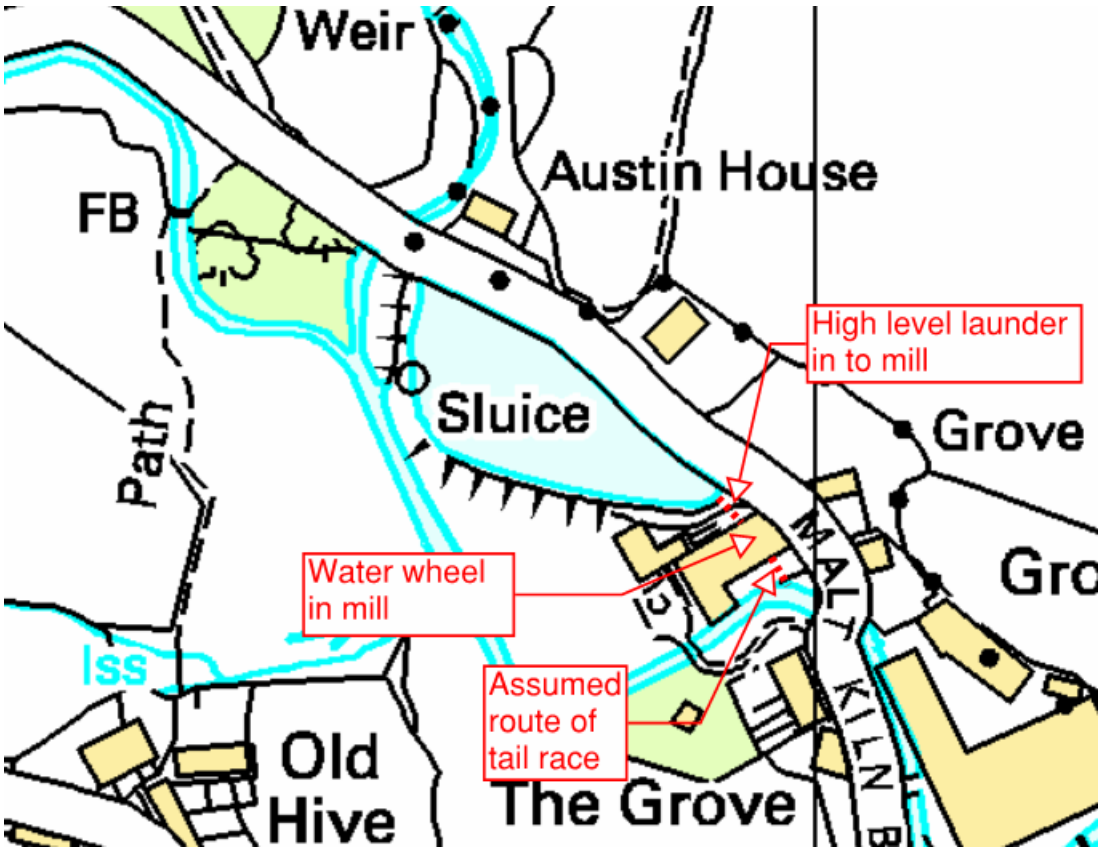
Site 5: Kirk Mills, Chipping (aka Berry's Factory)

Site Assessment

Figure 1 Map showing general layout



Berry's furniture mill in Chipping (also know as Kirk Mill) was originally a corn mill, turned cotton mill and records indicate that cotton spinning began around the mid 1500s using water power. The site was later redeveloped and the current mill building is reported to be one of the oldest Richard Arkwright designed cotton mills in the country, dating back to 1785. It is reported that from 1923 the water wheel was being used to generate electricity to light the mill and adjacent properties. The mill was taken over by the furniture maker HJ Berry in 1840, and they are believed to have continued to use water power up until 1940 when a diesel engine was installed. The mill was in use until 2010 and has recently been sold for redevelopment.

