

# ‘for beauty and desirability there is none in the kingdom to be compared’: Thomas Telford, James Watt and the evolution of Glasgow’s water supply

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## ABSTRACT

*Recent regeneration works in the east end of Glasgow prompted Forestry Commission Scotland to re-evaluate their landholdings at Cuningar Loop, north-east of Rutherglen. This paper explores Cuningar Loop’s hidden past as a key location in the wider early 19th-century attempt to furnish Glasgow’s ever-expanding population with water. Using historical sources, it examines how a committee of influential citizens established, managed and implemented the project. It also explores how the committee relied on the great engineers of the time, in particular, Thomas Telford and James Watt, to deliver the project using cutting edge technology which ultimately proved inadequate. This sheds light upon the network of social relations revealed by the correspondence of the protagonists, and explores the physical legacy of these early engineers in a city where these pioneering works have been eclipsed by the later Victorian scheme to draw potable water from Loch Katrine.*

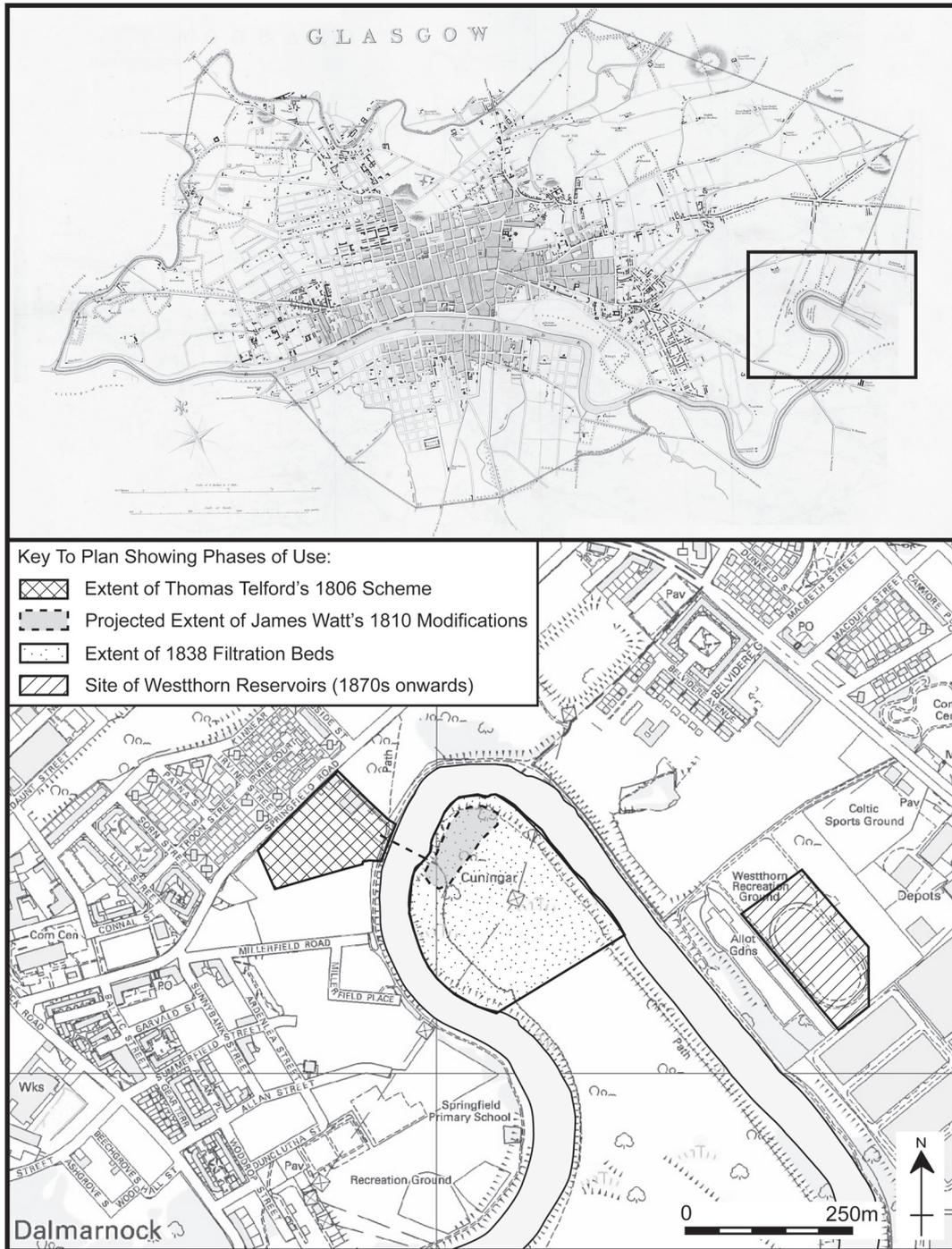
## INTRODUCTION

The regeneration of Dalrnarnock, precipitated by the 2014 Commonwealth Games, led Forestry Commission Scotland to reflect on the importance of their landholdings at Cuningar Loop. Lying just to the north-east of Rutherglen and bounded in the north by a pronounced loop in the River Clyde (illus 1), the lands of Cuningar look unprepossessing. Terraced dumps of spoil, representing debris from the Gorbals slum clearance of the 1960s, obscure the original land surface and the area is now thickly overgrown with scrub and small native trees such as rowan and hawthorn. While the natural heritage value of this landscape was appreciated, during the winter of 2011 Rathmell Archaeology Limited undertook an assessment of the archaeological and historical importance of this ground.

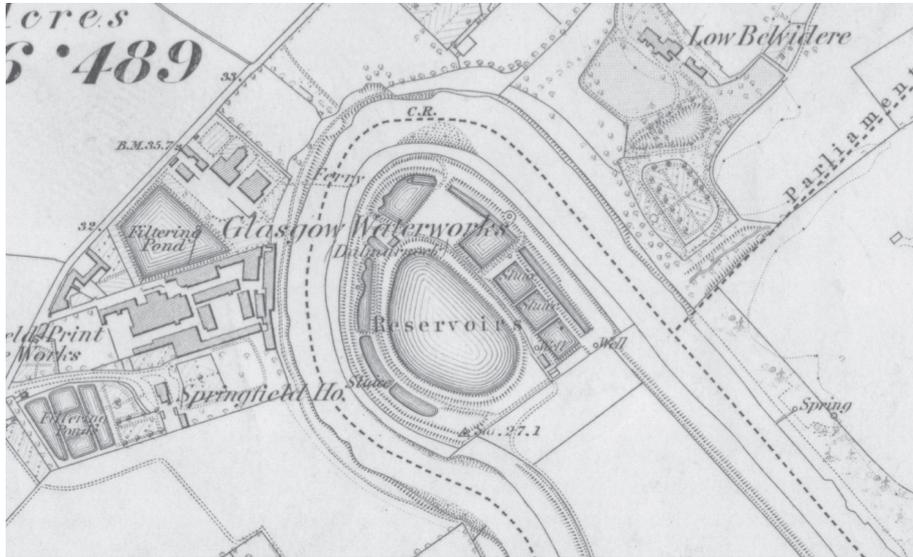
The earliest, sound, map evidence which covers the area in detail is the Ordnance Survey 1st edition map of 1858. This shows the Cuningar Loop to be occupied by a series of filter beds and reservoirs (illus 2) linked to the Glasgow Water Works. It would be easy to assume that this reservoir complex was the first modern land use on the site. However, Cuningar’s development was much more complex, with the works on the peninsula forming a component in a larger suite of infrastructure which served Glasgow’s need for potable water right up to the mid-19th century. With no visible evidence in the field, the interpretation of its narrative relied upon tools much more readily associated with the historian than the archaeologist.

Two key sources were available. The first was the *Letter Book of the Committee of the Glasgow Water Works*,<sup>1</sup> which records the outgoing correspondence penned by its Secretary, David

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ILLUS 1 Location plan showing the various phases of development at Cuningar, and featuring the 1832 Great Reform Act map of Glasgow (reproduced by kind permission of the National Library of Scotland)



ILLUS 2 Extract from Ordnance Survey 6 inch to 1 mile map (Lanarkshire, sheet VI, surveyed 1858, published 1865), showing 1838 filtration beds and reservoirs at Cuningar (reproduced by kind permission of the National Library of Scotland)

Denny. Denny's name became synonymous with the project, with a 19th-century writer noting that, in popular parlance, 'to raise a glass of David Denny' was the term used to describe the drinking of a 'limpid beverage'.<sup>2</sup>

The second was the Boulton and Watt Collection,<sup>3</sup> which represents the company archive of Boulton, Watt & Co., the Birmingham-based company created through a partnership established between Matthew Boulton and the Greenock-born inventor James Watt, who achieved great renown for his improvements on the steam engine.

