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MILLEND MILL – PART 2
THE BOULTON & WATT ENGINE HOUSE

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Introduction

Of all 19th century industrial structures, perhaps one of the most recognisable is the one housing the typical steam engine of the period. Although invariably, these differ in detail and dimension, as they generally followed the form of the engine that they housed, many tend to be of a similar configuration – most were tall and narrow with a pitched roof. At one time these were a relatively common feature in some parts of the country's industrial landscapes. However, in Gloucestershire, they remained something of a rarity.

In the case of Boulton & Watt (B&W), arguably the best-known supplier of engines of this period, during the first quarter of the 19th century, steam engines of varying capacities were sold to a small number of Gloucestershire manufacturers. A significant proportion of these went into woollen cloth mills in and around the Stroud valleys. However, other units were supplied to companies that included the Stone Pipe Company near Stow-on-the-Wold and the Purnells' tin plate rolling works at Framilode. Several others went to cotton mills in Bristol. As reported in previous GSIA Journals (2008 and 2010), four engines were eventually supplied to the wealthy woollen cloth manufacturer Henry Hicks, who at various times, ran cloth mills in Stonehouse, Leonard Stanley and Eastington. The present article focuses on the developments at one of the latter, namely Millend Mill.

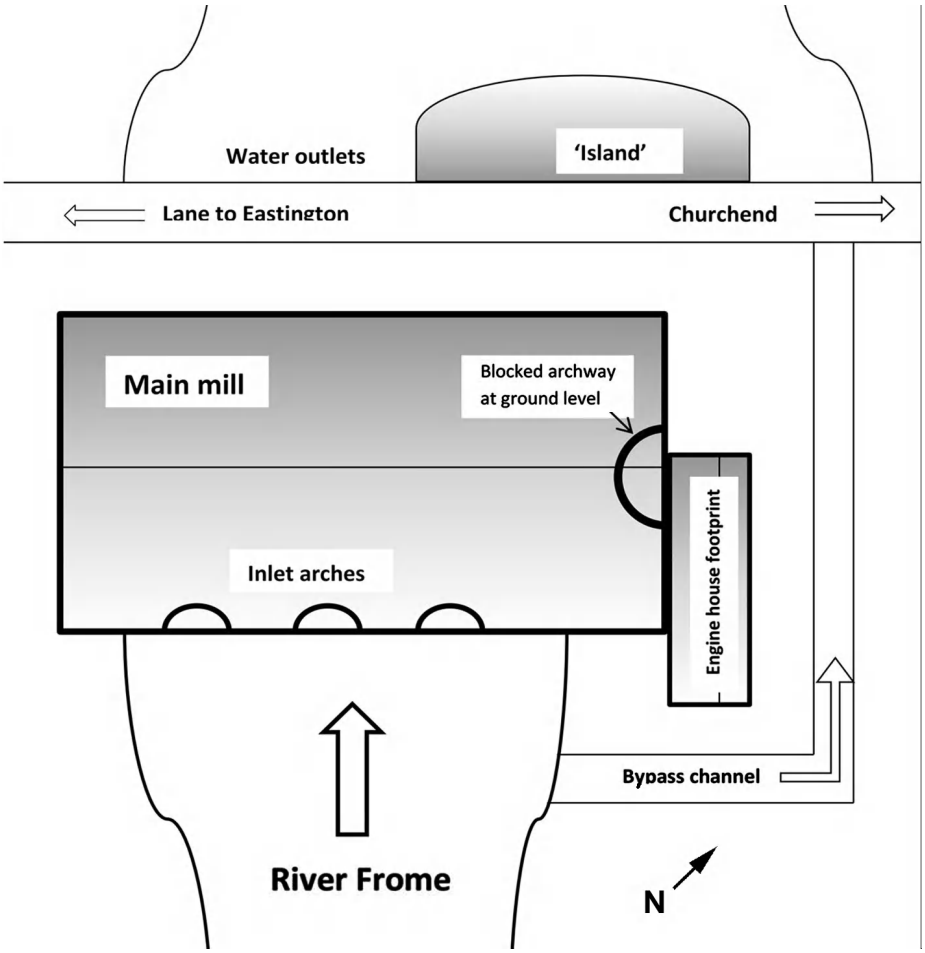

Figure 1. Schematic Layout of Millend Mill showing the position of the engine house