A site visit was conducted for this site, though no access could be gained into the mill. However, a review of historical records indicate that the wheel is in the region of 6m in diameter and 1.5m wide, constructed with timber spokes and cast iron buckets and was still partly in place in 1989, an upper segment of which was removed in the 1940s to make a new access to the second floor.

The mill is fed from a pond with a surface area of approximately 0.33 hectares, located behind a tall embankment at the back of the mill and is reportedly fed by two streams though this could not be confirmed on site. Transfer of water from the mill pond to the mill is via a high level mill lauder, an enclosed rectangular conduit constructed of cast iron and timber.

The tailrace appears to run in enclosed conduit below ground though the exact discharge location back to Chipping Brook has not been confirmed but thought to be beneath the crane in the yard.

The site is of historic value and future owners may want to consider renovating the waterwheel and installing a generator to produce electricity. The mill pond appears in good condition although the lauder would need to attention along with other infrastructure. The source of water supply to the mill pond would also need to be confirmed.

Figure 2

Underside of launder between mill pond and mill

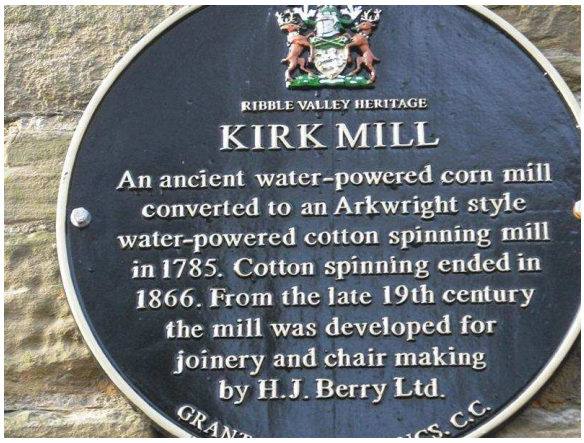


Figure 3 Plaque on mill wall

Figure 4

The water outlet thought to be beneath crane

Figure 5 Mill pond looking towards mill

Catchment Analysis

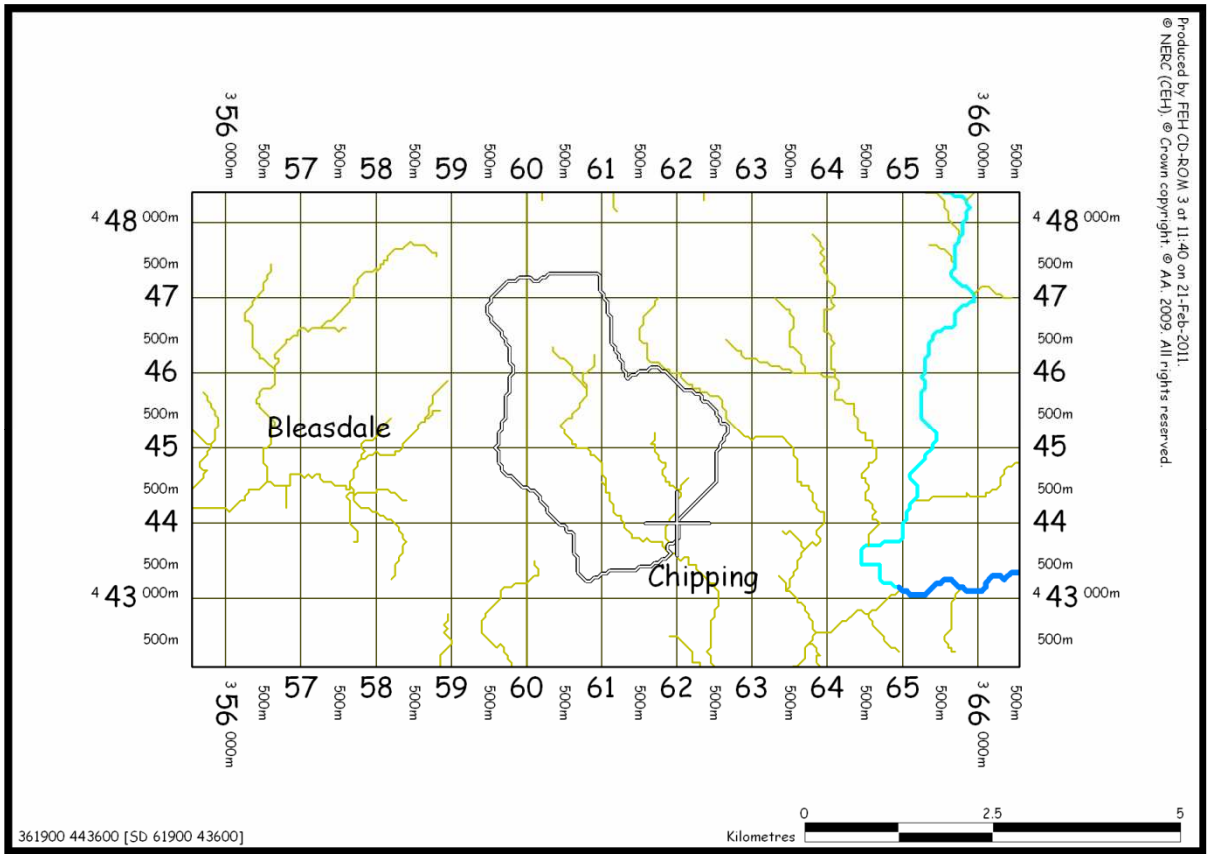