A thorough exploration of both sources yielded detailed insights into the early history of the Glasgow Water Works and the pivotal role of the Cuningar Loop in enabling the early to mid-19th-century growth of Glasgow. The detailed picture of the history of land use, both on the Cuningar Loop and in the wider locale, was underpinned by the social interaction of a 19th-century Scottish professional class. Work was commissioned, planned and executed by

individuals, and the social relations which underpinned these works were, it seemed, not always entirely cordial.

#### THE INDUSTRIALISATION OF WATER SUPPLY

The early history and development of Glasgow has been widely discussed and characterised elsewhere<sup>4</sup> – as has the town's water supply.<sup>5</sup> During the medieval period, it is thought that water was drawn from the Molendinar Burn, and from a number of private and public wells, as well as from the River Clyde itself.<sup>6</sup> The use of wells is confirmed by the *Protocol Books of the Town Clerks*, which date from the reign of James V onwards. Marwick<sup>7</sup> relates a number of instances where these wells are mentioned, noting references to the 'Deynside' (Deanside) Well, the Well of St Tenue, Saint Mungo's Spoutis, near Gallowgate, and St Kentigern's Well, also near Gallowgate. These early

references highlight the problems inherent in the upkeep of these wells. For instance, the Town Council Records of 1574 note that ‘the commune well, calleit Gleghornis Well, beside Andrew Sympleis house, under Robert Bareis house’ was ‘fillit up with stones, contrar the common weil’.<sup>8</sup> In spite of these tribulations, wells appear to have remained the primary source of potable water for Glasgow’s inhabitants until the early 1800s, with approximately 30 public wells recorded as being in use by this time, augmented by a small number of wells in private ownership. One enterprising Glasgow citizen – William Harley – made early efforts to create an alternative source of supply, piping water from several springs on Blythswood Hill, into a reservoir from which he drew water which was loaded onto water-carts, then sold on to the public at a price of one halfpenny per stoup.<sup>9</sup>

This was in direct contrast with Edinburgh, which was piping water in from the surrounding countryside from at least 1676.<sup>10</sup> Edinburgh’s method of water provision was a tried and tested one, which had been in use since antiquity. Fresh water was sourced outwith the town and moved, via a gravity-fed system using aqueducts and pipelines, into a mains network. The method was simple, but the infrastructure required to deliver sufficient fresh water to satisfy the needs of an expanding city like Glasgow was substantial. This may explain why the late 18th and early 19th centuries saw a shift away from this method of provision, towards a more technologically innovative approach. This typically drew water from major watercourses in the immediate vicinity and passed it through a series of purification beds. The purified water would be stored within a reservoir, from where it would subsequently be distributed throughout the city via a mains network.

The key factor which underpinned this change was the development of the steam engine. It was only through the application of steam power that water could be pumped from a river in sufficient quantities to keep both the

filtration beds and the reservoir supplied with enough water to satisfy the needs of a large, modern city. The earliest applications of this method in the British Isles were in London: by the early 1700s, a waterworks was operating at the York Buildings, Villier Street, using an engine manufactured by Thomas Savery,<sup>11</sup> followed later by the Chelsea Waterworks, established in 1723, and the Lambeth Waterworks, founded in 1785.<sup>12</sup>

These early pioneering London examples remained in virtual isolation until the 1790s and early 1800s, when several new schemes were established in various locations, including Liverpool.<sup>13</sup> All were fairly small-scale enterprises, intended to serve individual boroughs or districts. The driving force which generated them was invariably a committee made up of influential citizens, and works were funded initially by subscription, with investors hoping for some return, generated by the water rates that would be levied on customers following the scheme’s completion.

## DEVELOPING THE PROPOSAL

By the late 18th century, Glasgow’s citizens were well aware of the projects underway elsewhere and were watching developments with interest. A paragraph contained within the *Statistical Account* of 1790–9, encapsulates the mood at the time, stating as follows:

Many proposals have been made, for supplying the city with water from sources in the neighbourhood, but the quantity of the spring water, to be found in any one place, has been thought too small to supply the wants of the inhabitants; besides, a very great expense must be incurred in conveying it to the city, and in preparing reservoirs for it, which has hitherto prevented this useful scheme being put in execution. Perhaps the only permanent sources, and the best supply in point of purity, would be from the river Clyde, but this would occasion it to be forced up by a steam engine and a large reservoir to collect it in, in order to supply the pipes necessary for the different parts of the

city; which would be such an expense as could not be gone into, without a probability of being reimbursed by a tax, which would not, perhaps, be an agreeable measure.<sup>14</sup>

As this excerpt demonstrates, delivering a sufficient quantity of potable water from natural sources was viewed as unfeasible, with Glasgow’s citizens considering instead a purification scheme for their city. But it is also apparent that the cost of implementing such a scheme was viewed, by some, as an obstacle.

In spite of this initial reluctance, by 1806 the ‘Committee of Management of the Glasgow Water Works’ was established (henceforth known as ‘the Committee’). After raising an initial sum by subscription, they appointed a Secretary, David Denny, whose long association with the project made him a figure of some renown throughout the city. Denny in turn approached one of the most eminent figures of the day: the Dumfriesshire-born engineer, Thomas Telford.

Telford was an obvious choice, having worked on the Liverpool Water Works.<sup>15</sup> He had risen to prominence on projects south of the border, but his loyalty to his native Scotland remained undiminished and he was involved in a number of projects across Scotland in the early 1800s, including the Caledonian Canal and the Ardrossan Canal.<sup>16</sup> Denny wrote to him at the Salopian Coffee House in London, on 1 January 1806, informing him that ‘A large sum of money has lately been subscribed towards bringing a supply of Water into the City, and in all probability the measure will be carried into execution’.<sup>17</sup>

But Telford proved an elusive figure. His geographically diverse portfolio of works meant that he followed an itinerant lifestyle: his letters to Boulton, Watt & Co., between March 1805 and March 1806, indicate that during this period he travelled between London, Salop, Liverpool and Fort William. Denny’s first letter never reached him, so a fortnight later, Denny tried again, this time sending his letter to Shrewsbury.<sup>18</sup> Even at

this early stage, Denny was under pressure – the Committee was aiming to prepare a Bill which was to be placed before Parliament and approved during the coming Session, so Telford’s response was needed quickly.

Telford’s reply does not survive, but it is apparent that he was in Cheshire in early February and that he was intending to travel north in early March: a subsequent letter sent by Telford to Watt (sent from Shrewsbury on 25 March, 1806) indicates that he had indeed paid a visit to Glasgow at around this time.<sup>19</sup> It seems likely that this was the occasion that he presented his initial report to the Committee, in which he concluded with the stirring words: ‘there is every reason to be satisfied, that when completed, it will not only prove a very great acquisition to the inhabitants of the City, in general, but also a productive speculation to the subscribers’.<sup>20</sup>

It should, however, be noted that when Telford was approached, the specifications for the scheme had already been established, with Denny outlining the Committee’s plans as follows: ‘The Clyde will certainly be the place from whence the City is to be supplied with Water – to be taken off either the Green or Above Rutherglen Bridge – the Water must be purified by filtration or making subsidiary Basins somewhere about the Green – from thence to be forced by a Steam Engine to the highest part of the City, and afterwards distributed in pipes throughout the Streets.’<sup>21</sup>

Even at this early date, objections were being raised, with an architect named Henry Bell questioning the wisdom of the project on both the matter of costs and also on the noise pollution created by the steam engines. His alternative method was to transport water via aqueduct from outwith the city: it would, he said, cost the subscribers £23,500, as opposed to Telford’s £46,910. Though it was, he argued, ‘far from my intention to dispute the abilities of the gentleman who was lately employed to give a general survey and estimate of the expense’.<sup>22</sup> While it is possible to speculate that this individual was the

same Henry Bell – civil engineer – who devised the steam-powered ship *Comet*, this cannot be established with any certainty. Indeed, the fact that Bell signs himself ‘architect’ as opposed to ‘engineer’ seems to point against it.

Bell’s objections went unheeded and, later that month, Telford was in correspondence with James Watt. He was keen to obtain Watt’s input on the project design, informing Watt that ‘I have reason to hope that Engines of your construction will be employed in raising water to supply the birthplace of their progenitors, and as you are familiarly acquainted with the Situation of River and the City ... I am particularly desirous of benefitting by your opinion and advice.’<sup>23</sup>

Telford’s deferential role seems appropriate in the circumstances: Watt was 20 years his senior and one of the eminent men in his profession. Watt had withdrawn from the running of Boulton, Watt & Co. after the death of his son Gregory in 1804, he was no longer an active participant in the company, leaving his son James Watt (Junior) to carry on in his stead.<sup>24</sup> So it was in the form of peer-to-peer consultation that Telford contacted him, enclosing a copy of his report and asking him to comment upon it, with particular concerns about the performance of the steam engine.