In the GSIA Journal for 2010, it was noted that the main building at Millend was the subject of an on-going conversion into apartments. By this time, all of the auxiliary buildings added since the mill's original construction had been demolished. However, as a result of changes in ownership and the poor state of the property market in general, the conversion process subsequently stalled for nearly two years. When work resumed

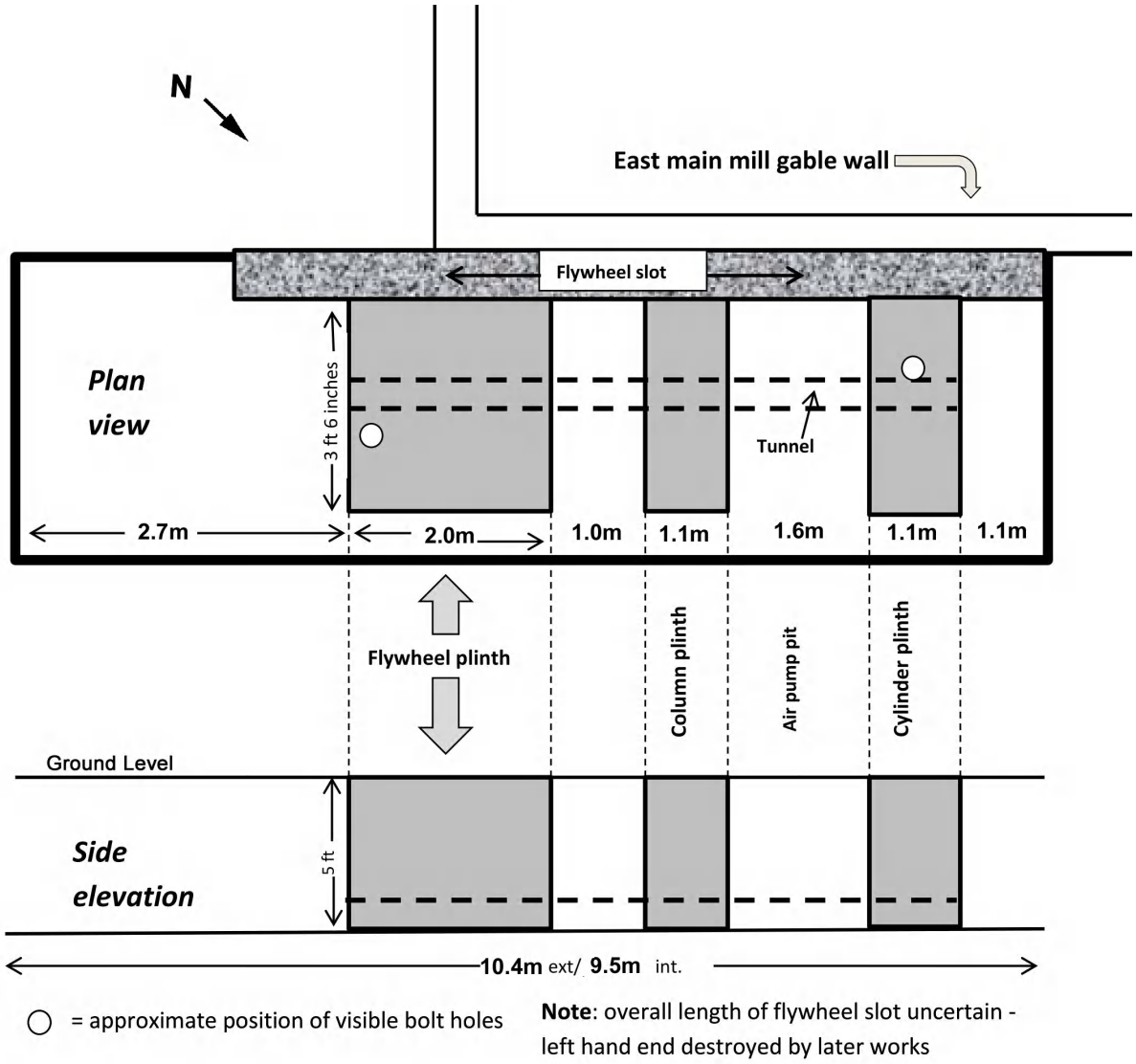

Figure 2. Layout of the Engine House

on site in late 2011, it was hoped that the large relatively modern slab of concrete at the foot of the eastern wall of the main mill would finally be removed. This appeared to cover the supposed location of a Boulton & Watt engine house built around 1820-21 (Figures 1, 2). This entire area had previously been covered by a large building dating to the 1930s or 40s – this was demolished in 2009. It was hoped that clearance of this area might reveal details of the configuration of the engine house that had been added to the main mill. Because of the inevitable stresses and strains imposed by a beam engine, foundations and footings for an engine and its ancillary equipment tended to be both deep and substantial. It was hoped that evidence of the engine and engine house might remain in situ beneath the concrete.

The present article reports what was uncovered when the concrete slab and other building remains were removed during the first quarter of 2012.

Documentary evidence

As detailed in previous Journals, based on information retrieved from the Boulton & Watt archive, it was suggested that the engine supplied was housed in a rectangular engine house added to the east end of the main mill building. The order for the engine was placed with Boulton & Watt in 1821 although it appears that this move had been under consideration for

