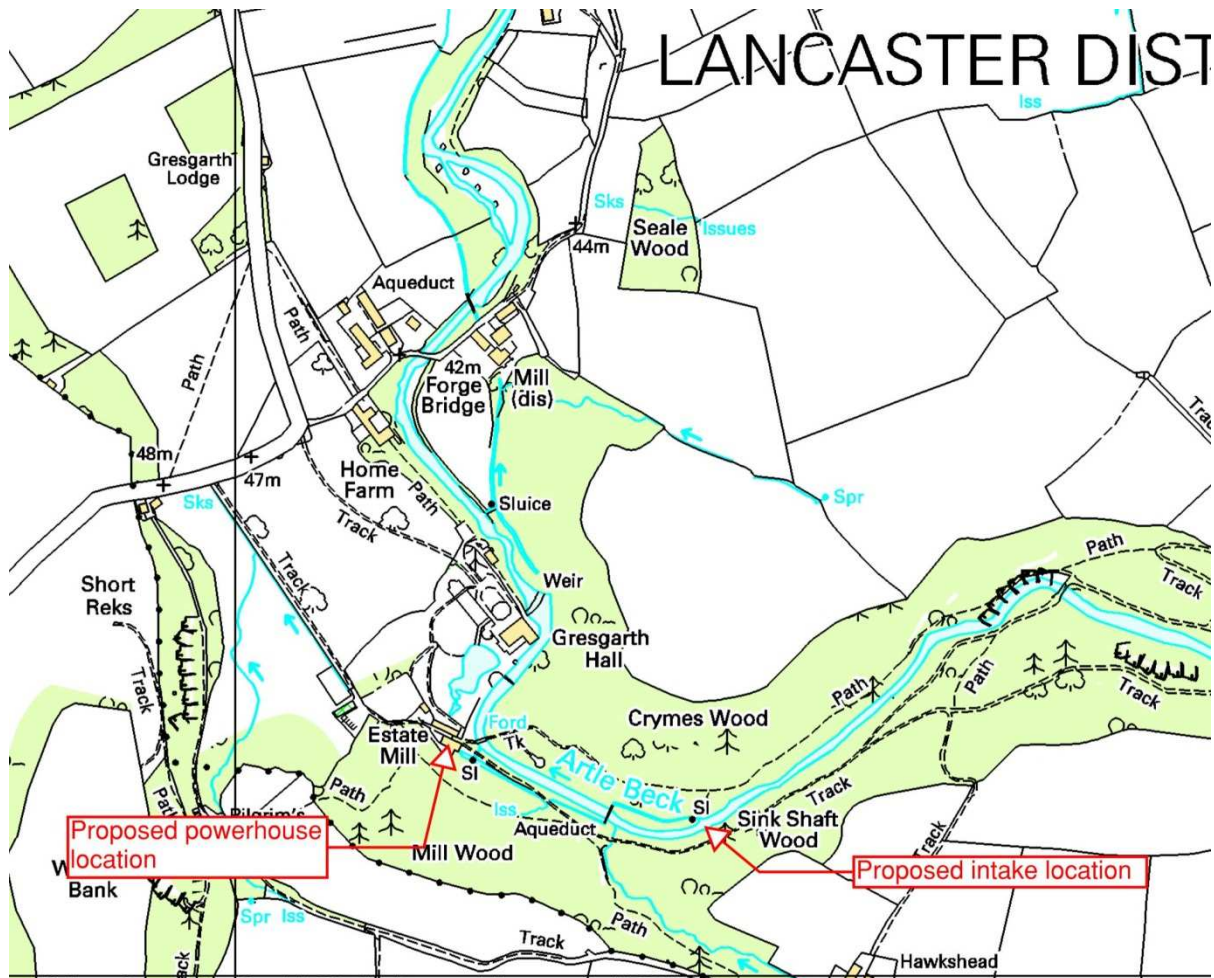


Site 15: Gresgarth Hall, Caton

Site Assessment

Figure 1 Map showing general layout



This mill is thought to have been built between 1770 and 1790 as a corn mill, becoming a threshing mill in 1843 and a saw mill most recently. The silted up headrace and sluices remain, plus the wheel pit and kiln. The turbine remains in situ. It is a Grade II listed building and is associated with Gresgarth Hall as the historic estate mill.

The weir which worked to feed the mill race is now mostly washed away and would need re-building. Significant portions of the mill race are silted up and would need digging out. The turbine pit remains and currently contains a turbine. The main mill building is in use as workshops.

It is proposed that the historic scheme is rebuilt, which would involve repairing/rebuilding the weir and intake and clearing out the mill race. It is proposed that a turbine is installed in the existing wheel pit rather than a waterwheel, due to the space available.