Watt appears to have forwarded Telford’s queries about engines on to his assistant, John Southern – a letter dated 30 March 1806, is written by Southern, with amendments by Watt. Southern had been working with Watt since 1782, and had already dealt directly with Telford on the steam engine orders for the Caledonian Canal. Telford had indicated that the amount of water required was 1,440,000 gallons per day (6,546,540 litres) to supply 120,000 inhabitants and industrial users. Southern’s suggestion (to Watt) was that ‘I should recommend this to be done by 2 steam engines in 12 hours so that if one should be out for repair the other will be working 24 hours give the whole supply ... The quantity by the two engines will be 120,000 gallons per hour ... This exceeds Mr Telford’s

quantity, very much.’ Calculations were also given for the various diameters of the mains pipes required to furnish the city with water, before Southern concluded with ‘I am of opinion that a rotation engine would be best for them, working by means of two wheels to reduce the speed’.<sup>25</sup>

Their response to Telford does not survive, though it appears that either Watt wrote twice or that both Watt and Southern furnished him with letters, as Telford notes on 5 April 1806, that he had received ‘both yours’.<sup>26</sup> A rather sheepish aside from Telford – ‘Altho’ I shall not, in future, trouble you on the subject of engines, but correspond ... with Messrs Boulton & Co.’ – suggests that Watt may not have appreciated being troubled with such routine business as steam engine calculations. This is swiftly followed by a comment on the calculations provided: ‘I perceive’, Telford writes, ‘that you are of opinion that powers should be established capable of attending a supply of nearly 3,000 Scotch pints per minute. There can certainly be no risque of error on this side, expecting the scale of operations exceeding the funds, a circumstance not infrequent in the practice of engineering’. Telford’s wry observations regarding escalating costs in engineering projects are as pertinent today as they were over 200 years ago, and they would return to haunt him at a later date.

More intriguingly, Telford moves on to personal matters, adding ‘I am truly sorry to hear that Mr Rennie has suffered so serious and disturbing a loss, and I am also sorry to inform you that his conduct prevents me from benefitting by his acquaintance’. Telford does not, however, elaborate further on the cause of this bad feeling between himself and his fellow engineer, John Rennie.

Lothian-born, Rennie was a contemporary of Telford’s who had worked briefly for Watt at Boulton, Watt & Co. until 1791. There are several instances where he could have locked horns with Telford. A difference of opinion over Rennie’s proposals for the harbour at Aberdeen<sup>27</sup>

was followed by another concerning proposed works in Ayrshire. In 1800, John Rennie compiled a report for the proposed line for a canal and harbour improvements at Saltcoats.<sup>28</sup> However, when Telford was commissioned to carry out a revised report a few years later, he dismissed Saltcoats as a potential site for a harbour, advocating instead major improvements at Ardrossan.<sup>29</sup> These improvements were later implemented.<sup>30</sup> Perhaps more importantly, he had fundamental disagreements with the line of the Ardrossan canal, as proposed by John Ainslie and endorsed by Rennie, stating, ‘If this statement is correct, I am unavoidably led to conclude that there is here a radical defect in the line of the canal, and it remains to be considered whether any mode can be devised which will remedy this ...’.<sup>31</sup>

Whatever the underlying circumstances, Rennie’s hostility was sufficiently significant for Telford to add in his letter to Watt, ‘Altho’ I never had any connection with him in his business or ever intentionally did anything to injure or interfere with him, I, in every quarter, hear of his treating my character with a degree of illiberality not very becoming – This is so marked a part of his conduct, that I really believe it does him a serious injury ... As I am desirous of not suffering in your good opinion, I mention this with a view of counteracting any insinuation which may be advanced to my disadvantage.’<sup>32</sup> Watt’s response, if any, to this heartfelt protest is not preserved for posterity.

Armed with the observations provided by Southern and Watt, Telford returned to the Committee at some point between March and May 1806. He later describes the meeting: ‘At Glasgow, I had to combat the phantoms of crude projects for supplying the City with Water, upon carefully examining the country as far as Lanark and considering the subject, I made a second Report and satisfied the Committee that the only advisable mode was to take the Water from the Clyde nearly opposite to Ruglen [ie Rutherglen] farm and raise it by means of your engines.’<sup>33</sup>

With the plan approved, Telford, Watt and Southern continued to work through the challenges posed by the project. In a letter<sup>34</sup> dated 23 May 1806, Telford describes the scheme as comprising one reservoir on the bank of the River Clyde, into which a steam engine would raise water. From here, purified water would be pumped into another reservoir located at Duke Street, with the city’s supply being drawn from here. Telford envisaged the riverside structure as a single reservoir measuring 6ft (1.82m) in depth, with a surface area of 1 English acre (0.41ha). However, even at this point he suspected that the water would prove difficult to purify, entertaining the possibility of constructing two reservoirs of similar surface area, each measuring 3ft (0.91m) in depth. By 12 June 1806, Telford had drawn up a plan<sup>35</sup> of the mains network, and was asking Watt for advice on which material should be used for the distribution pipes.

#### THE 1806 ACT OF PARLIAMENT

Meanwhile, Denny was endeavouring to ensure the smooth passage of the Act of Parliament for the Glasgow Water Works, with 4 acres of ground leased on the banks of the Clyde.<sup>36</sup> Denny’s contact in London throughout this period was the solicitor Alexander Mundell. A social commentator who wrote treatises on various issues relating to the politics of the time,<sup>37</sup> Mundell’s name crops up on a regular basis in legal documents relating to various Scottish aristocratic families – in this instance, he was employed as legal adviser and lobbyist for the Committee.

The Act faced a concerted opposition, orchestrated by the proprietors of various coal works and coal grounds located on the banks of the Clyde. Denny informs Mundell, in a letter<sup>38</sup> dated 28 June 1806, that these individuals were ‘alarmed’ at the quantity of water that might ultimately be removed from the Clyde, and that they were attempting to impose a restriction.

Denny contacted Mundell again, less than a month later, noting that this renewed opposition appeared ‘to the Committee entirely to arise from a wish to prevent the proposed undertaking from being carried on to effect’.<sup>39</sup> He then added: ‘The Committee therefore hope that you will be successful in convincing the Lords Committee of the Weakness of the objection ... for it would be greatly to be lamented if a factious opposition of this nature were to deprive the public of so great a benefit and the Inhabitants of this large and populous city of so great a comfort and advantage as the abundant supply of good water.’

Mundell’s lobbying was not undertaken without robust support. A week earlier, in a letter dated 1 July 1806, Denny wrote to Telford,<sup>40</sup> asking him to consult with Mundell so they could ‘concert together on the measures to be taken to counteract a new opposition that is about to be made on the Water Bill’. He further relates that ‘Some of the Proprietors of Coal Works on the Banks of the Clyde and others have got it into their heads that the Water Company may pump all the water out of the river and leave none to float their coal boats’. The idea seemed ‘frivolous’ given it was impossible for significant substantial vessels to travel beyond the Broomielaw, due to the shallow depth of the river, and with the water being removed via pipes, as opposed to a canal or cut, it seemed unlikely that there would be any impact on water levels. Denny remained fearful, however, that this opposition might slow the passage of the Bill or even prevent it from passing during the current session of Parliament.

A petition was, however, duly lodged with a House of Lords Committee<sup>41</sup> by a group of proprietors and subscribers who had interests in various coal grounds and works on the Clyde. Telford was on the case, travelling to London where he succeeded in both dispelling the fears of the opposition, and lobbying the Committee. The Act was passed on 21 July 1806,<sup>42</sup> and Telford immediately set to work on elaborating the details of the scheme.