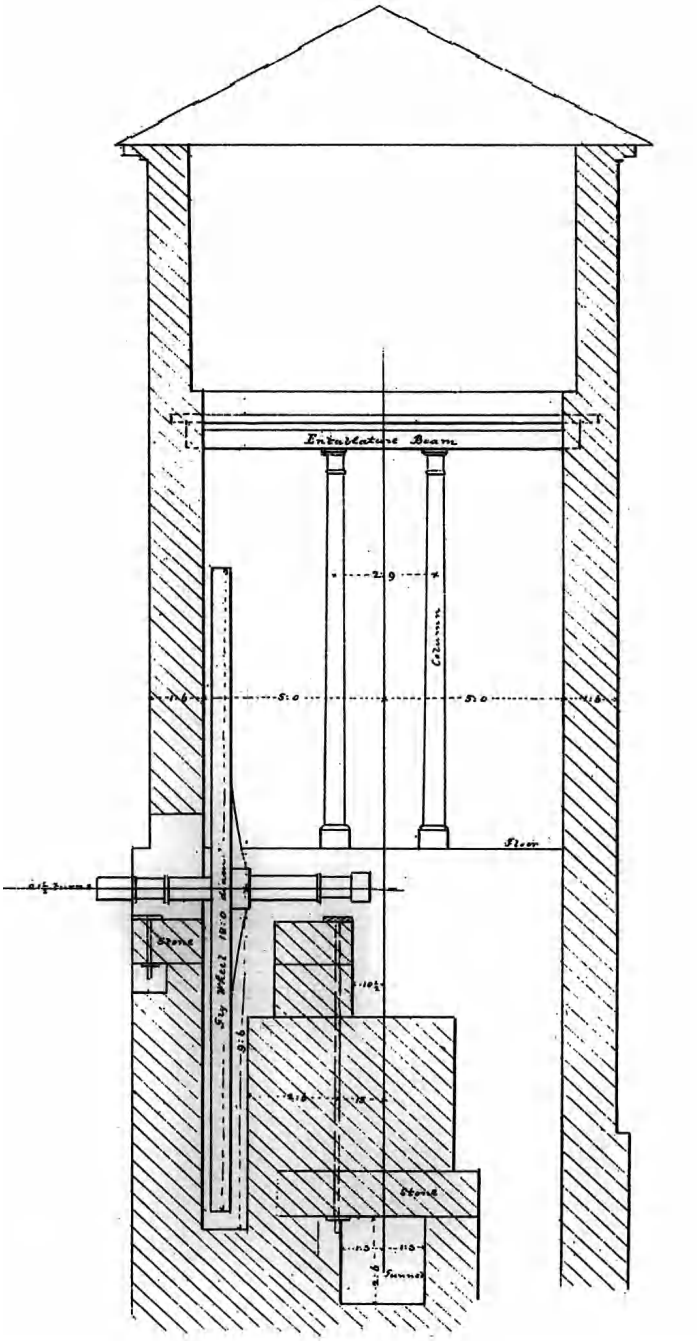

Figure 3. Drawing of the Boulton & Watt engine house built at Hicks's Churchend Mills (from Boulton & Watt archives). It appears to have been identical to the Millend engine house.

several years. The engine had a cylinder with a stroke of 3 feet and generated 14 horse power.

No drawings of the Millend engine house survive although detailed drawings for Millend's sister mill, a short distance away at Churchend, have been located and reported previously (Figure 3). At Churchend, a B&W steam engine was installed around the same time as at Millend. Evidence suggests that both engine houses were of similar size and configuration (Figure 4).

It is not known how the main engine components were transported to Millend although it seems likely that these were brought along the Stroudwater Canal, less than a mile away, then carted to the site. This was the arrangement adopted a few years later in 1826, when Hicks installed a larger Boulton & Watt engine in one of his other Eastington mills, Meadow Mill. Materials and components for Meadow Mill were unloaded at a dedicated wharf nearby, with the final stage in their journey being made via a small tramway built specifically for the purpose. Subsequently, coal for the local mills was unloaded here and stored in a secure coal pen close to the canal. A local observer commented on the passage of the Meadow Mill engine along the canal and noted:

My special interest was fixed on the noble fittings of a handsome steam engine, on which I could discern the name 'Watt, Soho, 1826', followed by two monster boilers.

It seems highly likely that the engine and boiler for Millend Mill also followed the same route. Stone for Millend's construction is thought to have come from quarries at Brimscombe, also the likely source of the large stone blocks used for the engine plinths. Again, transport along the canal seems the most obvious means of transport.