Figure 2 The main weir from beside Gresgarth Hall
(and the intake for sites 14 and 24)



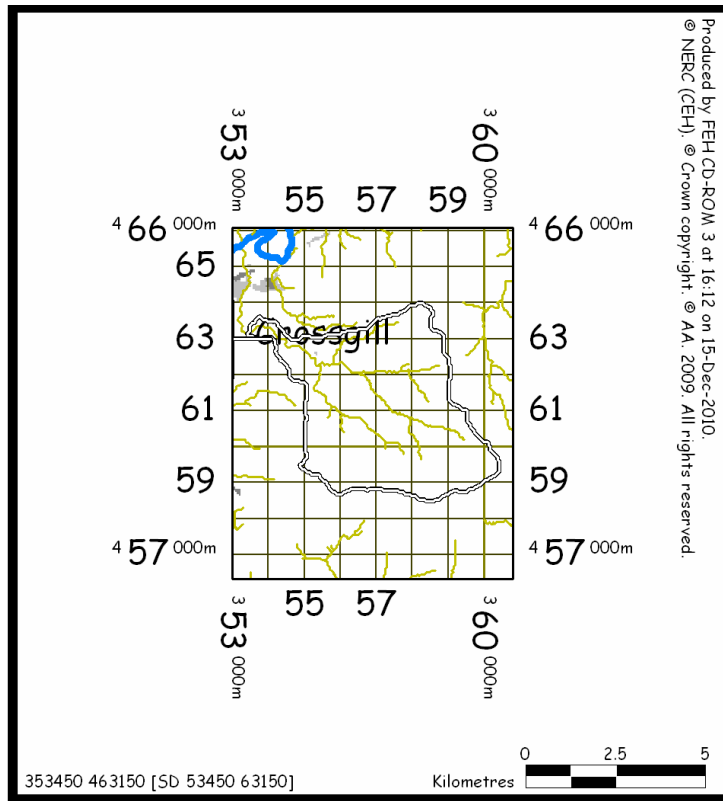
Figure 3 Location of the weir with the beginning of
the leat in the foreground



Figure 4 Gresgarth mill with the mill race running into
the right hand side of the building

Catchment Analysis

Figure 5 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	353210, 463210
Catchment Area	22 km ²
Annual Rainfall	1534 mm

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. '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

