded in the Fox Brothers Archives (Jessop 2007, 12, 17). Treated water from the towers was also used at Tonedale Mill, to which it was pumped via a pipe alongside the Back Stream (Williams 2007c). In 1927, a further system, a Permutit water-softening plant was installed in a room adjacent to the site of the boiler house. The two systems were complementary, providing water at the slightly different pH levels suitable for use in boilers and scouring machines (Williams 2007b, 14). Lime soda water was preferred for boilers and economisers, so the towers were retained and used in addition to the newer plant.

A self-contained electricity powerhouse was built to the south of the river at Tone Works in 1921-2 (building 13 on Fig. 39). However, the steam and water-power systems probably remained in use for another two decades (Williams 2016, 129). By 1947 the waterwheel was no longer used, and the steam engine had been removed (Williams 2007c, 17-18).

By the early 20th century the flow of water through the factory was complex, with a network of pipes, underfloor conduits and water storage tanks. Tanks for storing treated soft water and the remains of pipework connecting these with channels under machines were noted during site visits by the RCHME and English Heritage (Williams 2007b, 58, 123). Brick-lined open channels in the floor of the Finishing

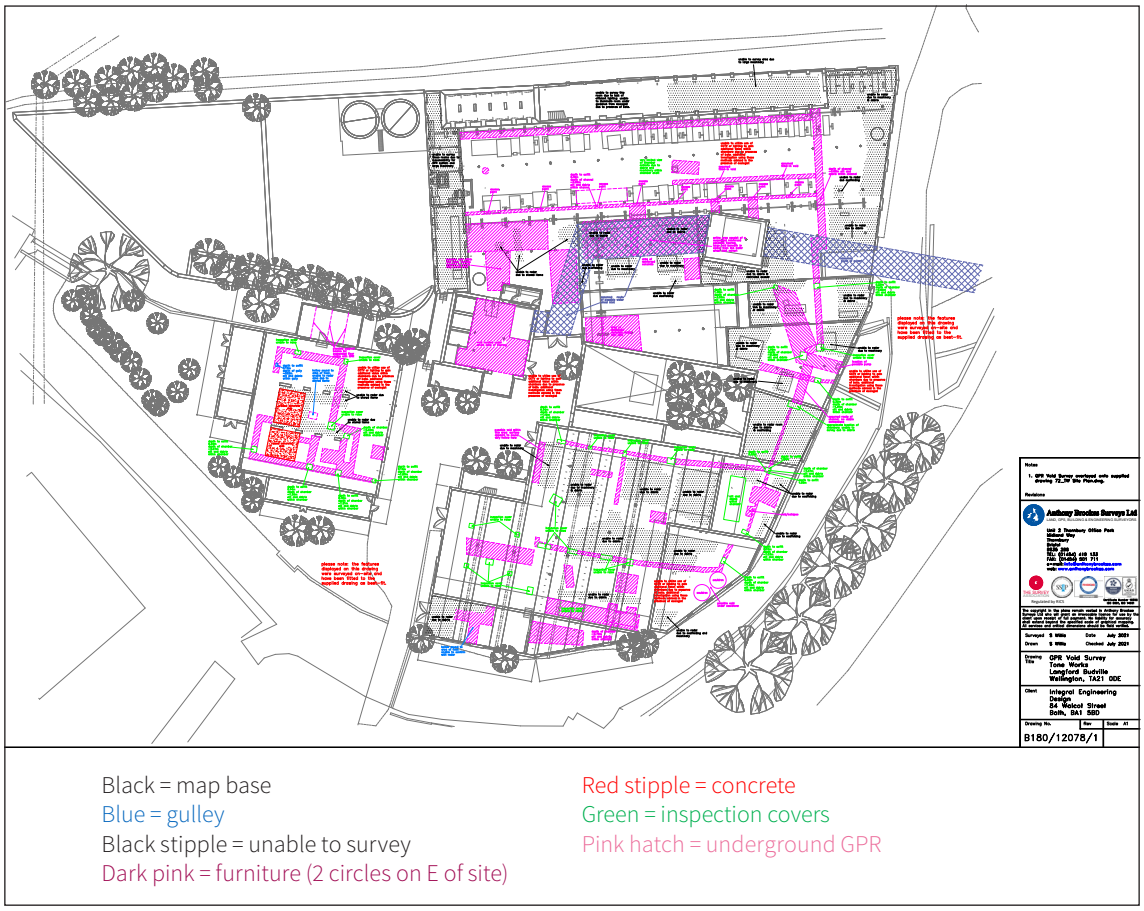

Figure 52: The wheel pit at Tone Works with the assumed routes of the culverted headrace and tailrace (cross-hatched) and subsidiary culverts (some of the diagonally-hatched areas) connected with cloth processing machines, as revealed beneath the factory buildings by Ground Penetrating Radar (GPR) survey in July 2021 commissioned by Somerset Council. Not reproduced at scale. [Anthony Brookes Surveys Ltd, drawing no. B180/12078/1, reproduced with permission of Anthony Brookes Surveys Ltd / Corbel Conservation Ltd]

Works conveyed effluent away from the machines into an underfloor effluent tank (beneath the south-east corner of building 7 on Fig. 39). The two largest channels [68], below the main rows of scouring and milling machines, are each about 2m wide by 1m deep. Waste water was piped across the river for treatment at a grease works [77] east of the Milverton Road (Williams 2007b, 58). Further underfloor tanks used to store effluent were periodically flushed out with river water (Williams 2016, 123). A large underground reservoir, 2.7m deep, and about 6.2m wide at the eastern end of the Finishing Works, comprising two parallel chambers with brick vaulted ceilings was reported by English Heritage. Its purpose was not known, but its alignment was not square with the building, suggesting that it might pre-date the building's construction (Williams 2007b, 58).

Buried features at Tone Works, including the apparent courses of both the headrace and tailrace, were mapped in July 2021 using Ground Penetrating Radar (GPR) (Anthony Brookes Surveys Ltd 2021) (Fig. 52). The culverts remain to be examined in detail, but a cursory inspection of the headrace tunnel from inside the wheel pit by English Heritage in the 1990s revealed a low brick arch some distance upstream from the wheel chamber, possibly the site of a bridge (Williams 2007b, 40).

The late-19th century Dye Works (building 4 on Fig. 39) also used a large amount of water. By 1912 it included a large indigo dye house with about 30 vats and a smaller number for other dyes (Williams 2016, 123). These were the only 'continuous vats' in the country, the firm's use of indigo vats being a special feature of the Fox Brothers. In 1996 the Dye Works still contained two indigo vats and two circular copper-lined vats, while in 2007 a tank remained at its west end which originally contained soft water (Williams 2007c).

The main outflow channel from Tone Works, formerly an open channel, emerged from the eastern side of the building complex and passed under Tone Bridge. It was culverted when the present Tone Bridge was built, and the tailrace is now restricted by new outflow pipes close to the rebuilt road bridge (Williams 2007c).

6. EFFLUENT TREATMENT

Feature numbers given in square-brackets throughout the descriptions in this section are to aid orientation and refer to the gazetteer (Appendix A) and labelled feature location map (*see* Fig. A1) presented at the end of this report.

The processes used in textile manufacture and dyeing produced large quantities of contaminated water and toxic effluent: scouring processes discharged a soapy effluent, while dyeing and other finishing stages released chemicals. Grease and acid waste harmed fish and cattle, and the river was frequently discoloured by dye liquor and earthy fluid from the mill-house.

As the Fox Brothers' operation grew, pollution from the factories became a major cause of concern for landholders downstream on the River Tone. As early as 1854, a Mr W. Burridge of Bradford-on-Tone threatened the Fox Brothers with legal proceedings for fouling the river (Fox 1879a, 16; Fox 1879b, 29-30). That same year - probably as a result of the threatened action - catch pits and filter beds for the factory's dyeing effluent were built to the east of Milverton Road (Stainer 2014, 2). But it wasn't until the 1860s that the company began collecting or distilling the various by-products of these processes for use or sale, and the late 1870s when innovations in purification methods started to result in some improvement in the river's condition (Fox 1879b, 29-30). However, the efforts were not enough to address the scale of the problem which grew as the business prospered and expanded.

6.1 Grease Works and pollution management

In 1859, the company began successfully using ammonia (distilled on site from ammoniacal liquor from the gas works at Taunton) as the main detergent for cleaning woollens before milling and finishing. Prior to this the process primarily relied upon using urine and other natural alkalis. Closure of the canal in 1866 cut off the easy means of transportation from the gas works, and with the more expensive railway now having the monopoly on carriage, the company looked for other options and soon adopted soda ash as their alkali of choice (Fox 1879b, 28-29).

In 1865 the company first adopted the 'acid process' to convert the soapy part of its refuse from wool cleansing into a saleable black grease, and by 1868 they were able to successfully distil this grease into other useful products (Fox 1879a, 16; Fox 1879b, 29). The first grease recovery plant, or refinery, (hereafter referred to as a/ the grease works), was located close to the main site at Tone Works and produced fifty tons of oil and twenty tons of stearine annually by 1879 (Fox 1879a, 16; Fox 1879b 29; Williams 2007b, 10). Wool stearine is the solid part of wool grease, extracted by distillation and chemical treatment (Scanlon 1951). Its uses include soap making, candle making and high temperature lubrication.

This initial grease works was demolished in 1882 after a flood caused oil to float into its furnace and catch fire (Fox 1933, 8). It was replaced, by 1887, with a larger grease works (HER 19940) [77], built east of the Milverton Road (B3187) in Tone. It was arranged around a central courtyard and had ten 'soap pits' [76] adjacent to it (Fig. 53, and *see* Figs 41 and 50). Pipes and aqueducts carried wastewater to

Figure 53: Extract from the coloured 1888 OS 25-inch map showing Tone Works ('Tone Mill & Dye Works') and adjacent grease works ('Grease Refinery') with its rectangular 'Soap Pits' for lanolin extraction and a channel taking wastewater to two rows of 'Filtering Pits' to the far east of the site. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

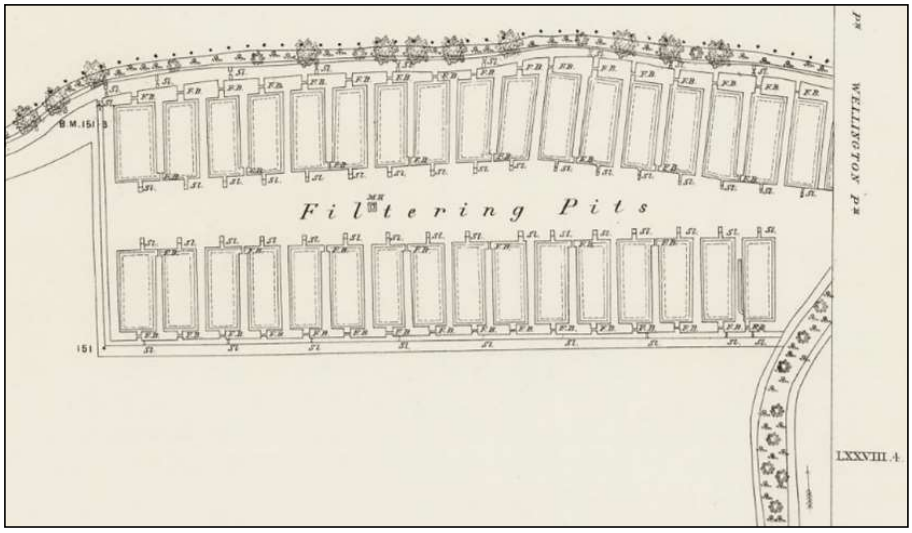

Figure 54: Extract from the OS 1:500 Town Plan of 1888 showing the two rows of filtering pits [79] with their sluices and footbridges, and the minor watercourses linked to them. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

the complex from Tone Works, while underground and overhead pipes conveyed it through the separating and settling processes (Stainer 2014, 3). Fleece scouring at Tonedale Mill also produced effluent, which was brought by pipe for treatment at the grease works which functioned as a shared processing site (Stainer 2014, 3).

When there was no saleable by-product 'natural filtration' methods were often used by the company. The 1850s catch-pits and filter beds east of the Milverton Road in Tone, were used to remove solid contaminants from 1865 onwards when adoption of acid processes meant these residues could be usefully repurposed (Fox 1879a, 16; Fox 1897b, 28-30).

In his account of the family business, Charles H. Fox (1879b, 29-30) describes how in 1877, inspired by scientific journals of the day, he became interested in the potential for light, air and freshwater vegetation to reduce impurities in contaminated water entering the river from the dye works and mill. It has been suggested that the company dug new ditches that year to enable oxygenation of the effluent (Stainer 2014, 2). In 1878 the company innovated by putting the full theory into action. The discoloured water was all pumped to higher ground at Tone, where its passage back through the natural ditches (Fox does not state whether these were new or pre-existing) and watercourses of the pasture land acted as a partial purifier (Fox 1879b, 29-30). Archive entries of 1879 and 1881 also mention the use of pottery pipes for filtering out wool flock (Stainer 2014, 4).

Despite all this, the company's pollution control measures proved largely ineffective. In 1885-6, the Fox Brothers' archives stated that '...careful examination proved the river to be far worse than we had ever dreamed. The weir causes all soap to froth into foam balls which float slowly down' (Jessop 2007, 16). Perhaps in response to this, a series of grease pits was created in 1886, almost certainly the 34 filtering pits [79] some 300m east of the Milverton Road shown in regimented rows and each controlled by its own sluice on the OS 1:500 Town Plan of 1888 (Fig. 54).

