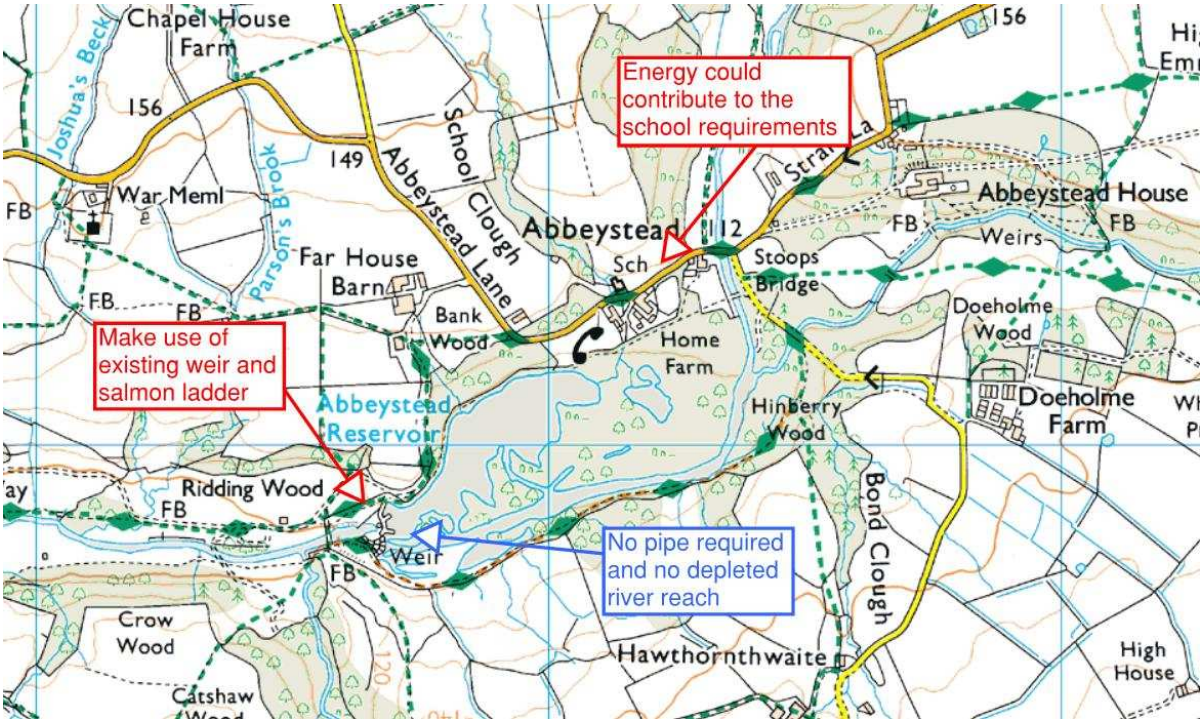
Site 7: Abbeystead Weir, Abbeystead

Site Assessment

Figure 1 Map showing general layout



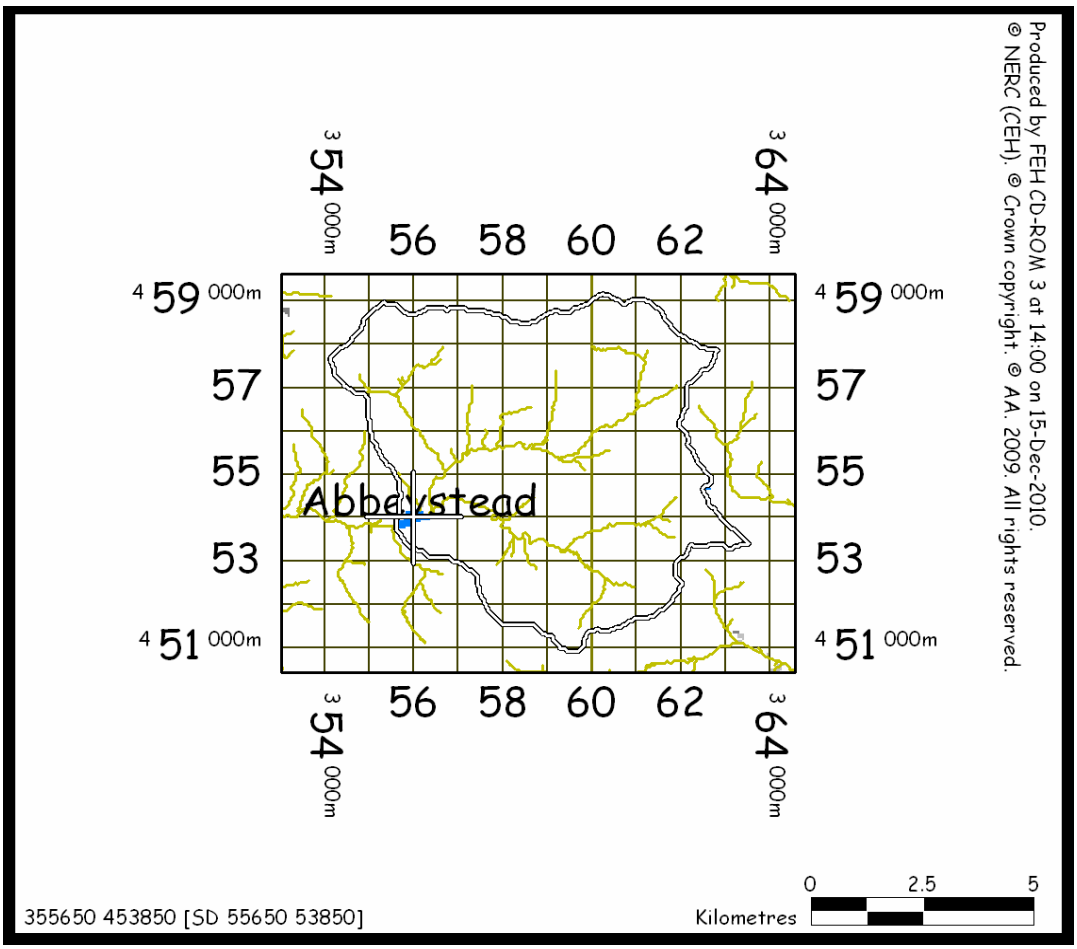
Abbeystead Reservoir is contained by an attractive curved overflow weir, thought to have been built in the mid-19th century to supply mills along the Wyre during dry periods. A hydro scheme at this site would utilise the existing head difference between the reservoir and the beck below. In addition to the water flowing over the weir and the water flowing down the salmon ladder, water leaves the reservoir via a pipe to the valve house pictured and back into the watercourse. It is suggested that this valve house is moved or partially demolished in order to accommodate part of the powerhouse or pipe system. It is likely that the small circular pond adjoining the valve house will be incorporated into the power house and outflow of the proposed hydro scheme.

Figure 2 The weir from downstream

Figure 3 Lower outlet from dam

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	355680, 453840
Powerhouse Grid Reference	355650, 453840
Catchment Area	48.77km^2
Annual Rainfall	1635 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. '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	1.982	0.264
January	3.045	0.539
February	2.172	0.415
March	2.424	0.447
April	1.539	0.293
May	1.124	0.267
June	0.828	0.207
July	0.966	0.201
August	1.398	0.203
September	1.732	0.248
October	2.308	0.284
November	2.962	0.475
December	3.293	0.599

Table 1 Annual flow duration data

Exceedance Probability	Flow Rate [m³/s]
5	6.812
10	4.682
20	2.797
30	1.957
40	1.416
50	1.048
60	0.789
70	0.603
80	0.438
90	0.316
95	0.264
99	0.197