Site excavations

The area of interest was cleared during the first part of 2012. As hoped, this revealed not only the almost complete footprint of the engine house, but most of the heavy stone footings that

Figure 4. Graphic representing the configuration of the Millend engine house. It is fitted to the surviving footprint and is based on the dimensions of the engine house at Churchend Mill.

carried the engine's main components. These comprise three substantial stone plinths that supported the engine's main axle, central supporting columns for the beam, and the cylinder. Beneath these, excavations carried out also uncovered the access 'tunnel' running beneath almost the full length of the engine house (Figure 5). Remarkably, although no iron components remained in situ, much of the arrangements to accommodate the engine remain largely intact below ground level. These are composed mainly of blocks of stone of such a size and weight, that they were left in place when the engine house was demolished and built over (Figure 6).

During excavation, several holes (of nearly 3 inch diameter) were revealed. These passed

Figure 5. Excavation between two of the engine platforms showing the depth of the stone foundations and the small access tunnel (filled with mud) running beneath them.

Figure 6.
The surviving large stone platforms that carried the engine's main components.

The blocked opening in the main mill wall behind probably formed part of the power transmission arrangements.

through the entire depth of the stone blocks making up the individual plinths/platforms and were used for the long iron rods that held down the engine's main components. They were presumably secured by nuts fitted from below in the access tunnel (see Figure 7) - this must have been a difficult job.