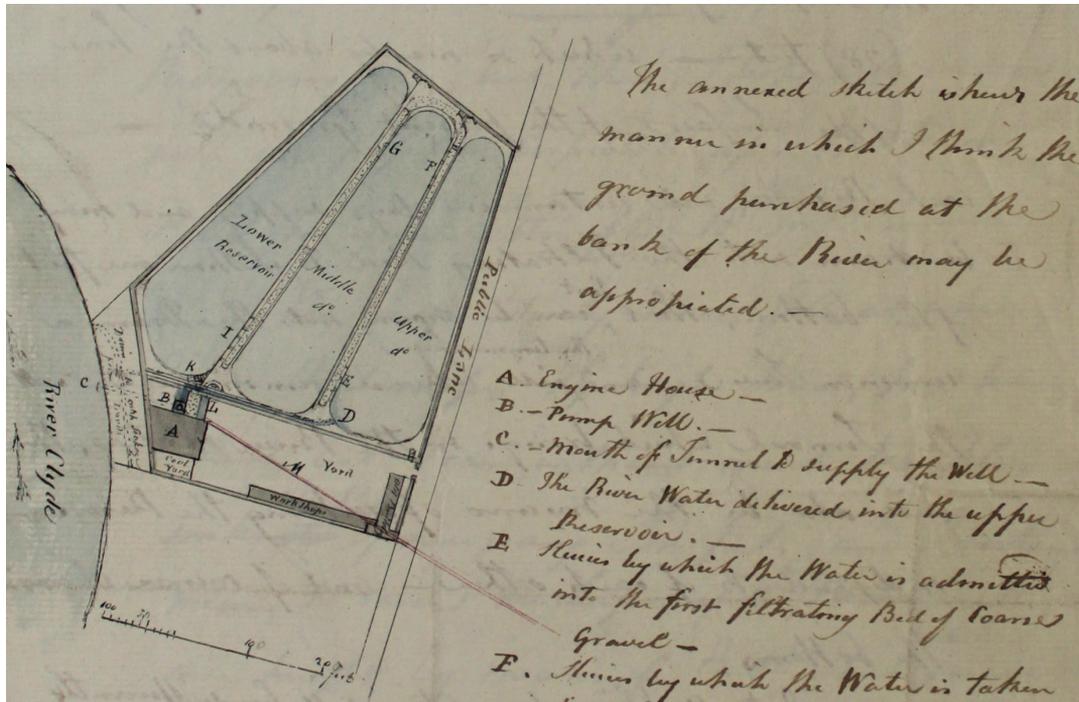
## CONSTRUCTING THE FIRST WATER WORKS

Just before the Act was passed, Telford was preparing to travel to Glasgow and he invited Watt to accompany him. Watt, however, declined, prompting Telford to respond on 7 July 1806:

I have received yours of the 6th. I shall regret very much to proceed in the business of the Water Works without the aid of Mr Watt ... On any occasion where Science or ingenuity were concerned, his opinion and advice would by me be considered of the first importance, but in this instance of giving his nation city a plentiful supply of Water by means of Engines through his Genius have added ... to the Power of Man, I feel it to be in the shape of sacrilege to proceed without him. State this to him, and add that now I must make my appearance at Glasgow before the 20th expected and be fully prepared to set in motion, what they consider to be a very simple operation ...<sup>43</sup>

The tone of this letter is curious: Telford clearly desired Watt’s presence in Glasgow. Telford’s phrase ‘what they consider to be a simple operation’ may suggest that his relationship with the Committee was not without its difficulties: perhaps he was managing unrealistic expectations and sought Watt’s support in this.

With the Act passed, Telford had a clear scheme<sup>44</sup> (illus 3) located on the north bank of the River Clyde as it flows around the Cuningar Loop. His plan featured three reservoirs with an adjacent engine house.<sup>45</sup> The engine pumped water from the river, via a tunnel (marked ‘C’), into the highest of the three reservoirs, each of which held a day’s supply of water. Each reservoir acted as a filtration bed, with the water flowing from the upper to the middle to the lower reservoir, before being pumped off-site for storage in two reservoirs within the city. These reservoirs at Duke Street/High Street and Sydney Street were to supply a gravity-fed mains network.



ILLUS 3 Detail of sketch plan by Thomas Telford, showing layout of 1806 waterworks (extract from MS 3147/5/1095 – reproduced by kind permission of Birmingham Libraries and Archives)

Denny advanced this scheme and, by mid-August, tenders<sup>46</sup> had been sent out for the masons tasked with building the reservoirs. Quotes were received from nine of them: in the end, Sinclair and Fairbairn were selected for the task, providing the second lowest quote for the works of £4,906 18s 4d. September saw the Committee considering how to construct the mains system. Wooden pipes had been used at Chelsea, but later schemes, such as Lambeth, had opted for cast iron. Indeed, a committee member named Gilbert Hamilton (whose roles variously included Lord Provost of Glasgow, and president of the Committee) was convinced that using stone pipes would be cheaper – with Portland stone cited as a possible material – with samples and accompanying estimates requested from a company in London.<sup>47</sup> Various ways in which costs could be further reduced were discussed, such as sourcing an equivalent local

stone,<sup>48</sup> or having stone transported north with the final working carried out locally. Subsequent tests of stone pipes, carried out under pressure, ultimately resulted in failure, so stone was discarded as an option.

Telford's last known correspondence on the project from 1806 is dated 4 August, from Glasgow, and it was sent to Boulton, Watt & Co. to commission the engines, requesting that the cylinder, boiler and pumps mentioned in a previous letter were added to the former estimate of £4,210 and asking for a delivery date.<sup>49</sup> Drawings for the engines and engine houses survive in the Boulton, Watt & Co. archive, although at least once the Committee<sup>50</sup> secured a second-hand engine rather than a new one. From August, a resident engineer – James Howell – had been appointed by Telford to deliver the project, although Denny remained in regular correspondence with Telford. Telford,

meanwhile, continued to harry Boulton, Watt & Co. on the subject of engines.

The beginning of 1807 once again saw Telford in Glasgow, where he wrote to Boulton, Watt & Co. on 7 January, regarding the engines: 'As I wish to make some arrangements respecting the execution of the Glasgow Water Works, I am desirous of knowing in what state of forwardness the Engines which you are making are at this time, and when we may, with certainty, rely on them being completed.' For Telford, this appears to have been a lengthy stay: in the same letter, Telford states that his address for the coming fortnight would be the Star Inn, Glasgow.<sup>51</sup>

During this fortnight, the issue regarding the mains pipes was finally resolved. The required iron pipes were to be sourced from the firm of Messrs Booth & Co. of Sheffield. They had already been commissioned to cast some of the larger pipes, with James Howell contacting them in November 1806 with a design specification for 14in (35.6cm) pipes. By 15 February 1807,<sup>52</sup> a consignment of pipes had been forwarded from Messrs Booth & Co., and the construction of the mains network could at last get underway.

### LAYING THE MAINS NETWORK

The Committee now undertook the major task, from scratch, of laying a water main network across Glasgow – a far larger undertaking than the construction of the water purification and pumping works. With the Carron Company established in 1759, it may seem surprising that the Committee appointed a manufacturer based in Sheffield rather than choosing a local supplier. However, the manufacture of an iron pipe of sufficient quality and durability to fulfil the task expected of it was a specialised skill, and this appears to have led to the selection of Booth & Co. in this capacity.

With their supplier located in Sheffield, the task of procuring the pipes proved to be a difficult one. As it was, finished pipes had to be

transported from Sheffield to Hull, presumably via inland waterway, before being shipped from Hull to Leith. Once unloaded at Leith, the pipes were shipped via the Forth and Clyde Canal to the basin at Port Dundas, from whence they were delivered by cart to their final destinations across the city.

Pipes were required in a variety of sizes, from the 14in main (35.6cm) that formed the main artery of the system, through the 4in and 5in pipes (10.2cm and 12.7cm) which supplied individual streets, right down to the 1½in pipes (3.8cm) which serviced each close. Lead pipes then piped water to each house, cast iron pipes of this thickness being too susceptible to rust. The specification for manufacture was precise:

The pipes are to be cast on end in dry sand in lengths of Nine feet four inches and a half each – They are to be Nine inches diameter within and to consist of Metal five eighths of an inch in Thickness – the quality of the metal is to be such as to receive a Column of Water two hundred feet in height. Each pipe to have a facet four inches and a half in length of a diameter to receive the end of a nine inch pipe with proper jointing as Shewn in the Section ...<sup>53</sup>

The quantities required were copious, in 1807 alone, supplies of 104 pipes (size unspecified, presumably 14in), 240 1½in pipes, 266 1in pipes, 440 9in pipes, 600 7in pipes and 500 yards each of 2in, 3in and 4in pipes were commissioned. Production seems to have progressed at a rate consistent with laying the mains. However, in 1808, the establishment of a rival water company – the Cranstonhill Water Company – which although set up in the west end of the city ostensibly to service the area around Anderston, was clearly created as a competitor, removed the Glasgow Water Work's monopoly over service provision. A race ensued: the more pipes lain, the more streets serviced, the more households and businesses supplied, so the greater annual rates levied.

