

Low Mill, Caton dates back to 1784, but was largely rebuilt in 1838. There were two original waterwheels. One of these was a 25ft 9' diameter overshot wheel powered by water from the two acre pond at the rear. There was also a 21ft diameter undershot wheel powered by water from a smaller pond. The complex is Grade II listed. Low Mill is now a large residential complex with extensive grounds, through which flows the historic mill race.

The intake for this mill race is at the weir at Gresgarth Hall, therefore this site shares its broad hydrology with Gresgarth Mill further south and Willow Mill in Caton. There is likely to be some runoff entering the millrace along its length from Gresgarth, but there may also be some leaks. In order to assess the flow available accurately it is recommended that flow measurements be taken.

There is a small fall over the Low Mill grounds, which could be utilised for a small turbine.

It is understood that the mill race presents some flood risk to Low Mill, and that seepage occurs through the mill race bank down towards the periphery of the grounds. This seepage may cause instability to the mill race bank. These factors have not been thoroughly investigated for the purpose of this report. However, the possibility of confining the water to a pipe may contribute to a solution to this flood risk. A solution to this problem is actively being investigated currently by the residents of Low Mill.

The scheme described optimises the head and assumes that at least a small section of the mill race is confined to a pipe. The intake would be situated in the northern most portion of the mill race just above some small cascades. The water would be piped down to a turbine at the existing mill race 'outflow' where water currently flows from a pipe down onto the River Lune flood plain.



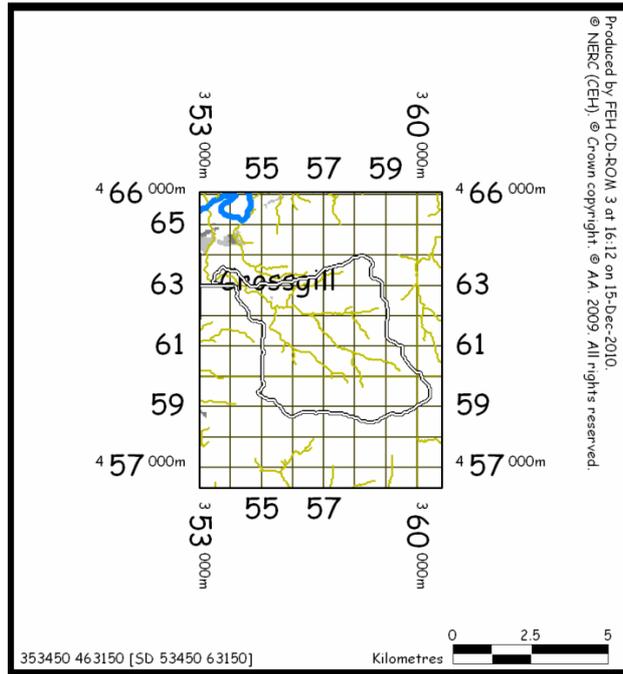
Figure 2 The watercourse with Low Mill in the background



Figure 3 The outflow onto the flood plain

Catchment Analysis

Figure 4 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	353450, 463150
Powerhouse Grid Reference	352570, 464870
Catchment Area	22 km ²
Annual Rainfall	1534 mm

Annual Flow Statistics

The intake for this mill race is at the weir at Gresgarth Hall, therefore this site shares its broad hydrology with Gresgarth Mill further south and Willow Mill in Caton. There is likely to be some runoff entering the millrace along its length from Gresgarth, but there may also be some leaks. In order to assess the flow available accurately it is recommended that flow measurements be taken.

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. 'Q₉₅' refers to the flow rate which is exceeded 95% of the year.

Table 1 Mean flow rate and flow rate at Q₉₅

Period	Mean Flow Rate [m ³ /s]	Flow Rate at Q ₉₅ [m ³ /s]
Annual	0.103	0.791
January	0.231	1.234
February	0.170	0.931
March	0.187	0.913
April	0.134	0.692
May	0.108	0.472
June	0.0764	0.338
July	0.0828	0.390
August	0.0771	0.543
September	0.0848	0.653
October	0.114	0.892
November	0.180	1.128
December	0.225	1.311

Table 2 Annual flow duration data

Exceedance Probability	Flow Rate [m ³ /s]
5	2.687
10	1.823
20	1.094
30	0.754
40	0.549
50	0.414
60	0.321
70	0.247
80	0.185
90	0.131
95	0.103
99	0.0750