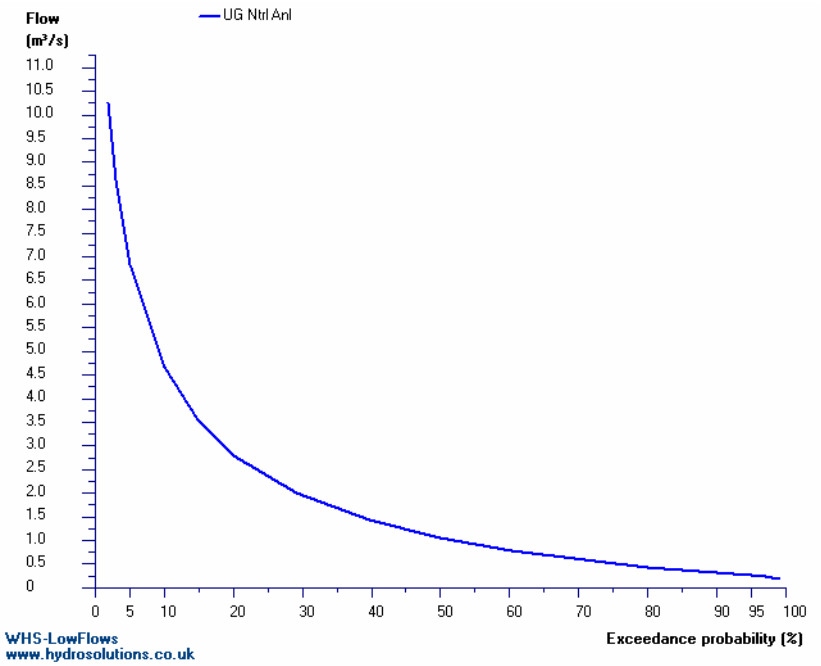


Figure 5 Annual flow duration curve produced using low flows software

Hydropower Analysis

Site: Abbystead
Run Date / Time: 15 December 2010 at 14:26

Mean Flow: 1.86 m3/s
Provisional Rated Flow: 2.03 m3/s
Residual Flow: 0.17 m3/s
Rated Flow: 1.86 m3/s
Gross Hydraulic Head: 12.00 m
Nett Hydraulic Head: 11.40 m

Applicable Turbines	Gross Annual Average Output	Nett Annual Average Output	Maximum Power Output	Rated Capacity	Minimum Operational Flow
Francis Spiral Case	688.2	681.3	191.0	183.3	0.73
Propellor	519.3	514.1	182.0	174.7	1.38
Crossflow	658.6	652.0	166.4	155.8	0.45
Kaplan	712.0	704.8	185.8	173.9	0.54
	MWh	**MWh**	**kW**	**kW**	**m3/s**

Table 3 Hydropower Analysis

Gross Head [m]	12
Net Head [m]	11.4
Design Flow [m^3/s]	2 m^3/s
Rated Capacity [kW]	160 kW
Average Annual Energy Output [MWh]	600MWh
Average annual Carbon Dioxide offset	261 tonnes

Impact Assessment

This site is within the Forest of Bowland AONB and is classified as a Wooded Rural Valley in the Landscape Character Assessment. This scheme design proposes that water currently flowing over the overspill weir would instead be channelled into a pipe for the hydro scheme, or piped from the base of the reservoir, making use of the existing pipe and valve house. This would have a visual impact, as only in high flows would there be any water flowing over the weir. The flow in the salmon ladder will not be affected, as this must be maintained for ecological reasons. An ecological assessment will need to be made at the site to investigate the impact of development, including the potential reduction in humidity, and the reduced wetted area on the weir. The reservoir is a Biological Heritage Site, as is Ridding Wood and Catshaw Wood.

Statutory Requirements

It will be necessary to consult with the Environment Agency about an abstraction licence and to apply to Lancaster City Council for planning permission to build a new powerhouse at the base of the existing dam. It is not known whether the existing dam and overspill weir are listed structures, but they do have an intrinsic historic value, and advice may need to be sought during the design stage. An ecologist will advise to what detail an environmental survey will be required.

Budget Development Cost

Table 4 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 **£292,700**. 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

This scheme produces a significant amount of energy and a grid connection is recommended to optimise the revenue. Alternatively, the obvious proximal end user would be Abbeystead village, with surplus energy then being supplied to the grid.

Under the current government feed-in tariff regulations, hydropower schemes receive a generation tariff according to their rated capacity. Schemes between 100 kW and 2 MW receive 11p/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 14p/kWh, giving an average annual value of approximately **£84,000**.This works out at a simple payback period of approximately 4 years.

Conclusion

This scheme has the lowest estimated payback period of this study, and it is recommended that further investigation be carried out to confirm the amount of water present and the condition of the existing infrastructure.

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