The slot for the engine's flywheel was also revealed, located immediately adjacent to the main mill's eastern wall (Figure 8). This had been partially infilled with concrete and now incorporates several later brick-built modifications (function unknown). Excavation revealed that the slot was at least 18 feet in length although the outer end had been destroyed by later works; possibly a further 4-5 feet once existed. The diameter of the engine's flywheel (assuming it was

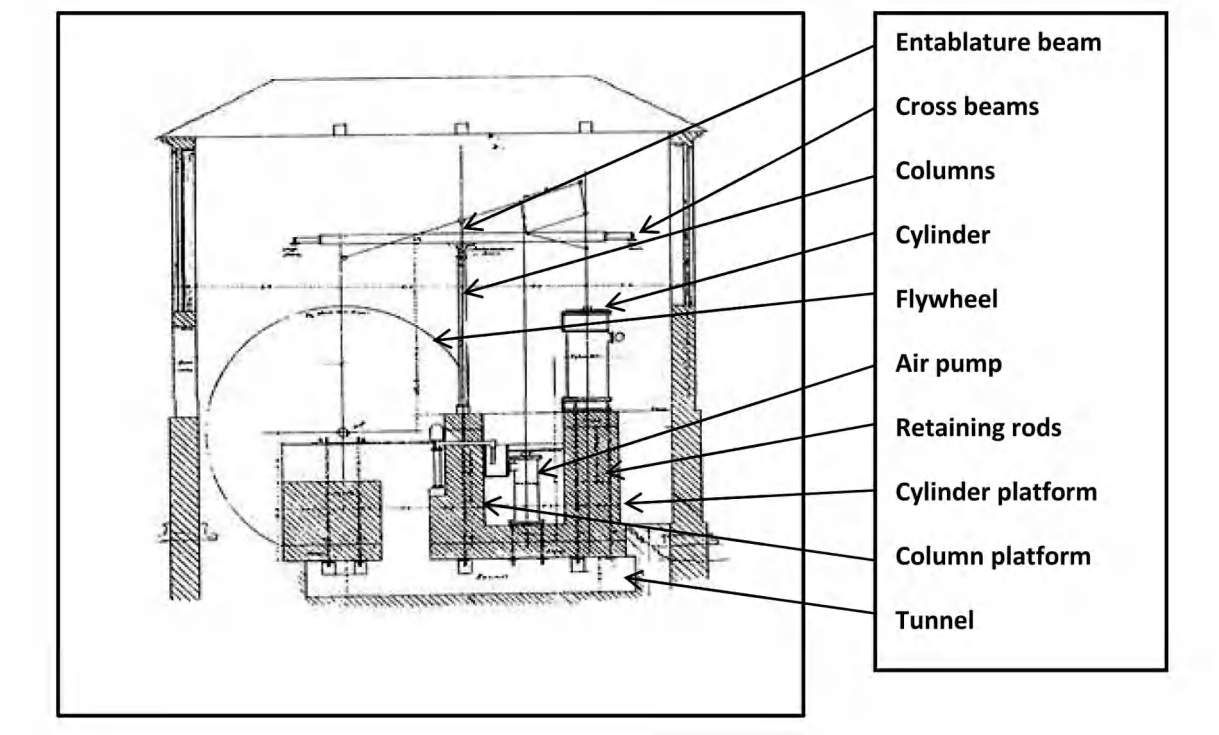

Figure 7. Drawing of the Churchend engine showing the long iron rods passing through the three platforms. These retained the crank/flywheel supports, the main columns and the cylinder. Retaining nuts were presumably fitted from below in the small access tunnel.

Figure 8.
Excavation of part of the slot for the Millend engine's flywheel. The brick additions are thought to be a later modification. The lower section appears to have been filled with concrete.

the same as the Churchend Mill engine) would have been 18 feet. The slot's width varies between 20 and 22 inches although it may have originally been wider, as at some stage, it has been lined with bricks, effectively narrowing it. The depth of the slot down to the concrete infill is now only around 20 inches.

Most of the footings and lower courses of bricks of the outer walls of the engine house can be traced. Although later alterations have obliterated some parts, the overall external length was found to be 34 feet and the internal width 10 feet; this tallies almost exactly with the confirmed dimensions of the Churchend engine house.

Clearance of the 1930-40s buildings at Millend revealed various scars and alterations in the stonework of the eastern wall of the mill where the engine house was once attached. Once the engine's main plinths had been uncovered, the reasons for a number of these became apparent. It was clear that when the engine house was added to the mill, the large arched opening that originally allowed access to the ground floor (the location of three large water wheels and equipment such as fulling stocks) had been at least partially closed off by its addition - it was probably at this time that the arch was infilled with a variety of stone blocks and bricks. The new engine house did not fit squarely against the main mill – a section of it extended beyond the mill's back wall.