In 1891, a disagreeable smell was reported from the river, cattle were found in a very bad state and the river was 'very black' (Stainer 2014, 2-3). In 1891-2, matters came to a head when William Ashford Sandford, owner of Nynehead Court, and Stephen Bailey, tenant of Hornshay Farm, brought a High Court action against the company (Stainer 2014, 2-3). The Fox Brothers lost the case, following which it invested in new facilities for effluent treatment and the grease works was enlarged (Fig. 55).

Later developments coincided with tighter restrictions on river pollution introduced in the 20th century. Settling pits were replaced with tanks and sludge beds were created in the 1940s and 1950s (Figs 56 and 57). Effluent was treated with aluminium to form a sludge that was pumped onto adjoining land (Williams 2007c). However, in later years water discharged from the factory contained a high percentage of chromium and Ministry of Defence specification cloth was heavily mothproofed, producing poisonous effluent (Williams 2007c).

The facilities were enlarged again in the 1950s to 1960s, following another change in the law controlling river pollution, but were becoming run down in the 1970s as the woollen trade began to decline (Stainer 2014, 3). Oblique aerial photographs taken in the 1990s and early 2000s show the area around the buildings and ponds of the grease works site becoming gradually more overgrown (Figs 58 and 59).

The grease works area was redeveloped in 2009 and nothing remains of the features, but they were recorded by AC Archaeology as part of the demolition and site clearance works (Stainer 2014). The site is now reoccupied by the enlarged sewage works on the east and south-east part of the site, by the Lowmoor Industrial Estate in the north-central area, and by housing for the new Thomas Fox Road residential estate immediately adjacent to the Milverton Road (Fig. 60).

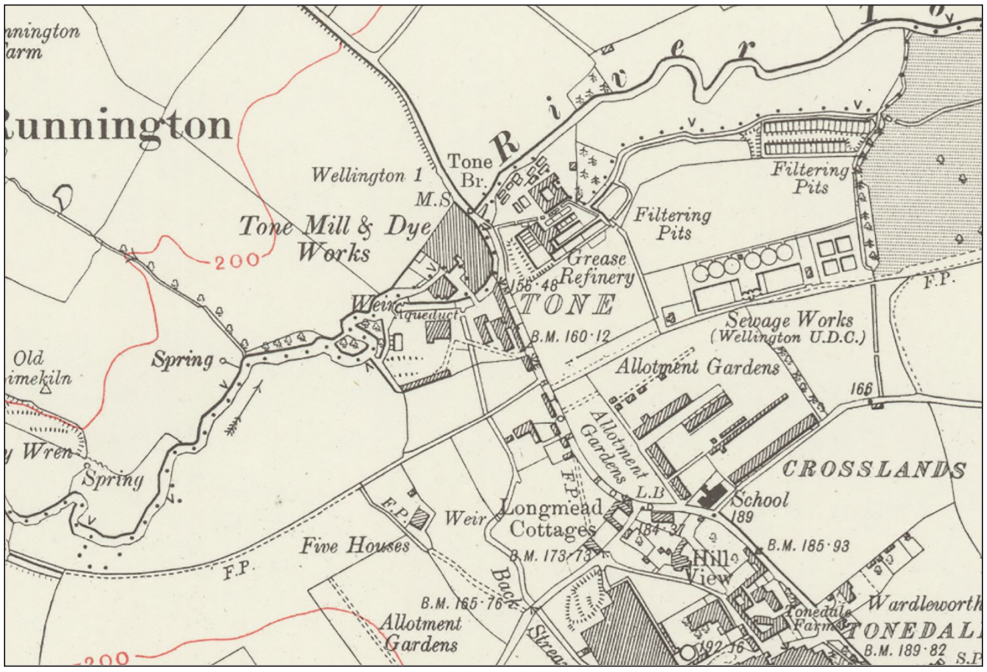

Figure 55: Extract from the coloured 1932 OS 6-inch map showing Tone Works and the adjacent grease works ('Grease Refinery') in the early 20th century, illustrating the development and expansion of the site, and the addition of the sewage works to the south of the filtering pits of the grease refinery. The canal has been infilled, but a footpath follows its north-easterly course to the south of the River Tone. Not reproduced at scale. [Reproduced with the permission of the National Library of Scotland]

Figure 56: Vertical view of Tone Works in 1946, with north at the top. The finishing and dyeworks on the west (left) of the road and the grease works with its rectangular settling tanks to the east (right). The later sewage works is located to the south and south-east. [RAF/3GTUD/UK/207/ PT1 5001 13-MAY-1946 Historic England Archive (RAF Photography)]

Figure 57: Tone Works in 1973, with north at the top. Additional long settling tanks now occupy the formerly open area to the south of the grease works (centre) and, east (right) of this, the later sewage works with its settling tanks have expanded. [OS/73039 006 29-MAR-1973 Historic England (OS Photography)]

Figure 58: Tone Works in 1993, looking east, with the already overgrown grease works in the foreground. [ST1221/351 22-JUN-1993 © Crown copyright. Historic England Archive]

Figure 59: Aerial view of the overgrown site of the grease works buildings and ponds as they were in 2003, looking east towards the Tone Works across the Milverton Road. [ST1221_83 16-APR-2003 © Crown copyright. Historic England Archive]

Figure 60: Tone Works in 2020, looking east. The site of the grease works has been developed for housing (the Thomas Fox Road estate). [HEA 33912_019 16-SEP-2020 © Crown copyright. Historic England Archive]

6.2 River Tone East of Tone Works

Immediately to the east of Tone Works, the 1839 tithe map and subsequent OS maps show the Wellington and Runnington parish boundary diverging from the river to follow a lesser watercourse [78] looping to the south and eventually re-joining the river further east (e.g. *see* Figs 40, 41, 42, 50 and 53). The placing of the parish boundary on this minor channel indicates that it was an earlier route of the river. By the late-19th century the channel had been incorporated into the grease works complex (*see* Figs 53 and 54), and by 1903 the westernmost part of it had been filled in (*see* Fig. 55), though a water-filled remnant was recorded as surviving in 2014 when the grease works survey was carried out (Stainer 2014, 6).

7. FOOTPATHS AND BRIDGES

Feature numbers given in square-brackets throughout the descriptions in this section are to aid orientation and refer to the gazetteer (Appendix A) and labelled feature location map (*see* Fig. A1) presented at the end of this report.

7.1 Footpaths

The origins of the framework of paths running through the study area appear to be much earlier than the industrial complexes that later came to utilise and expand them into a more complex network of interlacing footpaths and bridges to serve the mills and their workers.

An 'agreeable country walk' from Rockwell Green to the north end of Wellington town, 'facilitated by an excellent tarmacadam path', was said to have been made by the Fox Brothers (at an unknown date) to enable their many employees living in Rockwell Green to walk to the factory more easily and in some degree of comfort in bad weather (Hagen and Fox 2000, 26). While the tarmacadam may have been laid by the Fox Bothers, their routeways pre-date the expansion of the Tonedale operation. The main footpath predated the Basins' construction in 1801-3, since the ponds were laid out on either side of it and most, if not all, the paths in use today were extant when the tithe survey of 1839 was produced (*see* Fig. 7).

The network of footpaths between the factories and the town are likely to have much earlier origins than the tithe survey. Wellington was potentially the site of a Roman temple or shrine (Gathercole 2003, 3, 6-7), and aerial investigations have identified cropmarks indicating a number of fragmentary Iron Age or Roman settlements in close proximity to the modern town (*see* Appendix B). An Anglo-Saxon settlement was mentioned at Wellington in early-10th-century charters, and it was remodelled as a borough in the medieval period (Gathercole 2003, 4, 7-9). From its 'ford' place-name, Westford may also have Anglo-Saxon origins. Rockwell Green appears to have existed as a settlement in medieval times, from mentions of inhabitants 'atte Rowe' in 14th-century manorial court rolls (Gathercole 2003, 16). In later centuries, when the Fox Brothers and the Elworthys of Westford Mill were employing many of the local inhabitants, existing footpaths connecting these settlements would have continued to serve as thoroughfares to and from dwellings and workplaces.

7.2 Footbridges

Narrow footbridges, primarily 'blacksmith bridges', were provided to cross the watercourses at various points. These strong but lightweight blacksmith-made pedestrian bridges were built from readily available wrought iron bar and rod, manufactured for use in estate fencing of the type seen in the surrounding area. Local historian R. L. Thorne, who was active in the 20th century, reported meeting a man at the Basins who claimed that his grandfather, a blacksmith at Tonedale Mill, had made the iron footbridges and had put a date on the one at Oaken Ground [2] (Fig. 61). Thorne checked up on the man's story and found it to be largely correct,

Figure 61: Blacksmith bridge [2] at Oaken Ground, bearing the date 1831 (not visible in this image), viewed from the south-east [James O. Davies © Historic England Archive, DP347762]

Figure 62: Detail of blacksmith bridge [2] showing the incised date of 1831 on the inner side of the handrail on the north side [James O. Davies © Historic England Archive, DP347760]

though he reports the date as being 1838 (Thorne 1973, 72). The date on the extant bridge is 1831 – incised on the inner side of the handrail on the north side (Fig. 62) –, but it may otherwise be a plausible account. A series of similar bridges are found in the wider area around the factories, but the bridge at Oaken Ground is the only example shown on the Wellington tithe map (1839). By 1888, when the 1:500 OS Town Plan was produced, many other footbridges had been added. The other surviving examples do not have dates, but they are all similar in design to the bridge of 1831, albeit probably slightly later.

Figure 63: Blacksmith bridge [14] at the siphon, viewed from the north-west [James O. Davies © Historic England Archive, DP347740]

Figure 64: Blacksmith bridge [18], now crossing dry leat [10], viewed from the north-west [James O. Davies © Historic England Archive, DP347752]

Figure 65: Studholme or 'Girdle' Bridge, Nynehead (HER 36838), featured on a postcard of 1907. [Reproduced with the permission of Somerset HER, item 55429]

Six blacksmith bridges remain in situ in the open space south of Tonedale Mill, including the example at Oaken Ground [2]. Two cross the watercourses at the siphon – one over the Rockwell Green Stream [14] (Fig. 63), and the other [12] over the Basins' supply leat [10]. Another [18] crosses the dry leat close to the flood alleviation weir, while a larger bridge [15] spans the Westford Stream. At the weir north of (downstream/below) the Basins a single bridge [29] (*see* cover image and Fig. 18) survives out of three noted in 1980 when the site was visited by members of the Somerset Industrial Archaeology Society (SIAS). One of the two removed bridges [32 and 34] was donated to Rockwell Green Primary School in 1995 (HER 36840). Nineteenth-century OS maps depict further footbridges crossing the factories' waterways, some of which were almost certainly blacksmith bridges

Further blacksmith bridges (HER 36837 and HER 36838) crossed, or still cross, watercourses in the wider landscape around Wellington. One of these (HER 36838) was a larger bridge, at Nynehead, east of Tone Works, named 'Studholme Bridge' or 'Girdle Bridge'. It was designed and made by Wellington iron founder William Bishop in 1869 (HER 44406). Bishop had established himself as a blacksmith and bell hanger in North Street in 1837 and later developed his business as the North Street Iron and Brass Foundry and Machine Manufactory (HER 36462). Photographs of Studholme Bridge were made into postcards in around 1907 and 1926 (Fig. 65). By 1980 the bridge had been abandoned and it has since been removed for safekeeping and possible reinstatement by its owner (HER 36838).

Figure 66: Ornamental footbridge [50] crossing the Mill Head in the gardens of Tonedale House, September 2021 [Johanna Roethe © Historic England]

In contrast to the iron blacksmiths' bridges, an ornamental footbridge [50], with a timber deck and a decorative wooden parapet supported on metal girders, currently crosses the Mill Head, providing access between the garden at Tonedale House and the factory buildings west of the Mill Head at Tonedale Mill (Fig. 66). This bridge post-dates the tithe map of 1839, which shows the factory buildings in their early stages of development and no bridge in this position. A footbridge was present in this location by 1888 when the 1:500 OS Town Plan of the area was published (*see* Fig. 25), but the current bridge is likely to be a later replacement.

8. DISCUSSION AND CONCLUSIONS

8.1 Overview

Prior to the cloth-making activities of the Were and Fox families, Wellington's watercourses powered a series of mills dating from at least 1086. Although the exact locations of the earliest mills are not certain, later mills are likely to have made use of their pre-established water rights and infrastructure, the watercourses being modified as technologies and scales of production developed over time.

Thomas Fox's acquisition of the Were family's fulling mill and his purchase of Town Mills marked the beginning of a new industrial era for Wellington. From 1800, an overhaul of the water supply coincided with the mills' refurbishment and the beginning of mechanised production. Pre-existing waterwheel pits, and potentially other features, became part of the reconfigured system.

The water supplies to Tonedale Mill and Tone Works were separate, with Tone Works using the River Tone and Tonedale Mill relying on the relatively minor watercourses of the Westford and Rockwell Green Streams. Tonedale Mill's extensive and complex water management system secured a reliable flow of water to the mill in the face of seasonal fluctuations in stream levels and the activities of the mills upstream. The system is generally attributed to Thomas Fox, as part of his initial establishment of the Fox family's factories between 1801 and 1803, although evidence for the precise construction dates of many of its individual features is lacking.

The Wellington tithe map of 1839 shows the nascent textile mills, with the fundamental layouts of their water management systems much the same as today and major features such as the Basins, the Mill Head and other leats extant. These features remained in use as the factories expanded, some culverted beneath buildings and yards. The construction of the Bristol and Exeter Railway (B&ER) necessitated some changes to the watercourses south of Tonedale Mill, including the diversion of the meandering Back Stream.