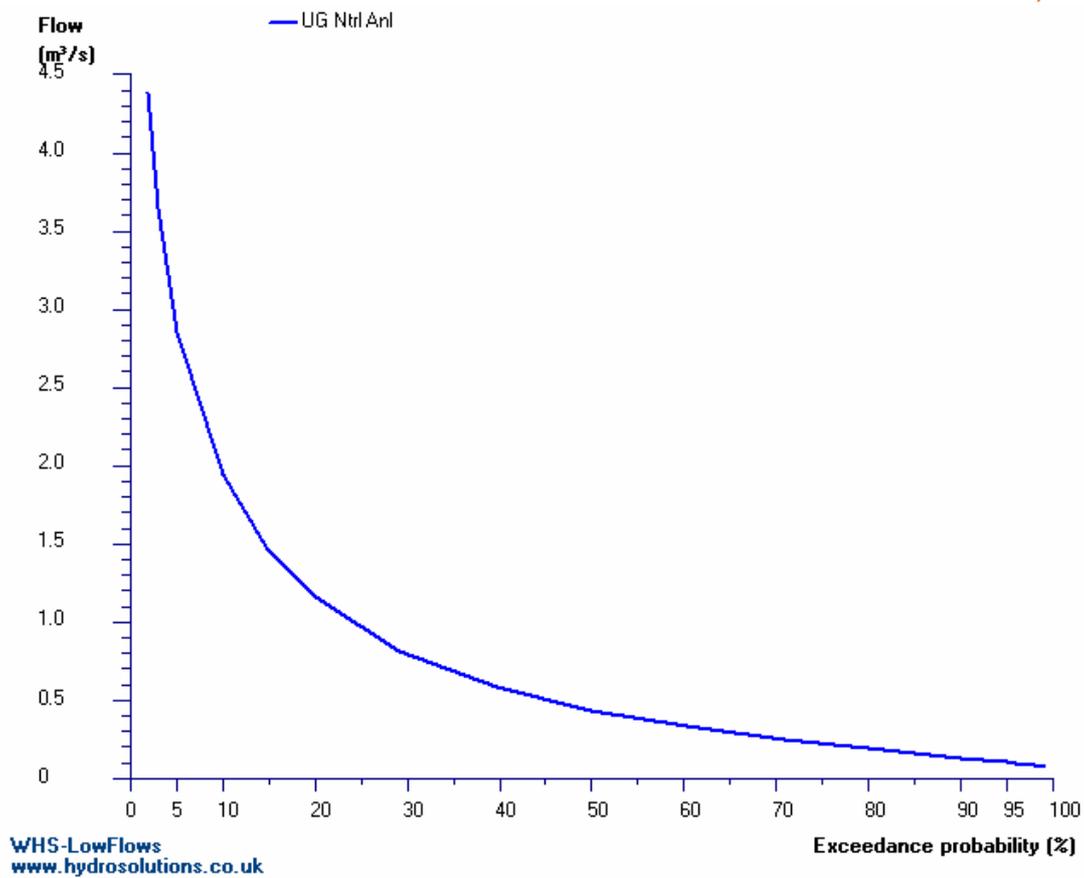


Figure 5 Annual flow duration curve produced using low flows software

Hydropower Analysis

The maximum power output of a scheme at Low Mill is approximately 4 kW, with the annual average predicted energy being 30 MWh.

Table 3 Hydropower Analysis

Gross Head [m]	6.0
Net Head [m]	5.8
Design Flow [m ³ /s]	0.1 m ³ /s
Rated Capacity [kW]	4 kW
Average Annual Energy Output [MWh]	30MWh
Average annual Carbon Dioxide offset	16 tonnes

Impact Assessment

The land through which the mill race flows is attractive and landscaped and it is likely to be well used by the residents at Low Mill. Any confinement of the mill race in a pipe, or the reduction of water over the small falls is likely to have a visual and aural impact for the residents. However, constraining the flow within a pipe around the grounds is likely to reduce the flood risk and prevent further bank instability.

Caton Low Mill is not within the Forest of Bowland Area of Outstanding Natural Beauty. The landscape character assessment is of Valley Floodplain.

Statutory Requirements

It will be necessary to consult the Environment Agency on the type of abstraction license required, and for advice on the potential flooding issues. Planning permission may need to be sought for the laying of pipe round the periphery of the complex, and the installation of an intake and turbine. It is not thought that any development would involve the Grade II listed Low Mill building itself.

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

Budget Development Cost

The total budget cost for the whole scheme is **£111,300**. 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

A grid connection is not thought to be necessary for this scheme, as the energy is likely to be consumed on the site. The revenue and payback time will therefore be calculated according to the electricity value to the Low Mill residents.

Under the current government feed-in tariff regulations, hydropower schemes receive a generation tariff according to their rated capacity. Schemes less than 15kW receive 19.9p/kWh. This generation tariff is received regardless of how the electricity is used. The owner has indicated that the electricity would be used on site, thereby offsetting import costs. This increases the value of the generated electricity by the import tariff, which we have assumed is 5p/kWh.

In conclusion, the total value of the generated electricity would be 24.9p/kWh, giving an average annual value of approximately **£4,350**. The simple payback time for this scheme is **26 years**.

Conclusion

The payback time for this scheme would not normally suggest that this scheme is economic. Depending on the degree of risk of flooding and the seriousness of the bank instability problems, it might be that mitigation work could be combined with a small-scale hydro power scheme.

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>

Table 4 Development Budget Cost

Budget Scheme Cost Estimate

Low Mill, Caton

	ITEM	UNIT	QUANTITY	MIN	MAX
Turbine					
	Turbine Quotation	No	1	£25,000.00	£31,250.00
Grid Connection					
	Grid Connection	No	1	£5,000.00	£6,250.00
Civils					
	Concrete Works	m ³	10	£5,000.00	£6,250.00
	Fish Pass	m ³	0	£0.00	£0.00
	Metalwork	m	1	£2,000.00	£2,500.00
	Fish Pass Length	m	0	£0.00	£0.00
	Pipe Installation	m			
	Rock	m	0	£0.00	£0.00
	Gravels	m	0	£0.00	£0.00
	Soft	m	0	£0.00	£0.00
	Pipe Materials	No	1	£10,000.00	£12,500.00
	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	50	£2,000.00	£2,500.00
Powerhouse					
	Powerhouse	kW	15	£15,000.00	£18,750.00
Prelims					
	Duration	Months	2	£6,000.00	£7,500.00
Sub Total					
	Sub Total			£70,000.00	£87,500.00
Professional Fees					
	Professional Fees			£10,500.00	£17,500.00
Sub Total					
	Sub Total			£80,500.00	£105,000.00
Contingency					
	Contingency			£16,100.00	£21,000.00
GRAND TOTAL				£96,600.00	£126,000.00