Figure 6 Catchment boundary defined by Flood Estimation Handbook Software

The Flood Estimation Handbook software is used to determine the following catchment descriptors, for the proposed intake location, selected during the site visit.

Intake Grid Reference	361864, 443649
Powerhouse Grid Reference	361981, 443614
Catchment Area	7.84 km^2
Annual Rainfall	1605 mm

It has been reported that the mill pond is served by water from two streams- Wolfhouse Brook (now Chipping) and Garstang (now Dobson's) Brook and the FEH analysis has been undertaken on this basis. Further investigation would be required to confirm the water available.

Annual Flow Statistics

Low Flows software is used to produce a Flow Duration Curve (FDC), which demonstrates how the river flow varies throughout the year. It presents the percentage time of the year each flow rate is exceeded. A particular notation is used to refer to FDC flow rates; e.g. 'Q_{95}' refers to the flow rate which is exceeded 95% of the year.

Table 1 Mean flow rate and flow rate at Q_{95}

Period	Mean Flow Rate [m³/s]	Flow Rate at Q_{95} [m³/s]
Annual	0.281	0.0438
January	0.501	0.112
February	0.406	0.0972
March	0.39	0.0979
April	0.277	0.0752
May	0.17	0.0594
June	0.116	0.0433
July	0.106	0.0386
August	0.139	0.0361
September	0.157	0.0348
October	0.247	0.0415
November	0.376	0.0633
December	0.481	0.0909

Table 2 Annual flow duration data

Exceedance Probability	Flow Rate [m³/s]
5	0.932
10	0.63
20	0.393
30	0.275
40	0.202
50	0.154
60	0.119
70	0.092
80	0.069
90	0.052
95	0.044
99	0.035