The development of the water management system associated with Tone Works is well documented and well dated, with progressive works taking place almost continuously from the early 19th century until the mid-20th century (Williams 2013, 117). Problems with flooding and the requirement for space to accommodate the expanding factory, constrained by its position in a bend of the River Tone, prompted changes to the watercourses in 1871, when the western part of the river bend was replaced by a straight channel. Construction of the Finishing Works between 1891 and 1893 involved an overhaul of the power system and modifications to incorporate the headrace, tailrace and waterwheel pit into the new building. At the same time the present reservoir was built immediately west of the Works to supply soft water for cloth finishing processes, boilers and engines.

By the late-19th century the water systems at both mills had become increasingly complex, with the addition of boilers, pipework, underfloor conduits and multiple tanks. However, waterpower continued to be used, in combination with steam power, long after the introduction of steam engines. Technological innovations in

the 20th century resulted in further developments, such as the shift to electricity as the primary power supply for the factories and modernisation of the machinery used for textile production, all of which are beyond the scope of this study. Piecemeal development and expansion of the sites throughout the 19th and 20th centuries allowed the complex to outlive many similar factories, and the Fox family remained at the helm until the original firm closed in 1999.

The factories' impact on the environment was considerable. Effluent was discharged directly into the River Tone or leached into the river from filter pits on the meadows to the east of Tone Works. Despite various steps taken to reduce pollution from the mid-19th century onwards, the problem persisted. The engineering and controlling of local watercourses through diverting, straightening and creation of new channels, as well as sluice operations, will also have altered the water table, impacting ground water content and soil conditions. This would have changed, removed and created localised habitats for flora and fauna, impacting the overall landscape character.

In the late 20th century, concerns following flash flooding due to adverse weather led to the implementation of a flood alleviation scheme at Westford, proposed in 1986 (Taunton Dean Borough Council n.d.). The adopted 1990s scheme involved construction of an earthen dam across the Westford Stream at Westford, creating a reservoir to contain floodwater, but it also saw the modification or insertion of features downstream in the Westford Stream to Rockwell Green area in the upper reaches of Tonedale Mill's water management system [3, 4, 8, 9, 10, 11, 16, 17 and 19] (*see* section 3.2.3).

8.2 Historical and geographic context

> 'The landscape features of water-power systems ... are perhaps the earliest and most extensive physical evidence of the [South West] region's industrial history. The prolonged importance of water power ... and the continual occupation of water-power sites ... has often resulted in the complex development of leats, ponds, races and bypass channels. Water power was also closely related to the history of farming, settlement and infrastructure' (Williams 2013, 204).

Exploitation of English river systems for power and other purposes has a long history. Water systems connected with large industrial complexes – such as this one at Tone Works and Tonedale Mill – form only a relatively recent part of this longer tradition.

The earliest watermills in England date to the Romano-British period, but only a few examples are known (Reid 1959, 5-6; English Heritage 2014, 6; Alexander and Edgeworth 2018, 5, 7; Historic England 2018). There was a resurgence in water engineering from the mid-8th century onwards and, by 1086, the Domesday Book lists over 6,000 'mills' of which over 5,000 true mills are estimated, almost all powered by water (a few were powered by animals, and windmill technology appeared only in the 12th century). The implication is that river systems in England were already heavily engineered and under a high degree of control by the 11th century (English Heritage 2014, 6).

The number of water mills increased as they became important to the medieval economy (English Heritage 2014, 4). Many leats were dug in the medieval period and the right to exploit the water flowing along them was often jealously guarded and frequently a cause for controversy (Watts 2002, 127). Watermills were first used in cloth production for fulling, with fulling mills found from the late-12th century onwards (Tann 1965, 53). By the 17th century many mill sites had been established for a considerable length of time and the number of processes requiring waterpower had increased (Watts 2002, 127). The existence of the material infrastructure of milling, the heavily engineered river and leat systems, as well as the mills themselves, laid part of the foundation for the Industrial Revolution of the late-18th and 19th centuries (English Heritage 2014, 6).

The longest lasting mills sites were commonly those in the best suited locations, enabling the most efficient arrangements for delivery of water to, through and away from water-powered mills. The hydraulic system of any mill is based on certain general principles and local topography – two basic requirements being a fall of water and a relatively constant flow (Watts 2002, 127). The layouts of watercourses supplying mills thus have many variations to suit the local topography, although they share similarities. For example, a leat was commonly taken off one end of a weir built at a bend in a stream or river, so that the main flow of the stream was directed straight into the channel, as at Tone Works [73]. Long leats were often used to provide an adequate drop where the topography was relatively level. Similarly, a tailrace sufficiently long and deep was essential to get water away from the wheel at a low enough level to prevent backwatering. Sluices were placed at entrances to leats, especially in areas where flooding was likely to be a problem, to enable the flow to be regulated. With long leats and those supplying ponds it was usual to have at least one spillway channel (overspill) and a sluice near the mill to provide an easily accessible point for controlling the water level and regulating the flow, as at Tonedale Mill.

To date, no comprehensive national thematic study of industrial water management systems or their component features exists. Several core studies that focus more specifically on mill buildings elude in a general way to the allied importance of the wider watermill landscapes (for instance Reid 1959, Giles and Goodall 1992, 125-33; Historic England 2024, 13-18), but they receive relatively little consideration by comparison. However, recent work by Alexander and Edgeworth (2018) on watermill landscapes provides an invaluable review of these systems by describing their key elements and examining the factors affecting their significance and condition. The report firmly acknowledges the lack of, and clear need for, a full national resource assessment and overview to quantify the known resource, address gaps in knowledge, provide guidance on how best to record watermill landscapes and to make recommendations for successful heritage management in the face of complex interconnected threats, such as erosion, flooding, development and neglect. A key point returned to throughout their work is that in historic water management systems 'the whole is greater than the sum of its parts'. That is, while individual elements may often appear of relatively limited merit when considered in isolation, if taken together they hold intrinsic group value and add much to our understanding of the form and function of these important adapted landscapes.

As with the national situation, no overarching regional study of the water management features associated with Somerset's mills has been produced to date.

Extensive work undertaken by Martin Bodman strove to compile research relating to water-powered sites across 'Historic Somerset', but unfortunately this work was never fully completed (SHC A/AEC/2). There have been a few focused studies looking at smaller areas not far from Wellington. Work has been undertaken to collate gazetteer-style round ups of the water-powered mills of Wivelscombe, some 8km north-west of Tonedale (Bodman 2000), and for the watermills of Tiverton parish, Devon (Keene 2004). The latter in particular looks at the area's early fulling mills and dye houses and their interconnected waterways, but neither study drills down to describe or consider individual components. Beyond these, there has been some study of the historic water management systems within inland waterways – primarily within the catchment of the rivers Kennet and Bristol Avon, but also citing examples from across England (Firth 2014), – and two notable accounts by Jennifer Tann (1965 and 2012) have examined the history and layout of water systems supplying Gloucestershire's woollen mills.

Further afield, the *Power in the Landscape* project has studied the extensive waterpower systems associated with the early textile industry of the Upper Calder Valley in West Yorkshire (Power in the Landscape 2007; Wyatt 2007). Particularly useful is an appraisal looking at historic water management assets in South Yorkshire, which identifies the physical nature of the extant features, uses principles of heritage value to assesses their significance, and considers their sensitivity and vulnerability (ECUS 2016).

While these various studies describe water management complexes which are broadly comparable with those at Tonedale and Tone Works, and can provide helpful background and comparison, detailed studies of water management systems of equivalent extent and nature are not currently available.

The complex of managed waterways and factory buildings of Tonedale Mill and Tone Works also plays a part in the rich industrial legacy of West Somerset. Several extant aspects of the 18th- and 19th-century investments and developments survive in the surrounding area, for example 1.5km east of Tonedale are the Grade II-listed remains of a canal lift and an aqueduct on the former Grand Western Canal, west of Nynehead Road near Poole.

8.3 Integrity and distinctiveness

The individual components of the systems at Tonedale Mill and Tone Works are relatively common, although the water management system as a whole is an important survival. The comparative completeness and integrity of the watermill landscapes and waterways around Wellington gives the component features a form of group value. This, alongside the system's overall good survival, historic importance and communal value in terms of distinctiveness and sense of place, contribute strongly to the importance of the whole. Prior to the 1990s, the water management system appears to have seen little change other than adaptions, additions and improvements made by the factories themselves, and so the overall interconnected system remains a largely readable and unfragmented heritage asset. Nevertheless, some parts are now damaged, degraded or redundant, either where aspects were added or altered to aid flood alleviation schemes for Westford in the late 20th century, or where disuse has led to deterioration over time. Sensitive repair

or modification may be required in places to bring features back into working order or to help balance the hydrological needs of the wider system.

The interconnected features, channels and footpaths of the water management system for the factories hold clear communal value by playing a continuing role in how local people use and enjoy these green spaces and routeways away from roads. Current use includes access between housing estates and to local schools, as well as leisure. The paths are well trodden by dog walkers and the pairs of mill ponds known as the Basins are particularly popular as an attractive and nature-rich location for recreational visits and fishing. The history and former function of the landscapes is still articulated through this series of well-used routes to and through the area, contributing strongly to the sense of place and local distinctiveness. In this way the landscape contributes to the connectivity-themed aspirations of the wider Wellington Place Plan (Somerset West and Taunton Council 2023), such as linking up with a long-distance greenway along the former canal route between Taunton and Greenham. Additionally, the character and continuity of these linkages through the landscape contribute positively to the setting and understanding of the factory buildings themselves, several of which are listed buildings.

The simple but distinctive iron footbridges are one highly visible element of the factories' network of paths through the wider landscape that are still used and valued today. They are notable examples of a once common type of bridge that has been routinely replaced, owing in part to them being a poorly recognised and often unregarded feature class (Disley 2021, 16). The surviving group of small iron footbridges enhances the historic character of the public footpaths upstream (south) of Tonedale Mill. They are vulnerable to issues such as corrosion, distortion or removal, and would benefit from careful recording and maintenance. Dick Nunn's Bridge, a more elaborate and well-documented example in Essex, has recently been listed at Grade II (NHLE 1471715) (Disley 2021).

The most notable aspect of the integrated water management system at Tonedale and Tone Works is not a specific type of feature or particular part of the site, but in its overall integrity, coherency and survival. As a whole, it articulates the intentional construction of a complex and effective 'designed' industrial landscape, adapting the existing topography and hydrology through considerable effort and planning to meet the needs of the business. Added to this, few examples survive elsewhere with such good documentation and working local knowledge, held through the long connections of the Fox Family and articulated through numerous published personal accounts and the recent short documentary film (McCluskey 2022).

9. HERITAGE CONSERVATION

A lack of research into historical structures within inland waterways in general is reflected in archaeological records. Riverine structures are generally mentioned only in passing within accounts of other features, or not recorded at all. They are commonly not indexed by their feature type and hence are not retrievable in database searches. A search of the Somerset HER for 'weir' as a 'site type' recovered just five results and none of the weirs at Tonedale were among them, although a single record for the water management system does exist (HER 36840). Similar searches returned ten 'sluices' and one 'sluice gate'. Leats have been recorded more comprehensively, with 55 examples. A more comprehensive record of these historic assets would improve understanding and aid future management decisions. At present, the review by Alexander and Edgeworth (2018) provides the most useful account of the current understanding of watermill landscapes – their nature, the threats they are under, and how we might aspire to better record and manage them – but, by their own recommendations, a bigger targeted study would be welcomed.

In terms of heritage protection by listing or scheduling, water management features do not fit easily into the categories of archaeological remains or historic buildings. While many of the buildings at Tone Works and Tonedale Mill are listed (*see* Table 1), the water management features beyond the buildings have no statutory protection and do not fall within the Conservation Area that covers Wellington's historic centre. Although little guidance exists to aid the assessment of water management features – either individually or as an integrated system – HE's Listing Selection Guide for Industrial Buildings does clearly highlight that as component features, they can add considerable weight to the overall importance and integrity of historic mill complexes (Historic England 2017, 18). Added to this, HE's overview of watermill landscapes provides a useful assessment of the current understanding, resources and issues relating to these features and systems (Alexander and Edgeworth 2018).

9.1 Issues and opportunities

Historical features within rivers are under threat. Their locations make them susceptible to erosion by water, particularly once they fall out of use and are no longer maintained or monitored. In addition to general erosion and decay, the increasingly common occurrence of severe flooding events can also force larger and faster bodies of water through channels not designed to carry such flows. Flood waters also often carry debris that can cause extra impact-damage to historical structures as well as silting up through deposition. Conversely, drought and water abstraction (removal) can also have negative effects on the fabric of individual features or the working potential of the whole system. These increasingly apparent impacts of Climate Change pose numerous challenges for future management of heritage assets on (and often submerged within) inland waterways. These types of feature are also under pressure from plans to modify or remove them (Firth 2015, 235; Alexander and Edgeworth 2018, 45-56). Historic water management systems can face threats such as river or channel management, change in agri-environment agreements and the management of adjacent land (such as eradication of water features for agricultural improvement), development pressures, neglect (such as

excessive vegetation growth causing root damage to structures), initiatives to benefit wildlife (such as weir removal, creation of scrapes, channel adaption) or adaption for sustainable hydroelectric energy capture.