Shipping agents based at both Hull and Leith were employed to identify potential vessels on

which the pipes could be shipped. Thanks to the survival of the Committee’s *Letter Book*, the information relating to this procedure is copious, with records relating to the shipping agents, the individual vessels involved, and even the names of the captains. Freight costs were paid by Booth & Co. and reimbursed by the Committee, along with stamp duty.

A letter sent to Booth & Co. on 24 June 1808<sup>54</sup> details all the consignments of pipes sent between Hull and Leith. Regular use was made of the *Montagu*, the *Edinburgh Packet*, the *Hull Packet* and also the *Earl of Dalkeith*. Incidents and accidents were occasional tribulations to be endured as necessary. One such irritation was a long-running dispute with a Captain Murton, who moved materials between Leith and Port Dundas, via the Forth and Clyde Canal, aboard the *Hawke* and the *Joseph & John*, who chose not to invoice Booth & Co. for his costs as Denny’s letter makes clear:

Mr Murton the owner of the vessels which brought the 14in pipes called for the freight of the last cargo – on being informed that I had neither the funds nor authority to pay it but that he must call on you for the freight, he threatened to arrest the pipes until he was paid. In case he should resort to any such measure which I think very likely be so good as to advise me on how I am to act.<sup>55</sup>

The dispute with Murton was not settled until 1809, when a court heard in Booth & Co’s favour. It was something of a pyrrhic victory, as correspondence from Denny to Booth, dated 11 April 1809, clearly demonstrates:<sup>56</sup> ‘The suit with Murton is now settled in your favour, but as he is bankrupt, you have to pay your own lawyers expenses.’

Besides finding passage via the *Hawke* and the *Joseph & John*, pipes were also freighted in those early months aboard the *Nancy*, the *Nonsuch* and the *Friendship*, not always to Denny’s satisfaction. He notes, for example, on 11 July 1807, how ‘the charges on the *Friendship*’s cargo in particular are extravagantly high,’ and asks Booth & Co. to ‘look into it’.<sup>57</sup>

The precarious nature of this long-distance supply chain was thrown into sharp relief with the sinking of the *Earl of Dalkeith* in the winter of 1807. A letter from Denny to Booth & Co., dated 28 February 1808,<sup>58</sup> refers to the loss of 28 7in pipes during the incident. Little is known of the circumstances surrounding the shipwreck, apart from the fact that the unfortunate vessel foundered off Alnmouth, on the Northumberland coast. Its loss resulted in a shortage of pipes in Glasgow, and sparked off a long dispute with the Busby brothers, John and Daniel, who managed to salvage some of the cargo and expected reimbursement.

John Busby was himself a noted surveyor and civil engineer.<sup>59</sup> Born in Northumberland, he subsequently moved to Leith, where he was involved with various projects including the Caledonian Canal (Telford gave him a glowing testimonial when he later applied to the Colonial Office for employment in New South Wales). He spent his later years in the Antipodes, where he became a celebrated figure for his success in refloating the Australian government brig *Elizabeth Henrietta* off New Zealand. He was also responsible for the design and implementation of a project to supply the citizens of Sydney, Australia, with water.

A letter from Daniel Busby, dated 4 March 1808 (later referred to by Denny), informed the Committee that 12 pipes had been recovered, and enquired as to their value. The Busby brothers expected to be paid the full value for the pipes, to which Denny responded with a spirited riposte<sup>60</sup> that ‘the pipes are injured by being so long in the Salt Water there is no doubt – nevertheless, if you send fifteen or sixteen of them here, you will be paid the salvage [that is the value of the raw material, as dictated by Booth & Co.] according to agreement’.

The salvage correspondence gives a good example of the misunderstandings that arose along the supply chain, instead of the 28 9in pipes Denny thought to be on the *Earl of Dalkeith*, the entire consignment of this size were aboard, some 73 pipes.<sup>61</sup> John Busby salvaged 36: facing

a dearth of these pipes, without which further work on the mains could not proceed, Denny asked for them to be forwarded directly to Glasgow.<sup>62</sup>

By May 1808, Denny was becoming frustrated in his attempts to procure pipes. Busby had not yet delivered the salvaged pipes, and there were delays in shipping at both Hull and Leith. This prompted Denny to write to Booth & Co., on 9 May, asking them to inform him of progress in manufacture and shipping of 7in, 5in and 4in pipes, because if 'it should be so, which I very much fear if the case, that they have not forwarded these pipes – it will be [?] with us again indeed for we are again entirely out of work. I have therefore to request that you will take the means to get the pipes forward as fast as they are made – we shall else be under the necessity of getting pipes made here – for our work must stand, especially with a Rival Company taking possession of the Streets before us.'<sup>63</sup>

Unbeknown to Booth & Co., Denny had already made alternative arrangements: on 27 February 1808, he had contacted the Carron Company to inform them that:

We have made a Conditional agreement with an English house to furnish the whole that may be wanted for the works – but are now satisfied it will be impossible for them to get the whole ready in sufficient time for our operations. Will therefore be glad that you advise me on what terms and what time you could supply us with about 2,000 yards of each sort (3" and 4") delivered at Port Dundas – to be paid in cash two weeks after delivery.<sup>64</sup>

This ultimately proved to be the way forward. By the end of 1808, the Committee had added a number of local foundries to their suppliers, including James Sword & Co., Martin Dalrymple of the Omoa Foundry, Thomas Edlington & Sons, Hugh and Robert Baird (Shotts Ironworks), Robert Fenton and Joseph Outram of the Clyde Ironworks, William Douglas of the Glenbuck Ironworks and, farther afield, Ayden & Elwell

of Yorkshire. This illustrates how hard-pressed the Committee were to obtain large quantities of pipes for their works, and how valuable the project was in providing local foundries with employment.

With such a broad range of suppliers, the focus changes from supply to problems regarding quality. Denny remarks on 22 March 1809, that the pipes provided by Hugh and Robert Baird were 'rather slender' and that they do 'not appear to me capable of bearing caulking'.<sup>65</sup> While Martin Dalrymple was informed on 30 March 1809, that, 'Split facets were found on several pipes ... The metal is much too hard and I fear we dare not [?] to lay them for they will not bear caulking.'<sup>66</sup> This was followed by another letter dated 8 July 1809, informing them that 'Yesterday we began to prove the 6½ inch pipes for the first time and are sorry to acquaint you that they are turning out very ill indeed – for out of which were proven 8 of them appear to be faulty. The pipes (excepting 2 or 3 ...) are quite unexceptional to the eye – and am at a loss to account for their being so bad.'<sup>67</sup> James Reid, at the Omoa Foundry, was told by Denny on 21 June 1809 that 'I have seen the 6½ Inch Pipes the faucets are too slender, unless they are made stronger they will not do at all. They are besides rather under 6½" diameter and lay only 8 feet 11 inches, instead of 9 feet.'<sup>68</sup>

Booth & Co., whose issues until that date apparently revolved around supply, were not immune from deficiencies in quality – a letter from Denny, dated 28 February 1809, sent to the foundry, adds almost as an afterthought: 'There ought also to be some deductions on account of several defective pipes – but this I believe we shall pass over'.<sup>69</sup>

## THE WATER SUPPLY FLOWS

On 11 February 1808, Denny wrote a letter to Alexander Mundell, summarising the work so far:

The Glasgow Water Works are not yet so advanced as to enable us to draw Rents but in the Month of June there is little doubt but that we will be able to supply the East End of the Town and all along the Main Street, the Main Pipe is now within 100 feet of the Cross – and but for the untoward Season – either heavy rains or frost – we would have been in a greater state of forwardness. To what amount the rents may turn out to be, it is impossible to say – but when the bad quality and even scarcity of our own present supply is taken into consideration, the great population of the town, and numerous manufacturers it is reasonable to suppose there will be a great demand for the water and that the Revenue will be considerable.<sup>70</sup>

In the space of just 18 months, the Committee had succeeded in moving from their inception to delivering a functioning water supply to a significant portion of Glasgow, a huge engineering achievement. He concludes with a tribute to the works undertaken to date: 'As to the Glasgow Water Works we may safely assert that for beauty and desirability there is none in the Kingdom to be compared to them all the pipes are of cast iron and all the Basins and Reservoirs of polished stone.'<sup>71</sup>

This eulogy masked an underlying discontent which was, however, to become increasingly manifest as time progressed. Telford had clearly been working with the aim of completing the project to high standards. An example of this is demonstrated in a letter to Boulton, Watt & Co., dated 25 July 1806, regarding the reservoirs:<sup>72</sup> 'I hope to make it [the Engine House] handsome, as a decent appearance has a considerable effect in cases of this sort. I mean to make the walls around the reservoir to be faced next the water, and covered on the top, with cast stone, so as to render the whole either a matter of curiosity, or at all events, enable them to keep every part remarkably clean.'