Several blocked openings let high up into the mill's eastern wall suggest that they once carried transverse reinforcement beams for the upper part of the engine. Based on the drawings of the Churchend Mill engine house, it appears that there was an upper floor and that the roof was carried on three main beams set transversely across its width - there are two openings cut into Millend Mill's eastern wall at the appropriate height that appear to match up with two of these supports. The third one would have been in the section of the engine house that extended past the main mill. Below these openings are a line of blocked joist holes that presumably carried the upper floor above the engine (Figure 9).

The shaft drive from the engine would have been taken through an opening in the mill's eastern wall. Because so many changes have been made to the fabric of the mill at this point, it is not possible to determine precisely how and where this was accomplished. However, there are several blocked openings that are possible candidates. In particular, there is a rectangular section of the wall's stonework that has been disturbed. At each corner of this, four rectangular

Figure 9 The main mill wall showing where the engine house once overlapped; the white line on the right indicates the one end wall. Note the earlier stone access arch, closed off when the engine house was added. Also note the openings cut high in the mill wall for the engine house roof beams and transverse engine supports, and the rectangular openings cut for reinforcement plates – these are thought to be associated with power transmission arrangements into the mill. The row of blocked upper holes carried the joists for the engine house's upper floor.

recesses (11 inches wide, 14 inches tall, and 1.5 inches deep) have been cut into the stonework, each with a central 2 inch diameter bolt hole passing through the wall. There is also at least one more such recess set higher up in the wall. These appear to have held iron reinforcing plates that once formed part of the arrangement for transferring the engine's drive into the mill. The vertical distance between the circular holes is 25 inches, and exactly 5 feet horizontally (Figure

Figure 10.
Close-up of one of the recesses cut for supporting plates. The bolt holes pass right through the mill's wall. These presumably provided reinforcement for part of the power transmission arrangements.

10). Inside the mill, it is clear that there has been considerable disruption to the wall in this area, and although highly likely, it is not possible to link this definitely directly to the power transmission arrangements from the engine.

Once the drive had been taken inside the mill, power would have been transmitted to machinery on the upper floors via a series of leather belts driving belt wheels attached to line shafting, the configuration most often encountered in local mills of the period. The alternative was the use of a large vertical iron shaft that transmitted power to upper floors via bevel gears at each level. However, this system remained uncommon in Gloucestershire mills. Such systems tended to be cumbersome, heavy and because of high frictional losses, wasted a lot of energy. Similarly, the use of rope drives, often encountered in textile mills in the north of England, was rare.

Part of Millend's power transmission arrangement would probably have included some form of clutch, used to disengage the engine when not needed. Often, for obvious economic reasons, operators of local mills tried to rely solely on water power (Millend had three water wheels) whenever possible, only bringing the engine into play when operational requirements dictated it. This could be the result of insufficient water being available, or later, as mechanisation increased in the woollen industry, the need for additional power to drive more machinery. Clearly, operating the engine required both manpower and coal, and the lack of the latter in the area meant that it was relatively expensive. At the time, most coal came along the Stroudwater Canal, brought mainly from coalfields in the Forest of Dean or the Midlands. Apart from a number of cast iron bearing boxes set into the eastern wall, there is no evidence of secondary power transmission arrangements surviving within the mill. These were associated with the line shafting installed at the different levels. There is no surviving evidence to suggest the design of clutch mechanism used; this could have been one of several types of ratchet or friction mechanism used commonly for such purposes.

Inside, the interior of the engine house appears to have been plastered and whitewashed. Remnants of plaster still adhere to the mill's outer/engine house interior wall. This contains a significant amount of what is probably ground boiler ash.