The survival of the water management features associated with Tonedale Mill and Tone Works – relatively complete and associated with nationally important mills charting the development of England's early woollen manufacturing industry – is thus fortunate and highly unusual. They form a highly visible element of the factories' history, reaching into the landscape beyond the buildings and accessible from Wellington town centre by public footpaths. While being good examples of their type, the component parts of the systems are also clear examples of features which are currently under threat. The issues and opportunities linked to individual physical elements may be multi-faceted and vary greatly between features and areas. More visible aspects of the system have a more tangible impact on the aesthetics and character of the area, often benefitting the overall sense of place. However, many parts of the system face complex degradation, repair and maintenance requirements. Some elements are more crucial to the hydrological operation of the whole system than others or may present more complicated challenges to carefully balancing the hydrological needs of the wider local area.

Weirs, perhaps the most striking landscape features associated with mills, are under the greatest threat (Stoyel 2015, 10). They are also one of the most widespread forms of channel modification, regulating flows usually to provide a head of water for power generation or to aid navigation (Howard et al. 2017, 3). Their construction, particularly in the north and west of Britain, has often been associated with industries such as textiles, chemicals, and mining (Getzler 2006, 22). Despite their relatively frequent occurrence, there has been little synthetic or thematic treatment of them at either a regional or national level (Riley 2015, 16). Removal of weirs is commonly advocated as a river restoration measure since they can impede the passage of migrating fish and prevent downstream movement of silt. Weir removal is a proposed River Basin Management Plan (RBMP) action for achieving the Water Framework Directive (WFD) of reaching Good Ecological Status for river ecosystems (Shaw et al. 2010, 127).

9.1.1 Modern hydropower

Hydropower schemes, which contribute to the UK government's sustainable energy targets and are generally positive in aspiration, can similarly involve removal of weirs, or insensitive modifications to them. In 2010 there were an estimated 25,935 barriers across rivers in England and Wales with potential to produce hydropower. A significant number of these may be predicted to be historic weirs (Howard et al. 2017, 3). Consultations on sensitivity of changes relating to hydropower appear to be largely restricted to species and habitat considerations related to Special Areas of Conservation (Howard et al. 2017, 3), although the heritage implications have been highlighted in guidance published by English Heritage in 2014, and more recently in the synthesis by Historic England (Alexander and Edgeworth 2018).

In the early 2000s, the South Somerset Hydropower Group (SSHG) – formed by owners of a group of historic mills in south Somerset – investigated the potential to use their mills to generate electricity using sensitively installed compact hydropower

units (micro-hydro) (Lacey 2004). They estimated that there are some 40,000 mill sites across the UK where small scale hydro might be viable, with especially high potential in South Somerset and South West England. The aspirations (supplying green electricity to the mill and its local community) and installations of micro-hydro units using existing mill machinery won them an Ashden Award in 2005 (Ashden 2023). While this example shows the undoubted benefits of such schemes in bringing new purpose and energy self-sufficiency to important historic buildings and related infrastructure, it also highlights the growing interest in this area of sustainable development, raising the need for thoughtful consideration of the adaption, or avoidance, of historic fabric and features. Work by Thread Architects (2021) assessed the sustainability potential of the Tone Works site including options for micro-hydro, and the newly adopted Wellington Place Plan (Somerset West and Taunton Council 2023) lays out sustainability objectives such as developing community-based local energy generation. This could include (re) harnessing power from the local waterways and, if taken forward, would require thoughtful consideration of the historic fabric.

9.2 Recommendations

> 'The archaeological potential of water power in the region is considerable but has not yet been fully assessed. The subject could add significantly to the understanding of the importance of industry in the history of land use' (Williams 2013, 204).

This statement was published a decade ago in relation to the textile mill industry in the South West, but still rings true. Water power systems remain an important but understudied archaeological resource. The first step towards increasing recognition and understanding of these 'designed' industrial landscapes would be to ensure that known examples are adequately recorded (Alexander and Edgeworth 2018, 57-66).

9.2.1 Monitoring and recording

Water management at Tonedale pre-dates the factories' construction, but little is known of the history of the sites prior to their development by Thomas Fox from the 1790s onwards. Detailed recording of the surviving elements of the water system, combined with a more in-depth study of archives may reveal further information.

The remains of earlier structures may exist within or below the later buildings at Tonedale Mill and Tone Works. Archaeological monitoring by watching briefs during alterations or repair work to the buildings will provide additional opportunities to examine whether traces of earlier structures have survived subsequent river and leat alterations and mill developments. It is recommended that archaeological watching briefs be considered for all aspects of work that involve demolition, excavation, replacement of ground floor structures or alterations to walls, to minimise disturbance and allow archaeological recording to take place.

The water management features beyond the mill buildings would benefit from further recording and detailed records will be essential for future monitoring and conservation purposes, as well as interpretation. Descriptive records, photographs,

large-scale plans and measured drawings of individual features would be of great value, as well as archaeological monitoring or input where any significant works are due to take place.

The culverted parts of the systems have remained largely unexplored due to their inaccessibility. Examination of the major culverts could confirm their routes and provide information about their structure and condition, as well as aid their management and the management of wider site hydrology through potential re-use. This could be undertaken using remote camera technology. Priority features include the headraces, tailraces and cross culverts linking the Mill Head with the Back Stream at Tonedale Mill. At Tone Works, close inspection of the culverted head and tailrace is needed to ascertain if any early-19th century features survive or if its route was altered in the late-19th century (Williams 2007b, 40). Examination of the open leats below the waterline may also provide information about their construction and any potential lining material.

Although earlier work involved in-depth architectural research, some of the mill buildings were not examined fully. In 2007, for example, when English Heritage staff investigated Tone Works, access to some of the site was restricted due to asbestos contamination. Asbestos has since been professionally removed and an architectural investigation to examine these buildings, including any water management features within them, would assist in establishing their uses of water and any interconnections between minor culverts. Architectural examination of portals leading into the buildings would also be beneficial to investigate where water was being used, for what purpose and the potential for the existence of additional waterwheels. The condition of the buildings previously visited has changed since the architectural evaluations carried out in the 1990s. An up-to-date report on which elements previously recorded remain in situ and which no longer survive would be valuable, particularly for Tonedale Mill.

9.2.2 Documentary research and local engagement

Previous studies of the mill sites by the RCHME, English Heritage and Historic England have examined some of the archival records, particularly those relating to the buildings, but they may contain further detail about water management at the mills, such as dates for the construction of individual features, alterations and repair work. The reasons for changes to the system may also be explained. At present, archival material relating to the company and mills of Fox Brothers are dispersed. The main company archive is held by Fox Brothers & Co. Ltd at Tonedale Mill, it may have been catalogued in 1988 by the Royal Commission on Historical Manuscripts but no further information about that index has yet been identified. Other records are held at Uffculme (Coldharbour) Mill, at Somerset Archives and potentially elsewhere, including some documents held by Jack Hudson, a former company director (Williams 2007a, information from SIAS). A more detailed study of the Fox Brothers' archive would be highly beneficial as part of any future programme of research.

The Fox Brothers' factories were major employers in Wellington and many older people in the town remember the factories when they were still operating. An oral history project would be valuable in order to capture these memories for posterity, for greater understanding, for future site presentation and for public outreach.

9.3 The future: heritage-led regeneration

The historical significance of the mill landscape as a whole – one of the best-preserved historic textile complexes in the country – has been firmly established by numerous investigations of the factory buildings and company legacy, and through this assessment of its integrated water management systems.

The difficulties of balancing development pressures and opportunities with sensitive conservation of the range of historic features across the factory sites and their water system landscape are numerous, but investigation, analysis and recording has provided baseline understanding to help inform and underpin efforts to secure positive prospects for the site. The distinctive character and form of this important industrial 'designed landscape', with its familiar waterways, structures and paths, as well the prominent factory buildings themselves, present positive opportunities for local regeneration schemes to enhance and reflect this tangible and embedded history to build a strong sense of place. Conservation programmes elsewhere have demonstrated that embracing the core heritage value of a place is a vital start point in the process of successful heritage-led regeneration of industrial sites. Likewise, – and with an acceptance of necessary renewal, maintenance and sometimes modification – managing the watermill landscape all together, rather than as a series of discrete entities, would facilitate the best outcome for the surviving water management systems for Tonedale Mill and Tone Works.

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APPENDIX A - GAZETTEER OF FEATURES

This gazetteer presents individual features (extant and lost/removed) relating to the water management systems of the interlinked woollen mills of Tonedale Mill and Tone Works near Wellington in Somerset. Feature numbers run from 1 to 81 and correlate to locations starting in the south-west of the study area then move roughly north-east. Thus, flowing approximately from the features located furthest upstream, and on towards the factory complexes and then beyond into the effluent management and grease recovery areas downstream of Tone Works.

Where known, approximate dates for the construction or alteration of individual features are outlined, but due to the difficulty in confirming precise dates for the individual elements, it has not been possible to produce meaningful dates for all aspects of the water management system. Future documentary investigation or discoveries may enable further refinement of this.

To aid orientation for the reader, features numbers can be cross-referenced with Figure A1 (found at the end of this gazetteer). Many of the features are also noted within the description chapters of the main body of this research report, where they appear in square-brackets.

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
1	Channel	ST 12720 20366	Rockwell Green Stream	Yes	Rockwell Green Stream, upstream from the blacksmith's footbridge [Feature 2], sides retained with stonework for around 50m.
2	Blacksmith bridge	ST 12711 20424	Oaken Ground footbridge	Yes	Blacksmith bridge, crossing the Rockwell Green Stream at Oaken Ground. Wrought iron footbridge with the date 1831 engraved on lower bar near the midpoint. The only blacksmith bridge at Tonedale with a date. It is earlier than the other surviving foot bridges. *p27, 64-5, 67.*
3	Weir	ST 12682 20443	-	Yes	Low concrete weir on a sharp double bend in the Rockwell Green Stream. Upper part funnels water through a central notch. Apron below with three low steps (possibly stonework), about 10m long. Adjacent stream banks stone-lined with distinct sections and straight joints visible. No sluices, but a vertical line in the stone revetment of the stream bank.

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					may be a filled-in sluice setting Date of concrete part unknown, but perhaps connected with the Westford flood alleviation work in the 1980s/90s, since it impounds water for the Basins' supply leat. However, the Rockwell Green Stream appears to have been impounded here and split into two channels by 1839 (Tithe Map) indicating a weir was already in place. *p27-8, 70*
4	Sluice	ST 12678 20441	-	Yes	Modern metal and concrete sluice on the Rockwell Green Stream. Situated at the entrance to a brick-lined culvert now supplying the Basins, via the Siphon, following 1990s flood alleviation work. *p21, 27, 70.*
5	Channel	ST 12635 21644 – ST 12575 20628	-	Yes	Channel depicted on Wellington tithe map, 1839, from Oaken Ground weir to the canalised Westford Stream.
6	Channel	ST 12677 20443 – ST 12663 20637	Rockwell Green Stream	Yes	Rockwell Green Stream from the weir [Feature 3] to the siphon [Feature 13]. Steep-sided, straight, earthen channel about 3m wide by 1m deep.
7	Portal	ST 12514 20565	(beneath a 'magic tree')	Yes	Small drystone arch embedded in tree roots on south bank of the Westford Stream. Known locally as a 'magic tree'. Situated at end of a channel from allotments to the south. Probable drain outlet.
8	Weir	ST 12559 20620	-	Yes	Concrete weir blocking the Westford Stream and diverting its flow into the Railway Back Stream. Constructed in the late 1980s as part of the Westford flood alleviation scheme. *p25-6, 70.*
9	Sluice	ST 12568 20630	-	Yes	Red brick slot, hatches missing, on the Basins feeder channel [Feature 10]. Post-dates the Wellington Tithe map (1839) but pre-dates the OS 1:500

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					Town Plan of 1888. Controlled flow of water from the Westford Stream into the channel. Now dry following Westford flood alleviation work in 1990s. *p22, 25, 70.*
10	Channel	ST 12566 20630 – ST 12761 20757	-	Yes	A leat from the Westford Stream [at Features 9 and 17] to the Waterfall Weir [Feature 25]. Constructed post-1839 and pre-1888, replacing Feature 22. Initial section from the Westford Stream to the siphon [Feature 13] is a straight earthen channel of regular V-shaped profile, 2m wide at the top, 0.7m deep and about 0.5m wide at the base. No indication of revetment or lining material, except a line of metal posts running for about 2m along the south bank. This part is now dry following Westford flood alleviation work in 1990s. Second part, from the siphon [Feature 13] to the Waterfall Weir [Feature 25] is a straight channel with a regular profile and fragments of stone revetment in its banks. Measures about 1m wide at the bottom and 2.5m wide at the top – trapezoidal in profile – approximately 1m deep. *p17, 19, 21-22, 25, 27, 67, 70.*
11	Portal	ST 12656 20635	-	Yes	Portal beneath a 'magic tree' immediately west of the siphon [Feature 13]. A piped water supply issuing from this now passes through the siphon, following Westford flood alleviation work in the 1990s. *p70.*
12	Blacksmith bridge	ST 12658 20637	-	Yes	Blacksmith footbridge crossing leat [Feature 10]. Not shown on the Wellington Tithe Map of 1839 or early OS map editions. First shown on OS maps on the 1930 25-inch edition. *p67.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
13	Culvert	ST 12664 20639	The Siphon, The Boiler	Yes	Large pipe in the Rockwell Green Stream bed, carrying the Basins' feeder leat [Feature 10] underneath the stream (from the portal at Feature 11). Post-dates the Wellington Tithe Map of 1839, but extant by the time of the OS 1:500 Town Plan of 1888. Originally constructed from a repurposed ship's boiler. *p21.*
14	Blacksmith bridge	ST 12664 20640	-	Yes	Blacksmith footbridge crossing the Rockwell Green Stream just north of The Siphon [Feature 13]. A larger, modern, bridge carries the main footpath over the stream. Not shown on the Wellington Tithe Map of 1839 but pre-dates the OS 1:500 Town Plan of 1888. *p66-7.*
15	Blacksmith bridge	ST 12544 20597	-	Yes	Blacksmith bridge crossing the Westford Stream. Larger than the others. Situated upstream from the concrete weir [Feature 8]. Date uncertain, but probably mid-19th century. *p67.*
16	Channel	ST 12558 20622 – ST 12549 20643	-	Yes	Short length of channel constructed as part of 1990s flood alleviation work to re-route the water flow from the Westford Stream into the Railway Back Stream. *p25, 70.*
17	Sluice	ST 12565 20632	-	Yes	Concrete settings for hatches of a double sluice on by-pass stream before entry to the Basins feeder leat [Feature 10]. Now dry following 1990s Westford flood alleviation work. *p21, 25, 70.*
18	Blacksmith bridge	ST 12576 20631		Yes	Blacksmith footbridge across west end of leat [Feature 10]. The leat and hence the bridge post-date the Wellington Tithe