Denny's subsequent letter to Mundell, quoted in part above, indicates that Telford's high standards were maintained, but there were sources of irritation. Telford's itinerant lifestyle and hectic schedule meant that, on

some occasions, progress was delayed while they awaited his arrival. For example, on 27 October 1807, Denny relates to Booth & Co. how he 'delayed answering your letter of the 12th ... waiting the return of Mr Telford to have opinions about the thickness of the 2, 3, 4 and 5" pipes'.<sup>73</sup> Telford's earlier hints of strain with the Committee may not have been unjustified: Denny notes that they 'would not be in want of more than £1,500 or £2,000 but that the Committee have resolved in extending the plan considerably that is by laying pipes in many inferior streets and lanes in Glasgow not taken in to the estimate by Mr Telford'.<sup>74</sup> He is also critical of the sub-contractors chosen for the work, writing to Howell, Telford's resident engineer, complaining because Sinclair & Fairbairn, the masons chosen to build the reservoirs, had exceeded the sum quoted in their tender by more than £2,000. He closes this letter with a tense comment: 'I shall be glad that you state the particulars for which this firm has been disbursed – in order that it shall be laid before the Committee.'<sup>75</sup> These comments make Telford's earlier observation regarding the ease with which major engineering projects run over budget seem sadly prophetic.

#### THE FAILURE OF ENGINEERED FILTRATION

Although the water works was in operation, the Committee was gravely dissatisfied with Telford's completed scheme:<sup>76</sup> 'Having found the filter ... on the plan as constructed by Mr Telford very defective, the attention of the Committee has been for some time directed to the means of finding a supply of pure water in the Neighbourhood of the Works and from the trial already made they are led to entertain sanguine hopes of success.' Denny continues, ominously, with the words: 'The Committee do not feel inclined to apply again to Mister Telford.'<sup>77</sup> In essence, the engineered filtration of river water, originally advocated by the Committee to

Telford, had failed by October 1809 to deliver reliable levels in both purity and volume for the constructed mains system.

Watt's role in this affair to date remains enigmatic. Telford was anxious to receive his advice from the outset and it was to Watt that he confessed his difficulties in purifying the river water. Despite Telford's entreaties for more direct involvement, Watt had remained a remote participant. This was, however, about to change. Correspondence between Watt and his son, James, dated 13 [?] 1807, indicates that he was preparing to join him at the Glasgow Water Works – presumably supervising the installation of a steam engine. Family circumstances had, however, delayed him, with Watt noting 'I have been as well as Mrs Watt confined to the house for some days with the cold, but we are now recovering and hope to get away by Tuesday next ...'.<sup>78</sup>

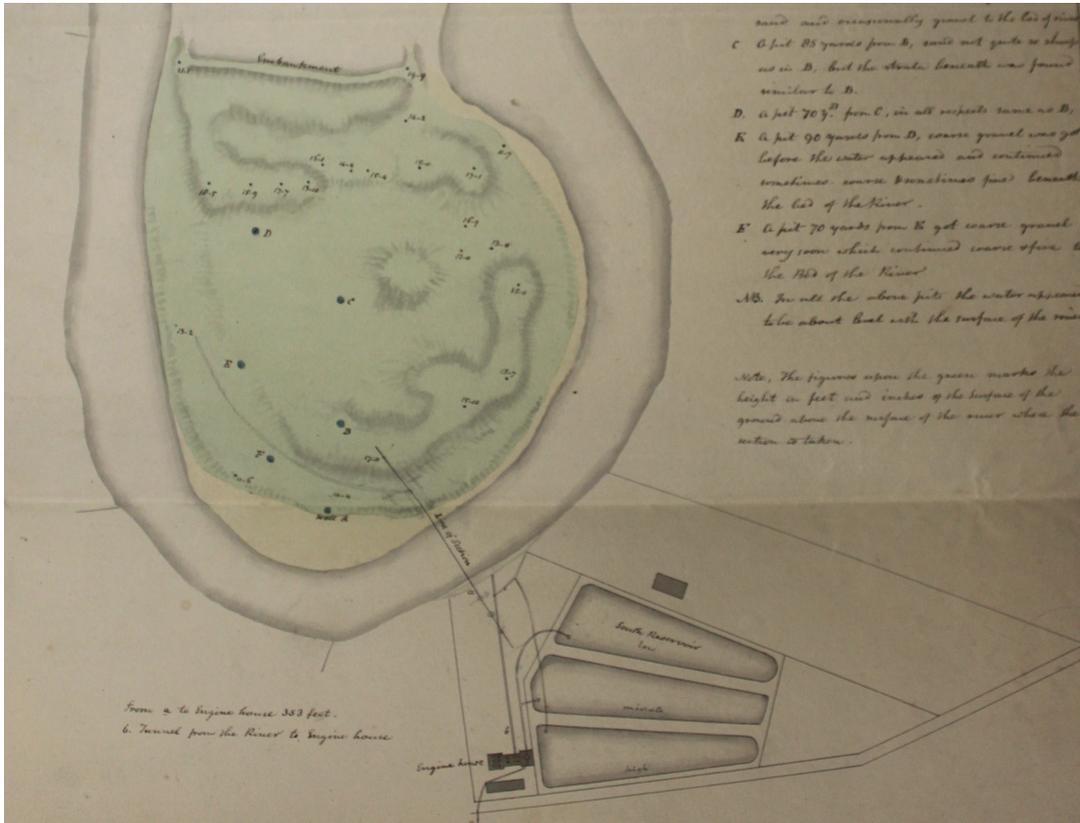
Watt slipped neatly into the void left following Telford's departure. During his stay in Glasgow, Watt met with the Committee, who responded enthusiastically. As Denny notes:<sup>79</sup> 'Mr Watt's stay here has fortunately presented them with much valuable information', before adding that 'as they are most anxious to have the work done in the best manner they have directed me to request your [ie Boulton, Watt & Co's] advice in the business and even propose to you the accomplishment of it'. The Committee's strength of feeling is summed up by Denny when he writes, 'The committee feel themselves under the greatest obligation to Mr Watt and are very anxious that those hints which he has in the most obliging manner given them may be executed in the best manner possible – it is for this reason that they wish the whole undertaking placed under your management'. What seems all the more remarkable is that throughout the whole undertaking, Watt provided his advice free of charge, though in the long run this generosity appears to have paid dividends, as the Committee, from then on, felt obliged to purchase all their steam engines from Boulton, Watt & Co.

Watt initially advised that they should seek a supply of fresh water on the north bank of the Clyde. However, this proved impractical with confirmation by December 1809 that 'trials have not been attended with success'.<sup>80</sup> Attention turned to the peninsula lying directly opposite Telford's original water works, the land at that time forming part of the Cuningar estate and which is now known as the Cuningar Loop. Here, initial test pits proved extremely positive, with a copious supply of pure water occurring, naturally filtered by the sands and gravels which made up the loop – but on the wrong side of the River Clyde. Watt's solution was revolutionary – his scheme was to extract the water with a steam engine located on the peninsula, then pump under the river via a set of iron pipes, furnished in some cases with hemispherical joints so that the pipe would have sufficient flexibility to lie on the river bed (illus 4).<sup>81</sup>

These new works were to be delivered by a new resident engineer, Hugh Baird – not the eminent Scots-born engineer of that name, but one of the Baird brothers who managed the Shotts Ironworks. And it was to Hugh's brother, Robert, at Shotts Ironworks that the order went for '... pipes and other ironwork necessary for the undertaking ...'.<sup>82</sup>

A report held in the Birmingham City Archives, which appears to be in Watt's handwriting, gives a detailed account of how these works should be accomplished.<sup>83</sup> The pipes would be fixed upon timber frames, joined together with hinges of cast iron – Watt pointed out that 'care must be taken that the axes of the pins of these hinges be in a line with the axis of the globular joints to which they correspond, otherwise the motion of the whole would be obstructed'. In theory, pipes and frames would then form a flexible chain which would adapt itself to the base of the river.

First, a row of piles was to be laid across the river in a straight line (each set approximately 4m apart) with their tops projecting above the water and joined by a rail. A groove at least 4m wide would then be dredged across the river bed



ILLUS 4 Plan of Cuningar Loop. Showing location of Watt's 1810 pipeline linking Cuningar with Telford's existing infrastructure (extract from MS 3147/5/1095 – reproduced by kind permission of Birmingham Libraries and Archives)

(to be made deeper on the south side, where the basal deposits were sand), with a similar channel to be hand-cut on the south bank, where the pipes and frames would be assembled ready for the operation to commence.