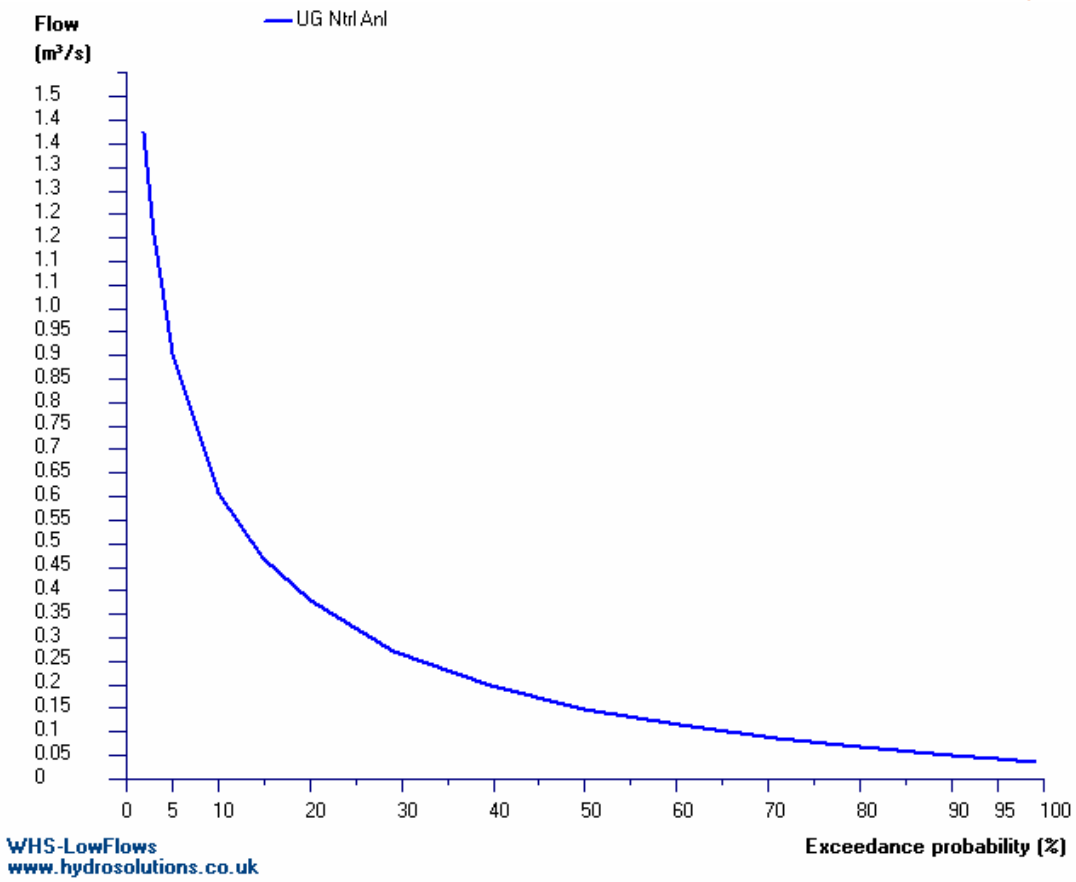


Figure 8 Annual flow duration curve produced using low flows software

Hydropower Analysis

Site: Site 5
Run Date / Time: 21 February 2011 at 12:06

Mean Flow: 0.22 m3/s
Provisional Rated Flow: 0.22 m3/s
Residual Flow: 0.024 m3/s
Rated Flow: 0.20 m3/s
Gross Hydraulic Head: 4.50 m
Nett Hydraulic Head: 4.32 m

Applicable Turbines	Gross Annual Average Output	Nett Annual Average Output	Maximum Power Output	Rated Capacity	Minimum Operational Flow
Propellor	23.2	22.0	7.3	7.0	0.15
Crossflow	28.5	27.0	6.6	6.2	0.053
	MWh	**MWh**	**kW**	**kW**	**m3/s**

Table 31 Hydropower Analysis

Gross Head [m]	4.50 m
Net Head [m]	4.32 m
Design Flow [m^3/s]	0.20 m^3/s
Rated Capacity [kW]	6.60 kW
Average Annual Energy Output [MWh]	24.50 MWh
Average annual Carbon Dioxide offset	13.3 tonnes

Impact Assessment

Restoration of this mill would be of historic benefit to the area. In February 2010 the Director of Planning for Ribble Valley Borough Council has sought Member agreement to the designation of a conservation area for the late 18th century industrial hamlet of Kirk Mill, Chipping. The Landscape Character Type is defined as Undulating Lowland Farmland.

It is not thought that there will be any significant impact resulting from the commissioning of this scheme.