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					Map of 1839, but both were extant on the OS 1:500 Town Plan of 1888. *p67.*
19	Channel	ST 12565 20633 – ST 12657 20655	Westford Stream	Yes	Westford Stream, canalised section roughly parallel with Basins feeder leat [Feature 10]. Irregular channel with earthen banks. Dry following Westford Green flood alleviation work of 1990s, when flow was diverted into the Railway Back Stream [Feature 23]. *p17, 19, 21, 25, 27, 70.*
20	Sluice	ST 12657 20656	-	Yes	Sluice setting on Westford Stream at its confluence with the Rockwell Green Stream. Top of a buried concrete sluice board slot visible. *p21-2.*
21	Channel	ST 12657 20657 – ST 12657 20672	Rockwell Green Stream	Yes	Stone-sided stretch of the Rockwell Green Stream following its confluence with the Westford Stream.
22	Channel	ST 12659 20684 – ST 12753 20764	-	No	Narrow channel running alongside northern bank of the Westford Stream [Feature 19]. Pre-1839. Replaced by new leat to the south [Feature 10] before 1888. *p17, 21.*
23	Channel	ST 12545 20603 – ST 12667 20837	Railway Back Stream	Yes	Channel constructed around 1843, to divert the meandering upstream course of the Back Stream (north-east of Westford) away from the new Bristol to Exeter railway line. *p19, 21, 25.*
24	Sluice	ST 12764 20760	-	Yes	Brick-built sluice with a concrete slot (board missing) in the Waterfall Weir [Feature 25]. To transfer surplus water from the Mill Head, with a fall of about 1.7m into the overflow channel. *p20.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
25	Weir	ST 12763 20758	The Waterfall Weir	Yes	Weir known locally as the 'Waterfall Weir', situated where the Basins' feeder leat [Feature 10] passes close to the overflow channel [Feature 27]. Of red brick with two outlets – a lower outlet containing the concrete setting for a sluice board and a higher setting with no apparent sluice, total fall of 1.4m. Its function was to remove surplus water from the Basins' feeder system or to stop the flow to allow for maintenance work. It may also have been used to divert water past the Basins and prevent them silting when the stream was muddy (R. Fox pers comm). *p17, 19-21.*
26	Channel	ST 12767 20756 – ST 12871 20813	-	Yes	Leat from Waterfall Weir [Feature 25] to the Basins [Feature 37], about 6m wide with vertical earthen banks. Embedded fallen trees indicate a shallow depth, perhaps less than 1m. Slow flowing and no flow control at inlet to north Basin visible at time of field visit in March 2022. *p17, 19, 21.*
27	Channel	ST 12762 20762 – ST 12928 20845	Back Stream	Yes	Watercourse parallel with north side of the Basins. About 3m wide with vertical earthen banks, no revetment visible, but stabilised in places with sandbags. Parallel to the Basins feeder leat [Feature 26] but at a lower elevation, separated from it only by an earthen bank. *p17, 19, 21-2.*
28	Sluice	ST 12936 20864	-	Yes	Southern of two brick-built sluices in the weir below the Basins [Feature 30]. For transferring surplus water from the Mill Head to the Back Stream. Crossed by a blacksmith's footbridge [Feature 29]. *p22, 24-5.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
29	Blacksmith bridge	ST 12936 20864	-	Yes	Blacksmith footbridge crossing sluice [Feature 28] on the Mill Head [Feature 39]. Has a single handrail. The Somerset Industrial Archaeology Society (SIAS) reports that in c1980 there were three wrought iron footbridges here, one of which was donated to Rockwell Green Primary School in 1995. The bridges may have been erected in the late 1860s by the same manufacturer who made similar, but larger, bridges nearby (HER 36837 and 36838). *p24-5, 67.*
30	Weir	ST 12937 20874	-	Yes	Weir below the Basins. Constructed of brick and stone, with most of the stone in its lower parts, suggesting that the brickwork was later repair or alteration. Contains two sluices [Features 28 & 33] which transferred water from the Mill Head into the overflow channel [Feature 31] 1.4m below. The OS 1:500 Town Plan of 1888 shows details of the weir, its sluices and footbridges. Weirs are not depicted on the Tithe Map, but the junction between watercourses appears as today, so a weir in this position is likely to have existed before 1839. *p22, 24-5.*
31	Channel	ST 12935 20867 – ST 12873 20983	-	Yes	Channel from the weir [Feature 30] below the Basins, taking surplus water from the combined Westford and Rockwell Green Streams to the Back Stream. Shown on the Wellington Tithe Map of 1839. *p22.*
32	Sluice; Blacksmith bridge	ST 12942 20875	-	No	A sluice with a footbridge over it is shown on the OS 1:500 Town Plan of 1888 crossing the Mill Head immediately north of the weir [Feature 30] below the Basins. Still shown on OS large-

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					scale mapping of 1969, but both gone by 1984. Probably one of three wrought iron footbridges seen by the SIAS in c1980. *p24, 67.*
33	Sluice	ST 12938 20874	-	Yes	Northern of two brick-built overflow sluices in weir [Feature 30] below the Basins. Its entrance has been blocked. *p22, 24.*
34	Blacksmith bridge	ST 12939 20873	-	No	Metal footings are the only surviving part of a probable blacksmith bridge crossing the northern sluice [Feature 33] at the weir below the Basins [Feature 30]. *p24, 67.*
35	Bridge	ST 12937 20855	-	Yes	Road bridge crossing the Mill Head and Back Stream immediately north of the Basins. Brick arch reinforced by the insertion of a concrete pipe running under its centre. It is the western of two road bridges carrying Corams Lane/Linden Drive across the watercourses. Both were extant in 1888 and are shown on the Tithe Map.
36	Sluice	ST 12931 20840	-	Yes	Discharge sluice in northern pond of the Basins. Regulated the water level in the ponds. A concrete post slot for the hatch remains, but the gate lifting mechanism has been removed, leaving the hatch (known locally as a 'fender') shut. The hatch released water from the ponds into the Mill Head about 2.5m below. A concrete slab serves as a footbridge across the outlet and a pair of iron girders brace the the top (one dated 'P S 20.2.79' and the other marked 'Buttles Folly →'). The opening is brick and stone, with evidence of much repair and reworking. *p22, 24.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
37	Pond	ST 12932 20808	The Basins	Yes	The Basins. Two large ponds (0.84a and 0.38a in area) separated only by a causeway carrying a footpath. The northern/largest, had an original depth of about 2m. Part of Thomas Fox's initial work of 1801-1803. They were dug out by hand and a footpath ran through the field, so one pit was dug each side of the footpath (Thorne 1972, 71). *p16, 19, 23.*
38a	Bridge	ST 12856 21091	Thunder Bridge	Yes	Metal girder railway bridge on red-brick abutments of c1843 carrying the Bristol and Exeter Railway over the Back Stream [Feature 40]. The bridge invert (stream bed under the bridge) is paved with sets, and a waterside footpath running beneath the bridge also has stone sets or cobbles covered with a modern surface.
38b	Bridge	ST 12835 21116		Yes	A short distance upstream (north) of 'Thunder Bridge [Feature 38a] this is a low red-brick segmental arch bridge across the back stream.
39	Channel	ST 12942 20869 – ST 12891 21336	The Mill Head	Yes	Mill Head from the Basins to Tonedale Mill. A shallow earth-cut channel some 1.5m wide north of the Basins. Widens significantly on its approach to Tonedale Mill, forming a mill pond. *p22, 28-9.*
40	Channel	ST 12845 21102 – ST 12809 21334	Back Stream	Yes	Section of the Back Stream leading north from the railway line and through into Tonedale Mill. *p28-0, 35, 39, 44-5.*
41	Pond	ST 12848 21250	Bathing Pool	No	Bathing pond, Tonedale Mill. Constructed after 1842 and before 1877. Occupied a former meander in the Back Stream [Feature 52]. Filled in and

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					covered by a woollen waste store in the mid-20th century. Clearly depicted on the OS 1:500 Town Plan of 1888. *p29, 38.*
42	Sluice	ST 12821 21321 (centre of trio)	-	Yes	Three sluices on the north-eastern side of the Back Stream at Tonedale Mill depicted on the OS 1:500 Town Plan of 1888. One of these sluices may have been the entrance to the culvert [Feature 49] supplying the blacksmith's waterwheel at Tonedale Mill.
43	Weir	ST 12807 21338	-	No	Weir on the Back Stream at Tonedale Mill. Shown on the tithe map of 1839 and the OS 1:500 Town plan of 1888. The stream was culverted from this point northwards by 1888. Purpose appears to have been to divert water into the factory [via Feature 45]. *p29, 35, 39.*
44	Waterwheel; Waterwheel pit	ST 12833 21330	Blacksmith's waterwheel	Yes	Secondary wheel pit within Tonedale Mill. Waterwheel powered by the Back Stream served adjacent workshops erected between 1839 and 1888. *p36-7.*
45	Channel	ST 12807 21339 – ST 12819 21355	-	No	Channel leading into the factory from a weir [Feature 43] on the Back Stream [Feature 40] at Tonedale Mill. Shown on the tithe map of 1839. *p29, 35, 39.*
46	Culvert	ST 12826 21337 (centre)	-	Yes	Tailrace from the Blacksmith's waterwheel pit [Feature 44] *p37-8.*
47	Waterwheel; Waterwheel pit	ST 12859 21352	-	Yes	Tonedale Mill main waterwheel chamber. Probably reconfigured at the beginning of the 19th century from an earlier feature. Originally housed a smaller wooden waterwheel, replaced with a 30ft cast iron waterwheel, which was removed in 1904. *p31, 33, 34.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
48	Culvert	ST 12891 21337 – ST 12866 21364	The Mill Head	Yes	Mill Head at Tonedale Mill. Pre-1842 it was an open channel, culverted by 1888. Passes beneath buildings and under a yard, where it turns west at a right angle to enter the wheel chamber in the fireproof mill of 1823.
49	Culvert	ST 12837 21314 – ST 12827 21330	-	Yes	Culvert from the Back Stream at Tonedale Mill to the Blacksmith's waterwheel [Feature 44]. Recorded by Westcountry Access Ltd (Craven 2007). *p36-8.*
50	Bridge	ST 12913 21320	-	Yes	Metal and wooden ornamental footbridge across Mill Head from Tonedale House. Not present on Wellington Tithe Map of 1839, but a bridge in the same place shown on OS 1:500 Town Plan of 1888. Current bridge is likely to be a later replacement. *p68.*
51	Culvert	ST 12889 21333 – ST 12851 21306	-	Yes	Culvert from the Mill Head to the Back Stream through Tonedale Mill. Shown as an open channel on the Wellington Tithe Map of 1839, culverted beneath buildings by 1888 (OS 1:500 Town Plan). *p28-9, 31-2, 38.*
52	Channel	ST 12834 21231 – ST 12843 21300	Back Stream	No	Former bend in the Back Stream at Tonedale Mill. Straightened at some point between 1839 and 1888, when a bathing pond [Feature 41] was constructed *p29, 32.*
53	Culvert	ST 12933 21258 – ST 12868 21237	-	No	Channel taking water from the Mill Head to the Back Stream, south of Tonedale Mill. An open channel on the Wellington Tithe Map of 1839. By 1888, the east end formed part of Tonedale House's ornamental garden, with west end culverted.