With the pipes assembled and the joints caulked with rope soaked in a warm mixture of tallow and whiting, the pipes would be hauled across the river via a rope affixed to a capstan set on the north shore. Pontoons (ie small ferry boats) were to be floated on the river, guided by the rail mounted along the line of piles. Projecting pieces mounted on the pontoons allowed the frame and pipe to be guided accurately down the centre of the channel. Watt envisaged that the weight of

the pipes and frames should be borne largely by the river bed, as this would enable the ground to be levelled as the pipe proceeded. The operation had to be executed quickly, as there was every possibility that the movement of the pipes would disturb sufficient sediment to fill up the groove which had been dredged.

On 27 June 1810, Watt's plan was put into action. Denny triumphantly writes to Boulton, Watt & Co. on the 28th, informing them that: 'I have the pleasure to acquaint you that following your excellent plan and directions, and without employing any Engines we yesterday succeeded in laying 15 pipes of 15 inches diameter measuring 136 feet in length across the River

Clyde ... The only deviation we made from your instruction was by attaching the whole 15 pipes and launching them altogether which was done with great care and exactness.<sup>84</sup>

At the same time, a filter well was sunk on the south side of the river. Watt had instructed that this should be lined with ashlar, unmortared, with a timber platform at the base, the wellhead to be built up well above the flood plain. The depth could not be ascertained in advance, as it depended upon the head of water required to draw sufficient quantity from the river gravels. This water was to be obtained via a tunnel, constructed of unmortared whin and packed with gravel: it was to be driven from the base of the filter well on a course parallel to the river, at a depth of approximately 3m, for a distance of 18m.<sup>85</sup>

Three acres (1.21ha) of land were duly purchased at Cuningar, with work upon the filter well and the tunnel completed by 3 August, aided by a spell of very dry weather. Despite the fact that the river was low, on account of the unusually dry weather conditions, Denny reported to Boulton, Watt & Co. that 'the Engine was wrought at more than ordinary speed to keep down the water'. He then concluded that 'We are every day more and more convinced that the supply of water from the Well will be quite equal to the consumpt of the City and Suburbs, and by lengthening the tunnel and down other wells the quantity can be increased at least five fold.'<sup>86</sup>

#### EXPANSION AND ULTIMATELY CONSOLIDATION

Just over a year after Watt had proposed his methods for improving Telford's scheme, the results of his intervention were evident. Denny jubilantly informs Boulton, Watt & Co. of progress, in a letter dated 8 February 1811:

From the 1st September to this day excepting one week in October we have been supplying solely from the Suction pipe upwards of Eleven thousand

private families besides more than Thirty Public Works in all which time even when the River was lowest and after 14 or 16 hours pumping we never had less than six feet of water in the well – and although during the winter the River has frequently overflowed nearly the whole of the Peninsula ... yet the Water was uniformly pure and might have been compared with the finest springs, which is also proof of the excellence of the joints of the suction pipe.<sup>87</sup>

Denny's gratitude was echoed by the Committee, overwhelmed by the success of Watt's proposal, they unanimously agreed to reward him with a piece of plate worth 100 guineas, 'in testimony of the high opinion they entertain of his abilities and for essential services rendered by him to the Glasgow Water Works – particularly for the very ingenious plan furnished to the Company through his recommendation ...'.<sup>88</sup> On consultation with his family, Watt chose a silver soup tureen manufactured by a goldsmith in London (Messrs Green, Ward & Green) an object which remained within the Watt family until the early years of the 21st century.

Watt had apparently saved the Glasgow Water Works and with the supply problem solved, the demand for water increased and the mains network grew ever more extensive. A Report of the Committee on the Glasgow Water Works for 1813 stated that:

Nearly 6,000 yards of pipes have been laid. The whole city, most of the suburbs, and part of the adjacent country are now supplied with excellent water. To the North as far as Sauchiehall Road, Cowcaddens and Port Dundas to the South including Gorbals, Hutchestontown and Tradestown and to the East reaching the extremities of Calton Bridge, Bridgeton, Camlachie and even to Haghall. The Water is conducted both for families and public works. To the West the Pipes are carried no further than York Street and will be subject of further consideration whether they should not be extended the length of Anderston.<sup>89</sup>

Not everything was running smoothly. The Duke Street Reservoir was leaking,<sup>90</sup> and there

were disputes with the local police force over whether monies should be paid to mount a nightly watch over premises, a suggestion which Denny considered wholly unnecessary.<sup>91</sup> There were also disputes with rent collectors working for the rival Cranstonhill Water Company, over their attempts to poach customers in Bridgeton,<sup>92</sup> and instances of water being drawn illicitly off the main, without the Committee's knowledge. One of the guilty culprits in this practice was Calton Jail, with Denny issuing a complaint to the Provost of Calton on 22 May 1820:

On going through Crosstone street this afternoon along with our foreman, we were much surprised to find that our main pipe had been cut, a branch put on and a pipe led from it to supply the Calton Jail with our Water. And all this done by some person or persons entirely out with our knowledge.<sup>93</sup>

Increased demand led to the purchase of additional ground at Cuningar on 24 March 1819,<sup>94</sup> with the expansion of the city into the area around Blythswood and Garnethill in the 1820s required the construction of additional engines in order to cope with the extra demand. A Boulton, Watt & Co. drawing, dated 1818, which shows one of the engine houses built at this time, is illustrated in Hume's *The Industrial Archaeology of Glasgow*, though the structure itself no longer survives.<sup>95</sup>

*The New Statistical Account* of 1834–43 is lavish in its praises of the Water Company's achievements, stating that, 'The Working Classes are better lodged, clothed and fed than formerly, and since the formation of the Water Companies, they are more cleanly in their houses, and healthy in their persons'.<sup>96</sup> The benefits extended beyond the needs of the domestic household, with conditions in the public jails also now much improved in terms of sanitation:

As there is a water-closet in every gallery, every individual prisoner, debtor and delinquent has access to one of them, and to an unlimited supply

of pure filtered water . . . and pipes are introduced into each court from which they are daily washed, and the air in them frequently cooled in hot weather.<sup>97</sup>

But despite this acclaim, with two companies actively competing for customers across Glasgow, it is hardly surprising that neither proved successful financially.<sup>98</sup> As a result, a merger was agreed by the respective committees. This was strongly opposed by the Town Council at first, though eventually agreement was reached and the two were combined in 1838.

#### THE RETURN OF ENGINEERED FILTRATION

Once again, the city's growth eventually resulted in demand outstripping the capacity of the water supply system. While it might be assumed that outbreaks of typhoid and cholera, in 1818 and 1832 respectively, might have provoked public disquiet about the water supply, this was not in fact the case as it was not until 1854 that the physician, John Snow, first realised that major epidemics of this kind were water-borne, rather than being passed through a population via a foul-smelling mist or *miasma*. Instead, it was once again the thorny issues of quantity and quality which were provoking criticism from the Water Company's customers. The problem was that so much water was being drawn through the filter wells from the river gravels that the water was not completing the natural process of filtration.

Cuningar remained the focus for efforts to improve the situation, and in 1838, another Parliamentary Act was passed.<sup>99</sup> This enabled the construction of a series of filtration beds on the Cuningar Loop, fed by the original three filter wells, with the purified water stored in a central reservoir. This purified water was then pumped north to the engine houses on the north bank, for supply to the water main reservoirs. The overuse

of the natural resource had led to the failure of Watt's scheme and a return – on a more massive scale – to Telford's original engineered filtration method. This third stage of the Glasgow Water Works is that mapped on the Ordnance Survey 1st edition map of Glasgow, and it represents the last attempt to procure a water supply for the city from local sources.

### A NEW APPROACH

The creation of the Gorbals Gravitation Water Company in 1846 marked a departure from the filtration method and heralded the end of the reliance on water drawn from the River Clyde and its immediate vicinity. Supplying the south side of the city, the quality of the water provided by this company far surpassed that distributed by the Glasgow Water Corporation.<sup>100</sup> The disparity in quality was due to the source of the company's supply: instead of filtering water from the Clyde, the supply was from a rural tributary of the White Cart – the water was pure from source.

The success of the Gorbals Gravitation Company sparked off attempts to launch more ambitious schemes to transport water over considerable distances for use within the city. Various sources were suggested, including the upper reaches of the Clyde, the North Calder, the Avon, and even the waters of Loch Lomond.<sup>101</sup> It was not, however, until 1852 that another proposal was set out to utilise Loch Katrine's waters, put forward this time by Professor Macquorn Rankine and John Thomson. The engineer, John Frederick Bateman, whose name has since become synonymous with the provision of Glasgow's water supply, was approached to carry out the initial investigations and submit a report to the corporation in 1853.