Later developments at the mill

In 1871, after the end of cloth manufacture, Millend Mill was bought by George Ford who turned it over to corn milling and saw milling. Sales particulars of the time mention a 14 horse power engine and two Boulton & Watt boilers – this was undoubtedly still the original Boulton & Watt engine and (presumably) boilers installed in about 1821.

By 1885, things had changed and machinery on site now included a 'stationary' steam engine (presumably the original B&W unit), a Ruston & Proctor portable steam engine, a 'high pressure' steam engine, and two waggon boilers (supplied by B&W). Two years later an inventory noted a 20 HP engine plus a new high pressure Cornish boiler - "70-80 lb pressure, with Galloway tubes and fittings, as fixed". Galloway tubes had been patented in 1848 by the company of the same name and consisted of tapered thermic syphon water-tubes usually inserted in the furnace of a Lancashire boiler. Their use increased heat transfer to the water, enabling higher pressures and faster steam generation. Unfortunately, it is not clear whether the 20 HP engine mentioned was new on site or if it was the existing high pressure engine or the Ruston & Proctor unit. By this time, steam engines were a common feature on industrial sites and tended to be less well recorded. The situation can often be further confused as, especially with smaller engines, it became common for units, most of which were by now stand-alone, to be moved between sites, unlike earlier beam engines that were essentially built into their bespoke engine houses.

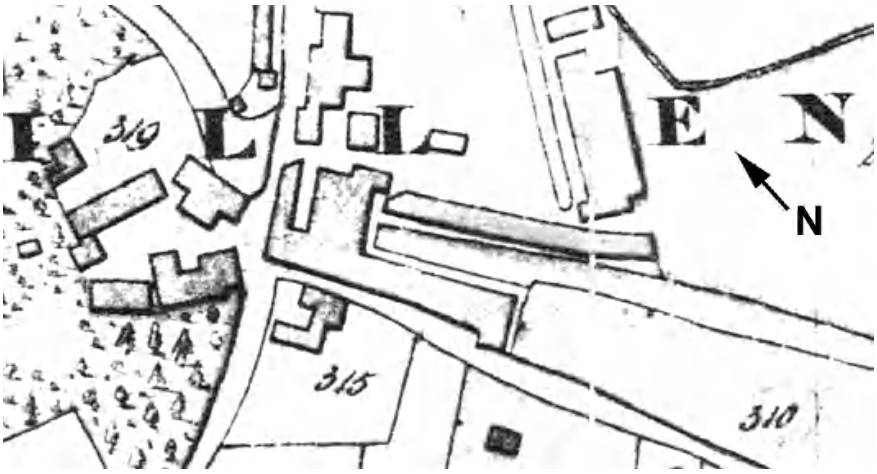

Figure 11.
The 1839 tithe map, showing how the engine house had been attached to the mill.

So, it appears that Millend's original B&W engine was still in situ up to at least the 1870s, and was probably still in use up to the 1880s. However, there are no later records to suggest when it finally went out of use. It is not clear when the engine house was demolished – its outline is clearly visible on maps of 1839, 1884 and remarkably, even 1923 (Figures 11 and 12).The supposition is that the building may have survived in some form until a large new building was added to the eastern end of the mill, probably in the 1930s. The engine may have been scrapped many years earlier so if this was the case, presumably the engine house was either unused or had been turned over to some other use. Ironically, it was the presence of the later building with its concrete floor that preserved much of the earlier evidence below ground.

Concluding comments

As with all engines of the period, the installation of the Boulton & Watt engine and its attendant