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					Survived as a drain but has recently been covered in earth and rubble and was no longer visible in 2021. *p28-9, 30.*
54	Culvert	ST 12856 21355 – ST 12648 21598	Tonedale Mill tailrace	Yes	Tailrace at Tonedale Mill. Pre-1842 open channel and culvert, later entirely culverted beneath weaving sheds. *p28-9, 34-5, 39.*
55	Pond	ST 12781 21429	-	No	Pond at Tonedale Mill shown on Wellington Tithe Map of 1839. Area covered by weaving shed by 1888. *p29, 39.*
56	Channel	ST 12807 21390 – ST 12685 21635	-	No	Channel leading north from Tonedale Mill to the wharf. Parallel with and to the east of the tailrace [Feature 54]. Depicted on the Wellington tithe map of 1839, but no longer extant. Uncertain purpose. *p29, 34-5, 39.*
57	Weir	ST 12629 21563	-	No	Weir on the Back Stream north of Tonedale Mill, immediately below the entry point of a channel [Feature 59]. Shown on current OS large-scale mapping but no trace found during field inspection (Jan 2022). Probably extant by 1839, when the Wellington Tithe Map shows the same configuration of channels. *p42.*
58	Sluice	ST 12527 21635	-	No	Sluice depicted on OS 25-inch map of 1888 at the junction between the former canal route and a channel [Feature 59] leading from the River Tone to the Back Stream. Possibly for filling the canal. No remains found on a field visit in Jan 2022. *p42.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
59	Channel	ST 12492 21740 – ST 12625 21568	-	No	Channel from River Tone to weir on Back Stream. Extant before 1842. Still present on OS 25-inch map of 1904 but mostly filled in by the 1930 edition. It carried water south from a bend in the river and entered the Back Stream above a weir [Feature 57]. It had no direct link with the Fox Bros factories and may have supplied water to the canal. No trace of it was found on a field visit in Jan 2022. *p39, 41-2, 44-5.*
60	Bridge	ST 12635 21644	-	No	Footbridge crossing the Back Stream behind Wharf Cottages, potentially a blacksmith's footbridge. Shown on the OS 1:500 Town Plan of 1888, but it no longer survives. *p45.*
61	Wharf	ST 12661 21761	-	No	Wharf on the Grand Western Canal. Owned by Henry Fox in 1839 (Wellington tithe apportionment). Cleared away following the canal's closure in 1863. *p39-40, 44.*
62	Channel	ST 12612 21684 – ST 12590 21759	Back Stream	No	Former meandering course of Back Stream, south-west of Tone, depicted on 1839 Tithe Map. This stretch had been straightened out at some point between 1095 and 1930. *p39, 44-5.*
63	Channel	ST 12526 21796 – 12581 21799	-	Yes	Short cut channel at Tone Works. Constructed in 1871 when natural bend in the River Tone was removed. *p45, 51.*
64	Channel	ST 12472 21752 – ST 12502 21780	River Tone	Yes	River Tone west of Tone Works. Former course was meandering and included a small island mentioned in 18th-century documents. Straightened in late-20th century. *p44-6.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
65	Weir	ST 12515 21799	-	Yes	Weir at Tone Works. Constructed in 1871. Contained water for the headrace to drive the waterwheel. Sluices in its east end [Feature 66] discharged flood water into a cut [Feature 63] taking water south of the factory. *p42, 45, 51.*
66	Sluice	ST 12527 21800	-	Yes	By-pass sluice of red brick, with twin gates, forming east end of weir at Tone Works. Constructed in 1871 to allow flood water to be diverted past the factory. Has a central brick pier with a pair of cast-iron rack and pinion shutters to either side. These were originally controlled by separate hand wheels on pedestals at the ends of the sluices, but later a gearbox mechanism was added to the east, probably electrically powered. No sluice gates survive but the sides have grooved concrete posts for the insertion of stop boards. *p45.*
67	Tank	ST 12559 21857	-	No	Sub-rectangular tank on north bank of River Tone at Tone Works, pre-1839. Attached to north-west side of the Streaming Shop and north side of Mill Head by 1888. Possibly retained as an underfloor tank in the 1991-3 Finishing Works. *p44-5, 50, 52.*
68	Channel	ST 12571 21870 (centre)	-	Yes	Two parallel brick-lined open channels, about 2m wide by 1m deep, in the floor of the Finishing Works at Tone Works. Situated under rows of scouring and milling machines to convey effluent away. Recorded by the 2021 GPR survey (Anthony Brookes Surveys Ltd 2021). *p55.*

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
69	Tank	ST 12572 21884	-	No	Small sub-rectangular tank at Tone Works. Pre-1839 and shown on the OS 1:500 Town Plan of 1888. Covered by the Finishing Works in 1891-3. *p44-5, 50, 52*.
70	Bridge	ST 12613 21887	Tone Bridge	Yes	Redundant Tone Bridge carrying the former course of the Milverton Road over the River Tone, survives west of current bridge. A 2-span bridge, comprising a pair of red-brick segmental arches supported on abutments and a central pier all of brick, with rough coursed stone above the arch rings up to chamfered dressed stone coping along the parapet. Probably 1914 rebuild of a late-18th/ early 19th-century turnpike bridge. *p44-6*.
71	Pond	ST 12548 21843	Tone Works reservoir	Yes	Soft water reservoir at Tone Works. Enclosed by brick walls and divided by a central low wall, the upstream side filled directly from the river via a sluice and the downstream side storing the treated soft water. Water in the soft water reservoir was kept slightly higher to avoid leakage and contamination from the hard water reservoir. Constructed in 1891-2. Two concrete lime soda water softening towers dating from 1914 are situated on a platform in the north-eastern corner. *p53-4*.
72	Waterwheel; Waterwheel pit	ST 12585 21879	-	Yes	Waterwheel pit at Tone Works, dating from the early 19th century. Originally open (as shown on the tithe map in 1839) and contained a wooden waterwheel driving fulling stocks which was replaced with a cast iron wheel and covered with a wheel house in mid-19th

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					century. Incorporated into the Finishing Works buildings in 1891-3. *p44, 47-50.*
73	Channel	ST 12518 21806 – ST 12550 21817	Tone Works headrace	Yes	Headrace at Tone Works formed from a short section of the River Tone. Revetted in 1871 when the main course of the river was diverted to the south-west. *p45, 47, 54, 71.*
74	Channel	ST 12555 21823 – ST 12592 21801	River Tone	No	River Tone former bend at Tone Works, west part, removed in 1871 to help prevent flooding and to allow factory expansion. *p44.*
75	Bridge	ST 12588 21788	-	Yes	Bridge crossing the Back Stream immediately south of Tone Works. Extant on OS 1:500 Town Plan of 1888. Not present on the Tithe Map (1839) and must post-date channel amendments of 1871. *p45.*
76	Filter bed	ST 12651 21939	-	No	Ten 'soap pits' north-west of the of Grease Works [Feature 77]. Mid- to late-19th-century. Shown on the OS 1:500 Town Plan of 1888. On an Insurance Plan, three surviving early soap pits are described as 'magma pits' and there are five 'filter beds'. *p45, 57-8, 60.*
77	Building	ST 12685 21921	Grease Works	No	Grease Works east of Tone Works. Built in the 1870s or 80s to replace an earlier grease refinery in Tone Works. It was used to produce saleable products from soapy effluent. *p45, 55, 57-8, 60.*
78	Channel	ST 12718 21994 – ST 13085 22094	River Tone	No	Channel diverging from the River Tone and looping to the south before re-joining the river further east. Placing of the parish boundary along its course indicates that this was an earlier route of the river,

No.	Type	National Grid Reference (OS GB)	Name	Extant	Summary *See page(s)*
					predating the tithe map of 1839. By the late-19th century it had been incorporated into the Grease Works complex (OS 1:500 Town Plan of 1888) and by 1903 it had been filled in, though a water-filled remnant survived when the Grease Works survey was carried out (Stainer 2014, 6). *p44-5, 58-9, 63.*
79	Filter bed	ST 12970 21983	-	No	Rectangular filtering pits in two rows, marked on OS 1:500 Town Plan of 1888. North row connected to the river, and south row to a channel leading to the River Tone further east. Arranged in two rows of eighteen (north) and sixteen (south) with many sluices and footbridges. Outflow was probably the 'Black Ham Stream' referred to in the 1890s pollution court case. Handwritten notes on the Insurance Plan state that the filter beds were 'shallow earth cut.' *p58.*
80	Pond	ST 12463 21664	-	Yes	Large pond west of Tone Works. First depicted on the OS 1:10,000 map of 1962 (so post-1930). Has been rumoured to be a duck decoy pond, but no evidence found for this and not recorded by Somerset HER. Field visit in Jan 2022 found it to be more amorphous in shape than OS depiction, with conjoined areas of boggy ground. *p47.*
81	Canal	ST 12057 21536 – ST 13036 21830	Grand Western Canal	No	Section of the Grand Western Canal. A tub boat canal which opened 1838, closed 1863. The section that passes near Tone Works is now filled in and used as a public footpath. *p39, 40, 42, 44-5.*

The following page presents Figure A1, designed to be viewed or printed at A3 size. The map shows the full extent of the combined water management system related to Tonedale Mill and Tone Works. It has been labelled with features numbers matching those used throughout the report and gazetteer.

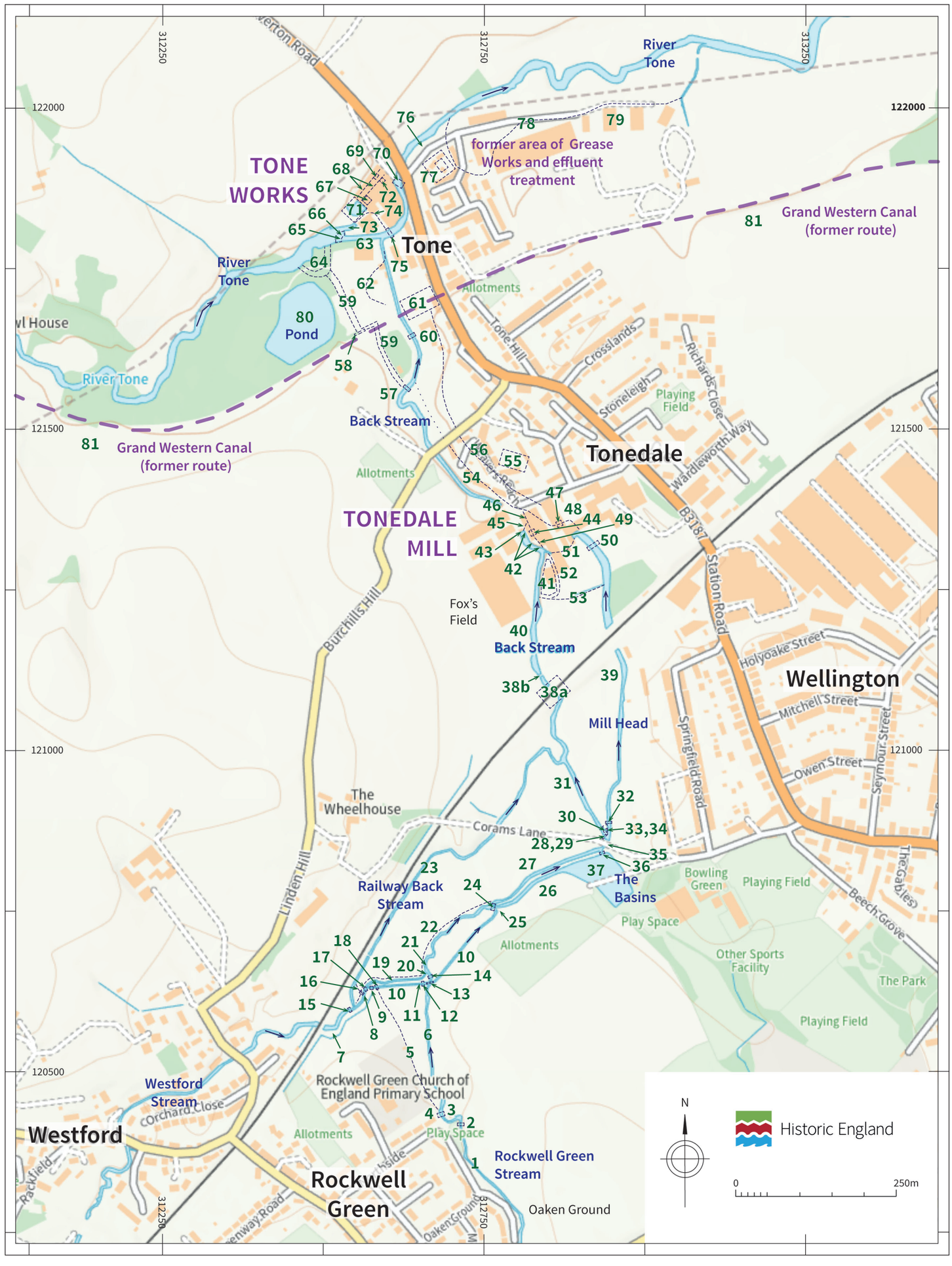

Figure A1: Plan of the combined water management system related to Tonedale Mill and Tone Works, showing individual feature numbers that can be cross-referenced with the report text and gazetteer. Produced at A3.

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APPENDIX B - AERIAL INVESTIGATION (PRE-INDUSTRIAL ARCHAEOLOGY)

The aerial investigation, mapping and research was undertaken between March and May of 2022, for a study area of roughly 2 square km, centred on the industrial complexes of Tonedale Mill and Tone Works (Fig. B1). This aerial assessment and the main desk-based assessment of the water management features for the two mills are collectively recorded under OASIS Id: nmr1-502873.