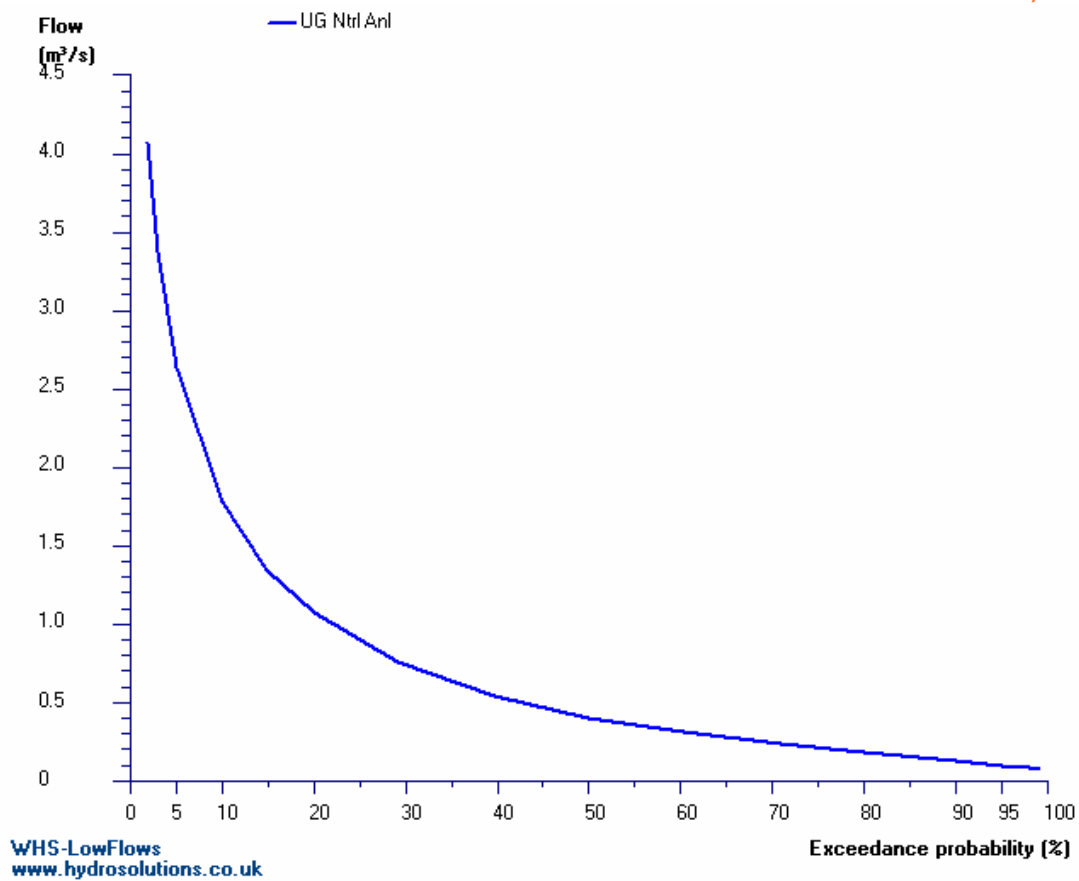


Figure 6 Annual flow duration curve produced using low flows software

Hydropower Analysis

Site: Gresgarth					
Run Date / Time: 15 December 2010 at 16:24					
Mean Flow: 0.80 m ³ /s			Rated Flow: 0.80 m ³ /s		
Provisional Rated Flow: 0.89 m ³ /s			Gross Hydraulic Head: 1.50 m		
Residual Flow: 0.090 m ³ /s			Nett Hydraulic Head: 1.42 m		
Applicable Turbines	Gross Annual Average Output	Nett Annual Average Output	Maximum Power Output	Rated Capacity	Minimum Operational Flow
Crossflow	36.0	35.6	8.9	8.4	0.21
	MWh	MWh	kW	kW	m³/s

Table 3 Hydropower Analysis

Gross Head [m]	1.5 m
Net Head [m]	1.4 m
Design Flow [m ³ /s]	0.9 m ³ /s
Rated Capacity [kW]	8 kW
Average Annual Energy Output [MWh]	36MWh
Average annual Carbon Dioxide offset	83 tonnes

Impact Assessment

This site is within the Area of Outstanding Natural Beauty of the Forest of Bowland, and the AONB landscape assessment is characterised as Wooded Rural Valley.

The mill building itself is Grade II listed and is an integral part of the Gresgarth Hall estate complex. In order to facilitate fish passage it is recommended that a fish pass is built in to the new weir, although it is not clear whether fish are able to overcome the main weir adjacent to Gresgarth Hall, which is just downstream. The woodland and Artle Beck are both Biological Heritage Sites.

The silted up mill race may need to be surveyed to assess the species present before the channel can be reinstated.

Statutory Requirements

It will be necessary to apply to the Environment Agency for an abstraction license and for in-river works, which can only be attempted between May and September. It will also be necessary to apply for planning permission for the installation of the weir and intake.

Some relatively minor alterations to the Grade II listed mill building itself may be required in order to remove the in situ turbine and install a replacement. This is likely to require Listed Building Consent.

An ecologist will be able to advise on the extent of environmental investigation required for development of a hydro scheme here, including the removal of silt and vegetation from the mill race.

Budget Development Cost

The total budget cost for the whole scheme is **£370,000**. 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%.

Table 4 Development Budget Cost

Budget Scheme Cost Estimate

Gresgarth Hall, Caton

	ITEM	UNIT	QUANTITY	MIN	MAX
Turbine					
	Turbine Quotation	No	1	£100,000.00	£125,000.00
Grid Connection					
	Grid Connection	No	1	£5,000.00	£6,250.00
Civils					
	Weir	m ³	40	£20,000.00	£25,000.00
	Fish Pass	m ³	10	£5,000.00	£6,250.00
	Weir Screen Length	m	10	£20,000.00	£25,000.00
	Fish Pass Length	m	4	£8,000.00	£10,000.00
	Pipe Installation	m			
	Rock	m	0	£0.00	£0.00
	Gravels	m	250	£10,000.00	£12,500.00
	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	230	£18,400.00	£23,000.00
	Soft	m	210	£11,550.00	£14,437.50
	Temporary Access on Good Ground	m	20	£800.00	£1,000.00
Powerhouse					
	Powerhouse	kW	8	£15,000.00	£18,750.00
Prelims					
	Duration	Months	6	£18,000.00	£22,500.00
Sub Total					
	Sub Total			£231,750.00	£289,687.50
Professional Fees					
	Professional Fees			£34,762.50	£57,937.50
Sub Total					
	Sub Total			£266,512.50	£347,625.00
Contingency					
	Contingency			£53,302.50	£69,525.00
GRAND TOTAL				£319,815.00	£417,150.00

Revenue and Simple Payback period

It is not anticipated that a grid connection would be required at this site, as the energy is likely to be consumed by the hall and associated buildings and businesses.

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 **£8,015**. The simple payback time for this scheme is 46 years.

Conclusion

The mill building is currently being used as workshops and is in good condition. The payback time for this scheme would normally suggest that the development is not economic. The cost calculations completed assume external contractors will carry out the work. However, it may be possible to complete most of the works using the labour and skills of the work force on site. This is likely to reduce the development costs significantly. Power produced on the site could be used by the existing workshops, and would present an additional conservation benefit in harmony with the site's history.

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>