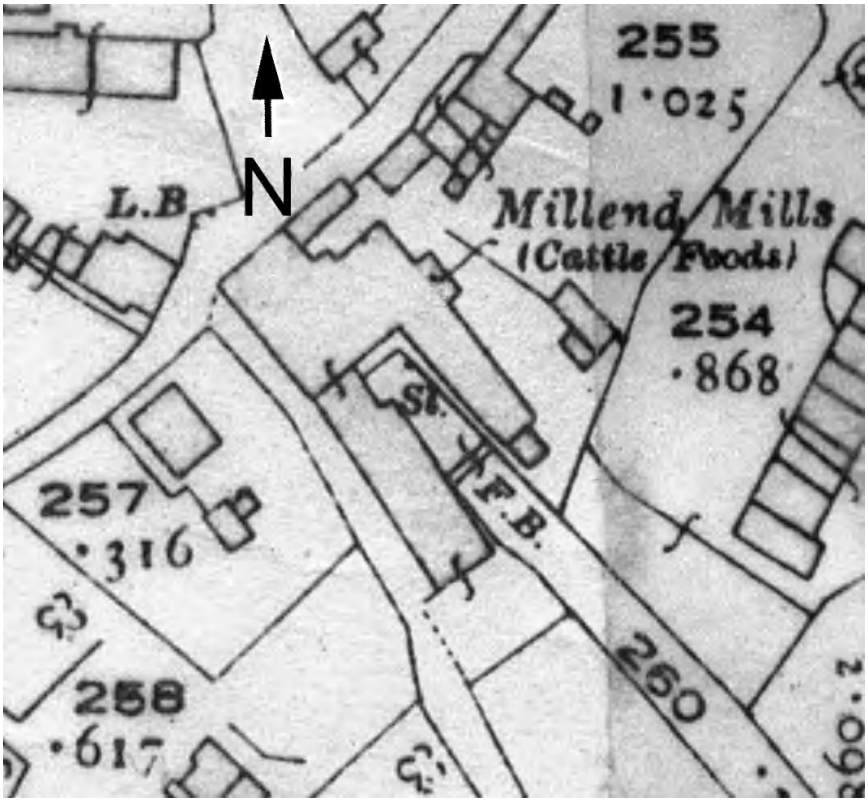

Figure 12.
The 1923 Ordnance Survey map showing that the engine house still survived at this date.

engine house would have required a considerable outlay on the part of Henry Hicks. However, like most of his contemporaries in the woollen trade, Hick's steam engine would only have been brought into service when power requirements dictated it; where adequate, the water wheels would have been the first choice as they cost nothing to run. However, when the water level in the Frome was low, as it sometimes was, the engine was a crucial lifeline in keeping the mill running. In times of drought, other local mills came to a stop until sufficient water had been impounded in their respective mill ponds. Until then, workers were forced to stand idle and deadlines for cloth orders were missed, often resulting in financial penalties for the mill owner.

Unlike many textile mills in the north of England that were solely dependent on steam power, even well into the 20th century, many Stroud valley mills continued to rely on combinations of water and steam power. Steam engines were only fired up when necessary, either under seasonal drought conditions or later, when additional power was needed to drive the increasing amounts of machinery being installed in the region's cloth mills - often, steam power was used to supplement water, rather than replace it. Millend Mill was just one of many operated in this manner.

Figure 13. The site owner's unusual means of transport to the site!

Although excavation and documentary evidence has now confirmed the exact location of Millend's engine house, there remains something of a mystery regarding the siting of the two boilers also supplied by Boulton & Watt. It was previously supposed that the boilers may have been situated adjacent to the engine house in an L-shaped building that wrapped itself around the corner of the mill. There are innumerable scars in the stonework of the mill's main walls that suggest this, although it is impossible to determine when these date from. Over the years, many alterations were made in this area. One other possibility (although it seems unlikely) is that the boilers were installed on the ground floor of the main mill. Again, many changes in the mill's stonework have become apparent, including several circular openings into the engine house, presumably made for pipes of different diameters. However, there is no way to confirm their age or function. In theory, there would have been sufficient room on the mill's ground floor to accommodate the boilers although this seems unlikely. It is possible that further work on site may provide a firm answer, although this appears doubtful. The best guess still seems to be the L-shaped building hypothesis.

Although re-development of the Millend Mill site is now well underway, it is likely to be some time before any firm decisions are made regarding the future of these interesting remains. Discussions with the site owner seem promising and it is hoped that perhaps the engine house footprint can be retained or marked in some way as part of what will eventually form the main vehicular access to the rest of the site. Useful meetings have been held on site with the developers (Figure 13).