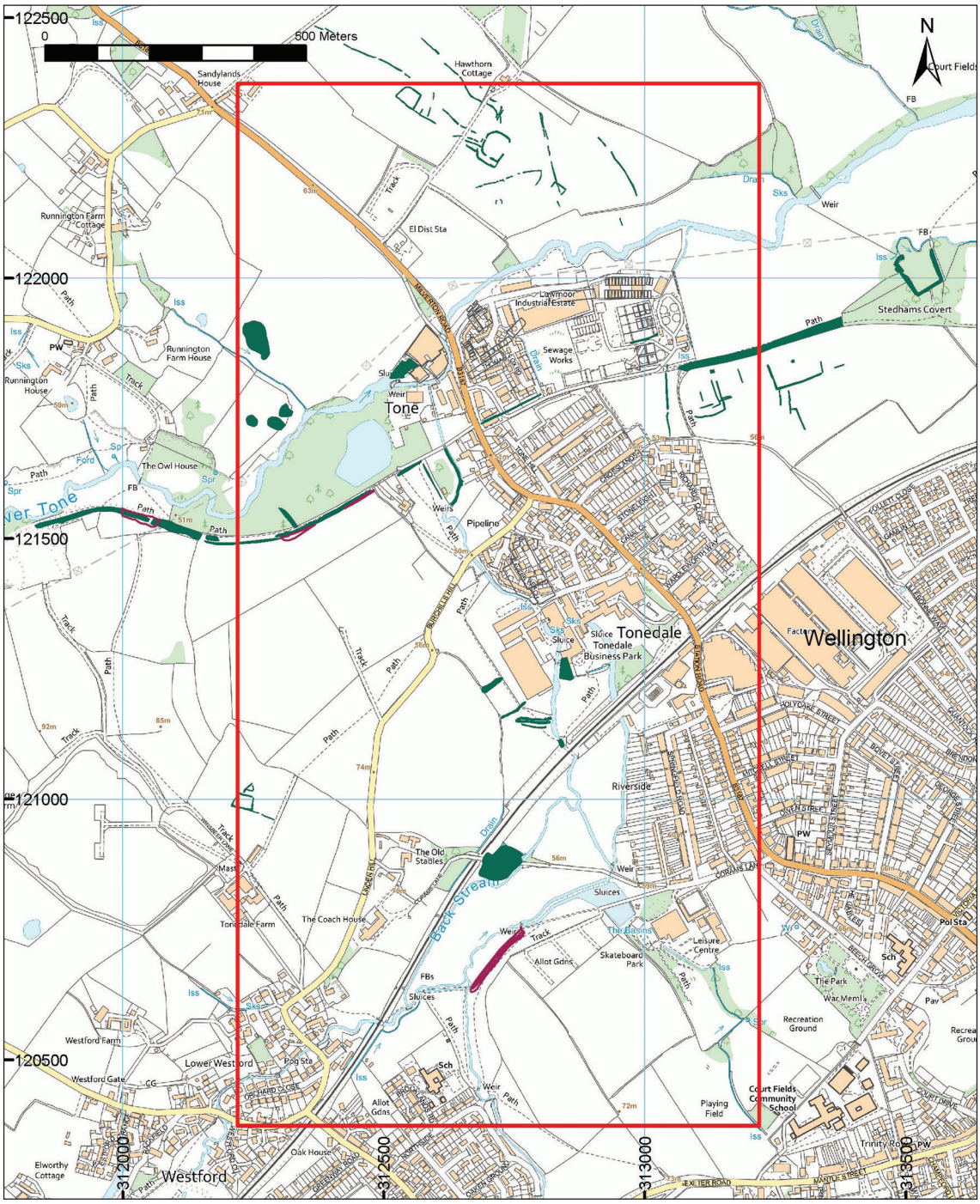

Figure B1: Aerial investigation and mapping study area. [© Crown Copyright and database right 2023. All rights reserved. Ordnance Survey Licence number 100024900 © Historic England]

The main body of this research report incorporates the results of aerial investigation and mapping of Tonedale Mill and Tone Works and their associated watercourses and water management systems into the history and description chapters. This includes information about the factory layouts and structures gained from historic aerial photographs from the 1940s onwards and from historic Ordnance Survey (OS) maps.

As well as mapping any features relating directly to the mill sites, the aerial assessment also recorded all other archaeological features observed within the study area. Discussion of these earlier archaeological sites, along with details regarding the method and sources used in the aerial assessment, are provided within this Appendix (B) to the main report. Features were recorded according to morphology using Historic England aerial mapping conventions and standards (Fig. B2) (Evans 2019).

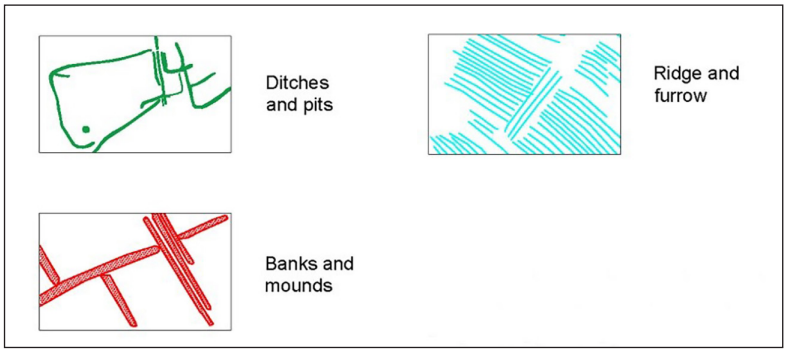

Figure B2: Standard Historic England aerial mapping conventions [© Historic England]

B.1 Discussion of archaeological sites

A thorough examination of all available aerial photographs from 1946 to the present day identified the cropmark traces of a handful of probable Iron Age or Roman settlement sites around the peripheries of the mill complexes and the town of Wellington. Also identified was a possible moated site thought to be post-medieval in date, and features associated with the 19th- and 20th-century industrial focus in this area, such as the mill complexes and the Grand Western Canal, which are all covered in the main report. The potential Iron Age or Roman sites were all located in fields to the north and west of Wellington and all sites have existing monument records, both in the Somerset Historic Environment Record (HER) and as Historic England NRHE entries (Table B1).

This relatively low number of sites identified from aerial sources is probably an underrepresentation of archaeological sites in the area where further remains have been identified through excavation. This may be due to a combination of soils, crops and conditions at the time of photography not lending themselves readily to cropmark generation.

Table B1: Monument record details

Somerset HER	NRHE (former NMR)	Summary	Location NGR, centre (OS GB)	Figure no.
44166	609593	Cropmarks of a sub-rectangular enclosure and associated features	ST 1223 2100	Fig. B5
44167	609594	Fragmented cropmarks of possible Iron Age or Roman settlement	ST 1314 2176	Fig. B4
44406	1631315	An earthwork enclosure defined by holloways or ditches on three sides, with the old course of the River Tone forming its N side.	ST 1352 2203	Figs B4 & B6
42682	1595624	Cropmark of a possible later prehistoric sub-square enclosure	ST 1270 2226	Fig. B3
42683	1595625	Indistinct cropmarks of a possible post-medieval enclosure	ST 1284 2215	Fig. B3
42684	1595627	Cropmark of a possible later prehistoric enclosure	ST 1255 2234	Fig. B3
42685	1595628	Cropmark of a possible Bronze Age ring ditch	ST 1246 2244	Fig. B3

B.1.1 Iron Age or Roman settlement

Within the study area, cropmark evidence thought to indicate Iron Age or Roman settlement and activity was identified and mapped in three discrete areas.

The first of these cropmark complexes is a probable Iron Age or Roman settlement seen as fragmented cropmarks of two D-shaped/sub-rectangular ditched enclosures and associated ditches which extends NW-SE across two large modern fields to the north of the River Tone, adjacent to Hawthorn Cottage, approximately 450m north of the Tone Works factory site (Fig. B3).

The north-westerly enclosure (HER 42684) measures 32m by 38m. Its south-western side extends south-eastwards beyond the enclosure with traces of further fragments of ditch, possibly the remains of further enclosures. The second enclosure lies 145m to the south-east (HER 42682). This is also D-shaped (measuring 42m by 50m) with traces of a second outer ditch around its southern side and has fragments of ditches or a possible trackway extending to the north-west.

To the north of this enclosure is the southern end of a NW-SE aligned double ditched trackway which extends across the modern field boundary and track immediately south of Hawthorn Cottage. Further possible fragments of former ditched boundary and a possible incomplete rectilinear enclosure can be seen between the settlement remains and the river to the south-east (HER 42683).

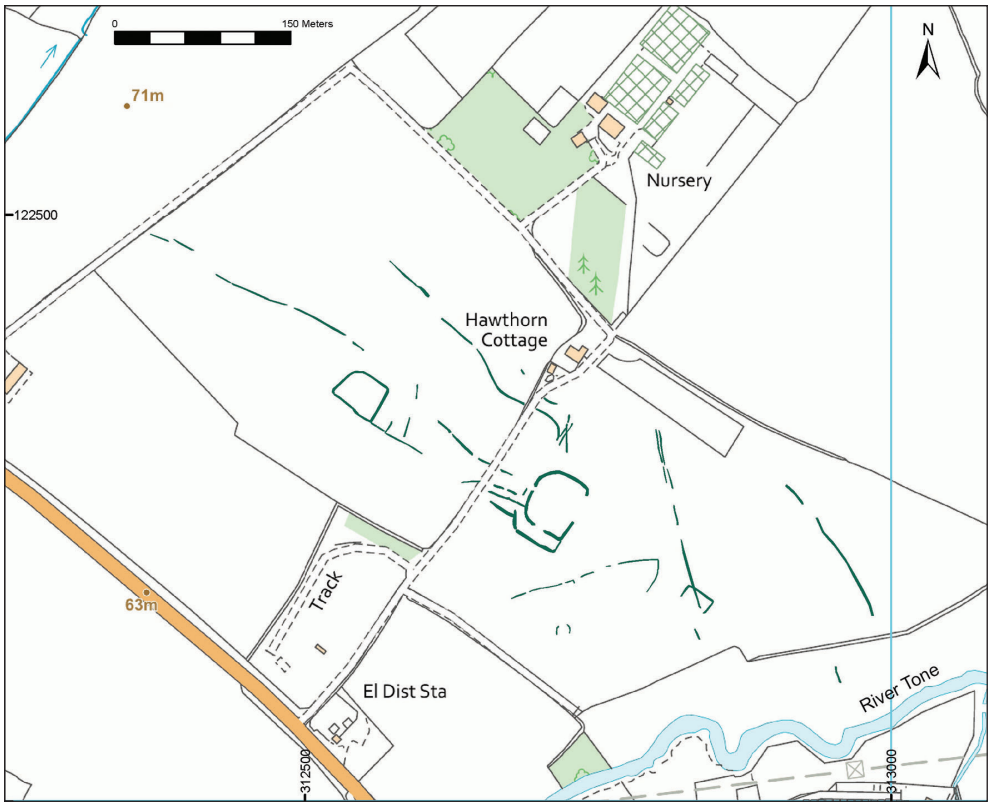

Figure B3: Cropmarks of a probable Iron Age or Roman settlement and fragments of trackway and field boundaries (HER 42682; 42683; 42684; 42685). [Mapping © Historic England. Base map © Crown Copyright and database right 2022. All rights reserved. Ordnance Survey Licence number 100024900]

This feature has been suggested as probably post-medieval in the HER record, but is probably associated with the adjacent group of probable Iron Age or Roman settlement enclosures.

Fragmented cropmarks of a second, possible Iron Age or Roman settlement, are visible as at least two large rectilinear enclosures located south of the River Tone, about 600m east of the Tone Works site and immediately south of the former route of the Grand Western Canal (Fig. B4). The cropmarks are visible on two aerial photographs taken in 1989 (prints held in the Somerset Heritage Centre (SHC)), but are not seen on subsequent photographs, possibly due to time of year and/or planting with less responsive crops or pasture at the time of photography. The slight traces of a stretch of the former Grand Western Canal – which opened as a tub boat canal in 1838 – can be seen as a slight earthwork extending east-north-east along the northern edge of this site to the corner of Stedhams Covert, forming the present field boundary.

Approximately 1km to the west of Wellington, in a field to the north of Tonedale Farm, are the cropmark remains of part of a third, probable small Iron Age or Roman settlement or farmstead site. It comprises a single sub-rectangular enclosure measuring 25m by 35m, and traces of further ditches and a possible smaller D-shaped enclosure (Fig. B5). No other features could be detected on the single photograph held by Somerset HER which recorded the site, and the site has not been identified on any other photographs.

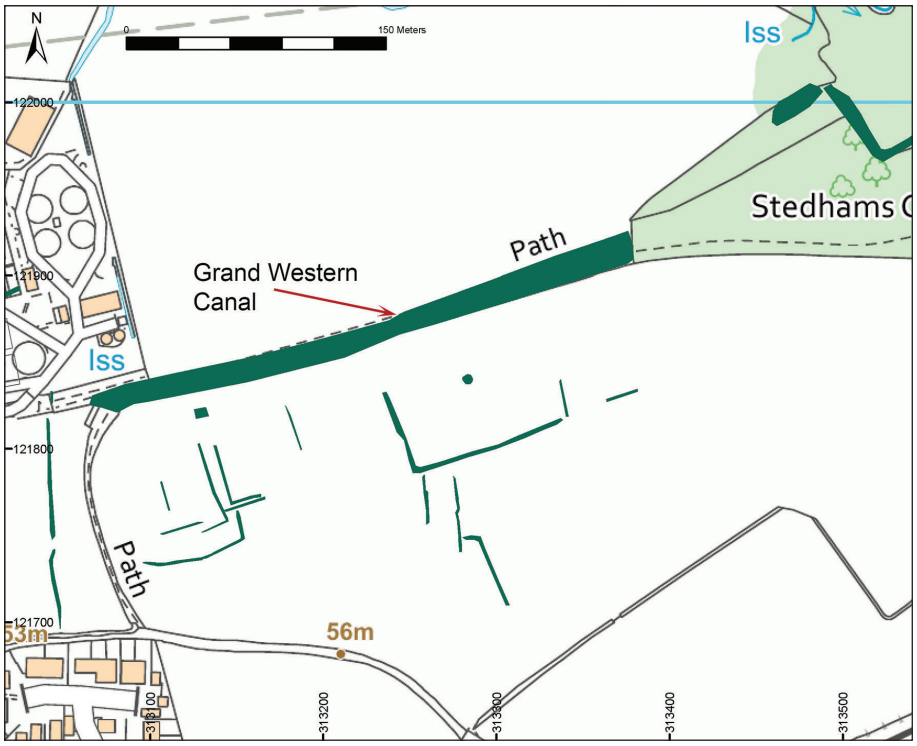

Figure B4: Traces of fragments of a number of rectilinear enclosures and pits of a probable Iron Age or Roman settlement (HER 44167), seen as cropmarks located immediately to the south of the infilled cut of the former Grand Western Canal. [Mapping © Historic England. Base map © Crown Copyright and database right 2022. All rights reserved. Ordnance Survey Licence number 100024900]