Statutory Requirements

It will be necessary to consult the Environment Agency on the type of abstraction license required. Planning permission may need to be sought for changes to the launder and tailrace and English Heritage should be consulted to confirm the listing status of the mill. This is now confirmed as Grade 2.

An ecologist would need to be consulted for advice on what environmental assessment would be required.

Budget Development Cost

Table 42 Development Budget Cost

Budget Scheme Cost Estimate
Kirk Mill, Chipping

ITEM	UNIT	QUANTITY	MIN	MAX
Turbine				
Turbine Quotation	No	1	£30,000.00	£37,500.00
Grid Connection				
Grid Connection	No	1	£5,000.00	£0.00
Civils				
Weir	m^3	0	£0.00	£0.00
Fish Pass	m^3	0	£0.00	£0.00
Weir Screen Length	m	5	£10,000.00	£12,500.00
Fish Pass Length	m	0	£0.00	£0.00
Pipe Installation	m			
Rock	m	10	£1,100.00	£1,375.00
Gravels	m	0	£0.00	£0.00
Soft	m	0	£0.00	£0.00
Pipe Materials	No	1	£0.00	£0.00
Temporary Access	m			
Rock	m	0	£0.00	£0.00
Gravels	m	0	£0.00	£0.00
Soft	m	0	£0.00	£0.00
Temporary Access on Good Ground	m	0	£0.00	£0.00
Powerhouse				
Powerhouse	kW	6.6	£15,000.00	£18,750.00
Prelims				
Duration	Months	6	£18,000.00	£22,500.00
Sub Total				
Sub Total			£79,100.00	£92,625.00
Professional Fees				
Professional Fees			£11,865.00	£18,525.00
Sub Total				
Sub Total			£90,965.00	£111,150.00
Contingency				
Contingency			£18,193.00	£22,230.00
GRAND TOTAL			£109,158.00	£133,380.00

The total budget cost for the whole scheme is **£121,269**. It should be noted that the civil works costs can vary considerably as material costs fluctuate. Likewise, mechanical and electrical (M&E) equipment costs vary in accordance with demand. Professional fees should be considered subject to change, as the scope of licensing and planning requirements are not yet defined. Consequently the budget estimate at this stage should be considered accurate to plus or minus 20%.

Revenue and Simple Payback period

It is unlikely that a grid connection is required for this scheme, and instead the energy could be used on site at the Kirk Mill. The simple payback can therefore be worked out according to the electricity bills saved by the domestic and business usage on site. A grid connection cost has been estimated at **£5,000** however, assuming that a Propeller or Crossflow turbine is used.

Under the current government feed-in tariff regulations, hydropower schemes receive a generation tariff according to their rated capacity. Schemes less than or equal to 15 kW receive 19.9p/kWh. This generation tariff is received regardless of how the electricity is used. The current base value of electricity per kilowatt hour on top of this has been assumed as 3p/kW.

In conclusion, the total value of the generated electricity would be **22.3 p/kWh**, giving an average annual value of approximately **£5,610.** The simple payback, taken as the budget scheme cost divided by the annual value of electricity generated, is **21.6 years**.

Conclusion

This scheme presents a great opportunity for the restoration of the mill and reinstatement of the mill wheel. The wheel and launder will require replacement along with internal work to the mill where modifications on the upper floor would need to be reversed to reinstall the wheel. A hydro scheme would be of benefit to the Kirk Mill by providing cheap low carbon electricity and potentially providing small but long-term and sustainable revenue. This scheme presents a great opportunity to enhance the character of the late 18th century industrial hamlet of Kirk Mill, Chipping.

Further Information

This site report is produced by Inter Hydro Technology on behalf of Forest of Bowland AONB, and funded by a partnership including Lancashire County Council, Lancaster & District Local Strategic Partnership, Pendle Borough Council and Ribble Valley Local Strategic Partnership.

This site report should be read in conjunction with the rest of the Forest of Bowland AONB Hydro Feasibility Study which can be downloaded at

http://www.forestofbowland.com/climatechange#hydro