Like Telford's scheme, undertaken almost half a century previously, Bateman's proposals provoked some opposition, this time from the Admiralty, prompting Glasgow Corporation

to commission a report from two of the most celebrated engineers of the time – Robert Stephenson and Isambard Kingdom Brunel – supporting Bateman's proposal. The Bill was passed by Parliament on 2 July 1855: this same Act of Parliament resulted in the purchase and subsequent dismantling of both the Glasgow Water Works and Cranstonhill Company works.<sup>102</sup>

With the completion of the Loch Katrine scheme in the autumn of 1859, the problem of Glasgow's water supply was resolved at last. The adoption of the Loch Katrine supply did not, however, mark the end of Cuningar's role in the city's infrastructure. The site itself, and perhaps the reservoirs, remained in use as the Westthorn River-Supply Works, created in order to supply industrial users with water. New engines were installed on the Cuningar Loop, two compound-tandem horizontal engines (of approximately 100 horsepower each) with double-acting pumps and four Lancashire boilers.<sup>103</sup>

However, the removal of coal from beneath the site of the pumping-station led to a catastrophic collapse in 1911–12.<sup>104</sup> After the cessation of mining, the engines were reinstated, with the water pumped from the Clyde being stored in reservoirs located on the north bank of the Clyde, directly east of the Cuningar Loop. But by the 1960s, even the River-Supply Works had fallen into disuse, with the remaining features being filled with rubble dumped from the Gorbals slum clearance. The area was subsequently landscaped, and virtually every trace of these earlier structures obscured.

### CONCLUSION

The provision of a clean, fresh and copious water supply is now taken for granted, but it was only in the Georgian period (1714–1830) that it became an achievable aim and one which was arguably seen as a mark of distinction amongst the major manufacturing and mercantile centres of Britain and Ireland.

Such enterprises were typically funded through capital raised from private investors, and Glasgow's clearly demonstrates the difficulties involved in using cutting edge technology to cope with an ever-evolving and ever-expanding demand. Telford's initial attempts to deliver the scheme were successful in the short term, but the subsequent expansion of the city, encouraged in part by the infrastructure he created, meant it could no longer perform its original function satisfactorily.

The next few decades saw a succession of attempts to deal with the shortcomings in Telford's plan, but once again, each of these was ultimately destined to fail. The copious supplies of water issuing forth from Cuningar Loop, deemed at first, in 1810, to be more than sufficient, had, by 1838, proved incapable of sating the ever-growing city's demands. Watt's ingenious solution was then replaced, in turn, by a larger, more grandiose arrangement of engineered filtration beds and reservoirs that replicated Telford's original.

The eventual adoption of the Loch Katrine scheme in 1858 has totally eclipsed these earlier achievements in the public consciousness. Victorian engineering success has meant that these earlier adventures of Georgian technological ingenuity, played out in a series of trials and errors which were dismissed at the time as white elephants, have been almost totally erased from Glasgow's history. This process of large-scale experimentation is summed up perfectly by a summary of the early history of engineered filtration, written by one of Telford's resident engineers and included in his posthumously published autobiography:

So little has been written on the subject of filtration of a practical nature, that the art of conducting the process upon a large scale was yet to be acquired, and improvements to be made upon the works at Glasgow, Manchester and other places, where it appeared that instances of failure, as well as success, had occurred.<sup>105</sup>

Engineered filtration ultimately failed in Glasgow, but other elements of Telford's scheme did not. Arguably the greatest and most significant undertaking was not the construction of reservoirs, filtration beds and engine houses, but the laying of a mains network across much of the city. Each successive attempt to counter the perceived deficiencies of its predecessors was wholly reliant upon this pre-existing mains network, established under Telford's guidance, and consistently taken-for-granted by those who followed after him.

Telford's mains network has now been replaced, and all traces of his original scheme eradicated from the landscape. But elements of James Watt's 1810 well and pipeline may well survive at Cuningar, along with the 1830s filtration beds that succeeded it, buried beneath a thick terrace of rubble. The physical landscape at Cuningar may not now be much to look at, but the area remains nonetheless a valuable resource, a tangible link with a period in the city's history where private enterprise combined with technological innovation to enhance its future ability to flourish as a successful centre for industry and commerce.

## NOTES

BCA Birmingham City Archives

GCA Glasgow City Archives

- 1 Held by Glasgow City Archives.
- 2 Strang, 1857: 464.
- 3 Held by Birmingham City Archives.
- 4 For example, Gregory, 1921; Stevenson & Torrie, 1990.
- 5 Marwick, 1901.
- 6 Ibid.
- 7 Ibid.
- 8 Cited in Marwick, 1901: 5.
- 9 Aird, 1894: 137.
- 10 Winant, 1997.
- 11 Carlyle, 2004.
- 12 Dickinson, 1954.
- 13 Brook, 1853: 387–8.
- 14 Anon, 1791–9: 533.

- 15 Paxton, 2007.
- 16 Ibid.
- 17 GCA F13/1 letter to Thomas Telford of 1 January 1806.
- 18 GCA F13/1 letter to Thomas Telford of 17 January 1806.
- 19 BWC MS 3147/3/525/10.
- 20 Telford, 1806.
- 21 GCA F13/1 letter to Thomas Telford of 25 January 1806.
- 22 Bell, 1806.
- 23 BWC MS/3147/3/525/10.
- 24 Birmingham City Archives, pers comm.
- 25 BWC MS 3147/3/525/21.
- 26 BWC MS 3147/3/525/22.
- 27 Telford, 1838.
- 28 Rennie, 1804.
- 29 Telford, 1838.
- 30 Telford, 1838.
- 31 Telford, 1805.
- 32 BWC MS 3147/3/525/22.
- 33 BWC MS 3147/3/525/23.
- 34 BWC MS 3147/3/525/25.
- 35 BWC MS 3147/3/525/26.
- 36 GCA F13/1 letter to John Buchanan Esq. of 24 April 1806.
- 37 For example, Mundell, 1838.
- 38 GCA F13/1 letter to Alexander Mundell dated 28 June 1806.
- 39 GCA F13/1 letter to Alexander Mundell dated 8 July 1806.
- 40 GCA F13/1 letter to Thomas Telford dated 1 July 1806.
- 41 PH HL/PO/JO/10/8/109.
- 42 Scotland. Laws, Statutes etc. 1926.
- 43 BWC MS/3147/3/525/30.
- 44 BWC MS 3147/5/1094.
- 45 A later plan shows the engine house sited farther from the river.
- 46 GCA F13/1 letter to Thomas Telford of 11 August 1806.
- 47 GCA F13/1 letter to Samuel Hide of 24 September 1806.
- 48 GCA F13/1 letter to Capt. James Forbes of 1 April 1807.
- 49 BWC MS3147/3/525/36.
- 50 GCA F13/1 letter to James Watt dated 27 October 1809.
- 51 BWC MS 3147/3/525/37.
- 52 GCA letter to Messrs Booth & Co. dated 15 February 1807.
- 53 GCA letter to Messrs Booth & Co. dated 14 April 1807.
- 54 GCA letter to Messrs Booth & Co. dated 24 June, 1807.
- 55 GCA F13/1 letter to Messrs Booth & Co. dated 26 September 1807.
- 56 GCA F13/1 letter to Messrs Booth & Co. dated 11 April 1809.
- 57 GCA F13/1 letter to Messrs Booth & Co. dated 11 July 1807.
- 58 GCA F13/1 letter to Messrs Booth & Co. dated 28 February 1808.
- 59 Walsh, 1966.
- 60 GCA F13/1 letter to John Busby dated 4 March 1808.
- 61 GCA F13/1 letter to James Kidd (Leith shipping agent) dated 26 April 1808.
- 62 GCA F13/1 letter to Daniel Busby Esq. dated 26 April 1808.
- 63 GCA F13/1 letter to Messrs Booth & Co. dated 9 May 1808.
- 64 GCA F13/1 letter to Carron Company dated 27 February 1808.
- 65 GCA F13/1 letter to Hugh & Robert Baird dated 22 March 1809.
- 66 GCA F13/1 letter to Martin Dalrymple dated 30 March 1809.
- 67 GCA F13/1 letter to Martin Dalrymple dated 8 July 1809 .
- 68 GCA F13/1 letter to James Reid dated 21 July 1809.
- 69 GCA F13/1 letter to Messrs Booth & Co. dated 28 February 1809.
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- GCA Glasgow City Archives D-WA 4-22 F/13 Waterworks Letter Book 1806–25
- PH Portcullis House Records of the House of Lords: Journal Office: Main Papers 1800–50

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