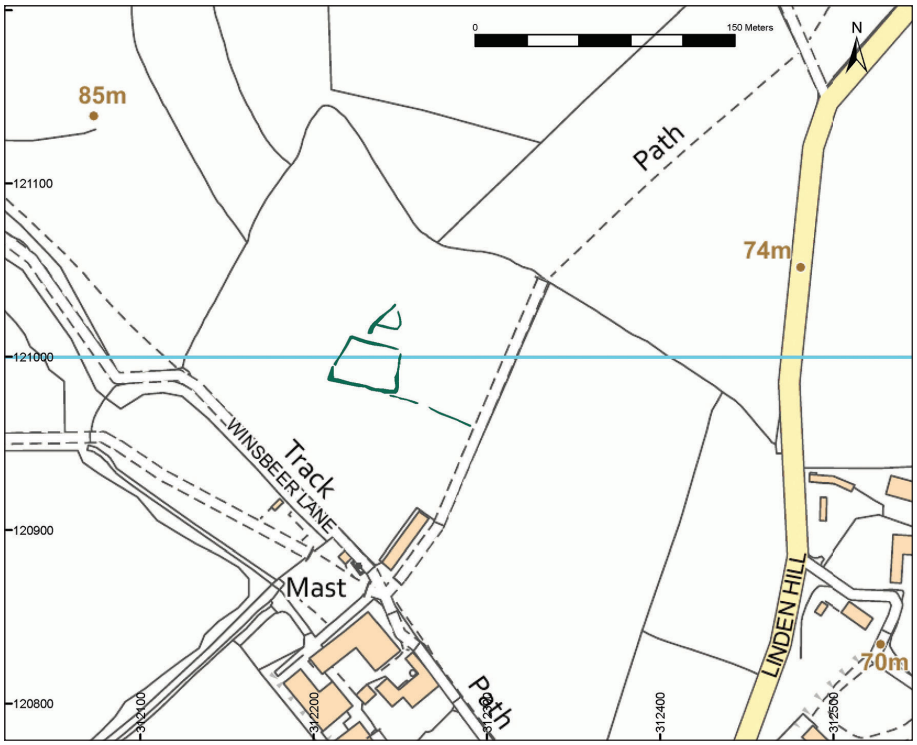

Figure B5: Cropmarks of a small probable Iron Age or Roman settlement enclosure (HER 44166), located north of Tonedale Farm. [Mapping © Historic England. Base map © Crown Copyright and database right 2022. All rights reserved. Ordnance Survey Licence number 100024900]

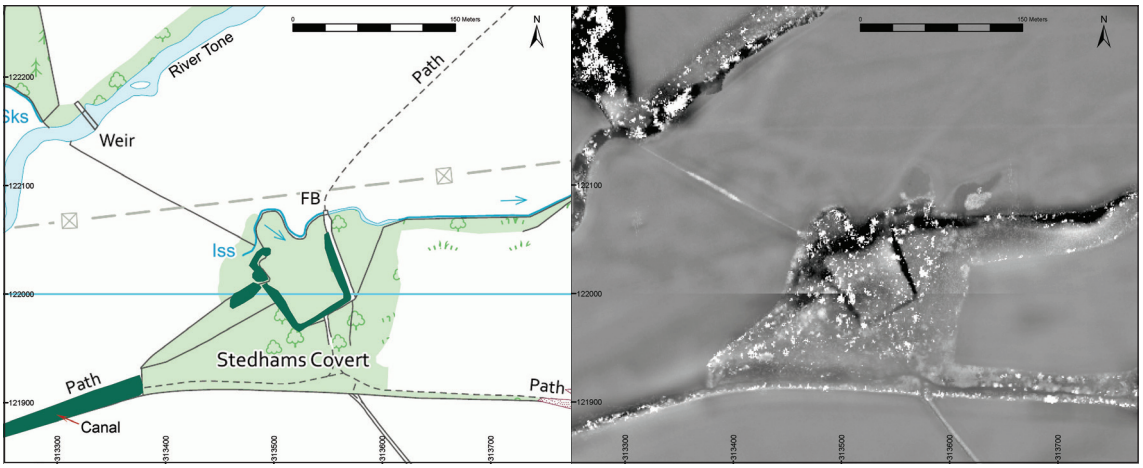

Figure B6: Traces of a possible moated enclosure (HER 44406) within the woodland of Stedhams Covert, visible on the southern side of the former course of the River Tone, as mapped (left) and as seen on lidar data captured in 2020, processed and presented as openness data. [Environment Agency © Crown Copyright]

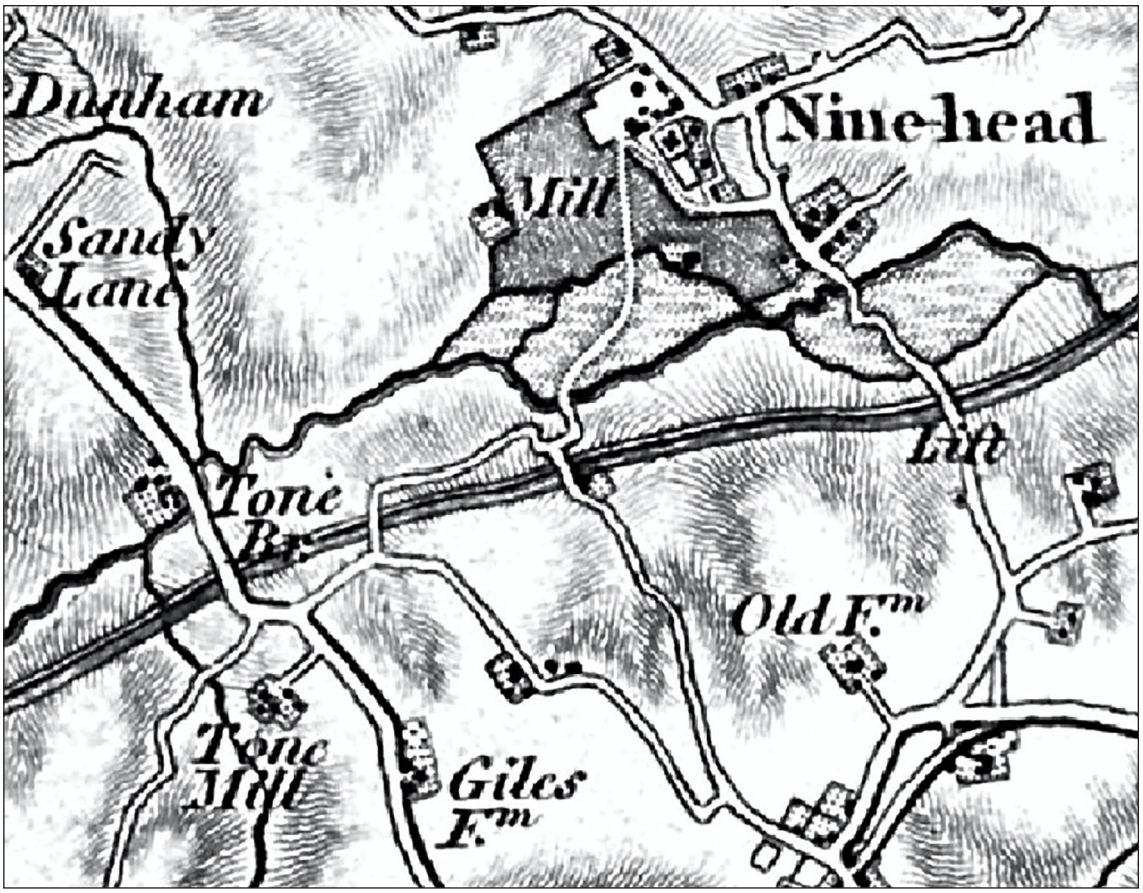

Figure B7: Extract of the 1809-20 OS 1-inch map, showing Tone Bridge and Nynehead ('Nine-head') Park bisected by the course of the Grand Western Canal, and the Tone River flowing on its original course. The lane describing three sides of an enclosure between the river and the canal can be clearly seen (centre). Not reproduced at scale. [© and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2023). Licence numbers 000394 and TP0024]

B.1.2 Moated enclosure in Stedhams Covert

To the east of Tone Works, within woodland known as Stedhams Covert, the earthworks of a possible moated enclosure hidden within trees has been identified on Environment Agency Lidar (Fig. B6). The site appears as three sides of a rectangular ditched enclosure measuring 65m by 80m and located on the southern bank of the ghost of the former course of the River Tone which was redirected through the parkland of Nynehead Court to create a design feature within the park (the landscape park is registered at Grade II*: NHLE 1000528). The eastern side and part of the southern side of the enclosure appears to be utilised as a incised track from the park to the north-east which crossed the old river via a bridge, skirting two sides of the enclosure before heading south-east from mid-way along the southern side where it promptly crossed the canal via a bridge before the canal was infilled.

The original OS 1-inch map dated 1809-20 also shows the track continuing around the southern side and part-way along the western side before striking westwards along the northern side of the canal (Fig. B7). The unusual course of the trackway might suggest it was following a route around a pre-existing feature, such as a boundary or ditch such as a moat.

B.2 Method

All available aerial photographs and lidar data were used to identify and record features relating to the 18th- to 20th-century industrial complex, and all archaeological features visible as cropmarks, soilmarks and earthworks on aerial photographs and lidar not previously recorded by earlier aerial surveys were mapped within the study area. This included features with a potential date range from the Neolithic to 20th-century.

The aerial investigation was undertaken between March and May of 2022 and followed the guiding principles set out by *Historic England Aerial Investigation & Mapping (AI&M) Standards* (Evans 2019). Features were recorded according to morphology using Historic England aerial mapping conventions (*see* Fig. B2).

Using historic OS mapping from 1889, historic aerial photographs from 1946 onwards, and recent georeferenced sources of aerial photographs and Environment Agency lidar, the watercourses through the survey area have been assessed to discern the natural from the engineered and managed drainage around the mill complexes.

Georeferenced and rectified digital images were produced of key photographs using the University of Bradford AERIAL 5.36 rectification programme. APGB 5m height data was used to compensate for differences in height across each rectified photograph. Ordnance Survey Mastermap and the APGB orthophotos were used as control to correlate the aerial photographs to the base map. Average errors at control points in each transformation were below 2m, and typically below 1m.

Environment Agency DSM airborne laser scanning data (lidar) was processed using the RVT 2.2.1 programme (Relief Visualisation Software Toolbox software) to generate a number of visualisations (Zakšek et al. 2011; Kokalj and Somrak 2019).

The georeferenced aerial photographs and lidar were imported to ArcMAP 10.7.1 and archaeological features transcribed onto layers according to the form of remains, for example: ditch, bank and Extent of Feature. Attribute data were attached to each feature with information on archaeological type, period, evidence (such as cropmark or earthwork) and the aerial sources used for mapping.

Any archaeological sites mapped will be recorded in the Arches-based Historic England research record database including information on archaeological interpretation. Somerset HER records, Historic England research records (National Record of the Historic Environment Record (NRHE)), unpublished excavation reports and published sources were used to aid interpretation of the archaeological remains.

B.3 Aerial sources

The aerial photographs consulted ranged in date from 1946 to the present day, including oblique and vertical photographs held in the Historic England Archive. A small number of digital aerial photographs held online by Somerset Heritage Centre (SHC) were also consulted. Other sources included APGB, Google Earth and Environment Agency lidar 1m DTM (flown 2020) and DSM (flown 2017).

B.3.1 Aerial photography (1946 to 2020)

All available aerial photographs held by the Historic England Archive were reviewed as prints or born-digital files. This included aerial photographs taken for non-archaeological purposes, such as by the Ordnance Survey or RAF, at intervals from the 1946 to 1998.

Recent colour vertical photography in the form of georeferenced digital images as orthomosaic datasets were supplied to Historic England through the Air Photography for Great Britain (APGB, https://www.apgb.co.uk/) agreement by Next Perspectives for 2010, 2017 and 2020.

APGB images ©Bluesky International/Getmapping PLC tiles: ST1220, ST1221, ST1222, ST1320, ST1321 and ST1322, flown 20-JUL-2001, 01-OCT-2002, 23-MAY-2010, 08/09-APR-2017 and 09-APR-2020.

In addition to this, online sources of vertical aerial photographs including Google Earth (taken at intervals from 2001 to 2021), and the satellite imagery available via Bing Maps (www.bing.com), were also consulted.

B.3.2 Lidar data (2017 and 2020)

Environment Agency lidar at 1m resolution was acquired from the Government DEFRA Survey Data Download website in ASCII grid format. This came as digital terrain model (DTM) flown 2020, and digital surface model (DSM) flown 2017:

Environment Agency LIDAR DTM_1M 2020 tile: ST12sw

Environment Agency LIDAR DSM_1M 2017 tiles: ST1220, ST1221, ST1222, ST1320, ST1321 and ST1322

B.4 Bibliography

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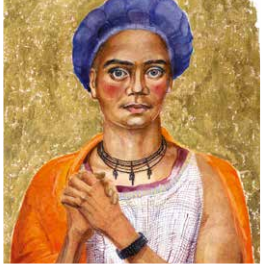



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