Hol Beck
Determination Report

Decision Statement

Water Resources Act 1991 (as amended) and the Environment Act 1995.

We have received applications for licences for two competing schemes on Hol Beck, Windermere. The two competing schemes are located at Low Wood Hotel and Holbeck Ghyll Country House Hotel.

Applicant	Licence type	Application number
Holbeck Ghyll Country House Hotel Limited – (Holbeck Ghyll applicant)	Full Abstraction	NPS/WR/016815
Low Wood Hotel (1958) Limited – (Low Wood applicant)	Full Abstraction Impounding	NPS/WR/014784 NPS/WR/014788

We have compared the two schemes against a number of factors that we consider are relevant to this site and we have decided which of the two schemes is most desirable in the public interest. In doing so we have had regard to the guidance provided in 'Competing hydropower schemes' guidance dated December 2012, which is attached in Appendix 2. In summary as set out in section 19 of that guidance –

"Every case will turn on its own merits. The Environment Agency will seek to grant those hydropower applications which are of greatest public benefit, bearing in mind their short and long-term effects on the local and national environment and the overall desirability of any particular scheme in the public interest, when considered against all other actual or potential proposals at the site."

In accordance with the competing schemes guidance we have had regard to the site specifics of each scheme and we have compared the schemes by reference to a number of relevant factors. There are a number of points of comparison where we have weighed the relative merits and de-merits of both schemes and we have concluded that overall the Low Wood scheme is preferable to the Holbeck Ghyll scheme.

Accordingly, having considered the relevant information and data from both applicants, having considered representations from the Angling Trust, and having had regard to our statutory duties and to our guidance we refuse the Holbeck Ghyll application number NPS/WR/016815 and we grant licences to the Low Wood applicant (application numbers NPS/WR/014784 and NPS/WR/014788).

In summary we conclude that the Low Wood scheme is preferred because:

- It could generate more electricity.
- It will use water more efficiently by generating more electricity per m^3 of water used.
- The carbon offset would be greater over its lifetime.

The Nature of this report
The determination report comprises this decision statement with the appendices listed below.

Appendices
Appendix 1 – Describes in more detail a number of other factors and areas of comparison including those where we conclude there is no significant difference between the schemes. Further matters that are relevant to our decision including details of the applications and how we have had regard to our statutory duties and to the representations are also set out.

Appendix 2 – Competing hydropower schemes guidance December 2012

Appendix 3 – Carbon Footprint Calculations

Differentiating Factors
The Low Wood scheme is considered to be the most desirable scheme for the following main reasons:

1. Electricity Generating capacity

In order to compare the electricity generation capacity of each schemes we have assessed two sets of data as detailed below. Firstly, we looked at the estimated total generation amount provided in each application. In calculating their estimation the Low Wood applicant has taken into account changes in head and system efficiency for different flows and abstraction rates. The Holbeck Ghyll applicant has not taken these changes into account. Secondly, we have calculated an estimated total generation amount for each scheme using the respective applicants flow duration curves. This method does not take into account changes in head and system efficiency, but allows for a more accurate comparison of the schemes.

The head of the proposed Low Wood scheme is 96m. The Low Wood applicant has estimated a total generation amount of 196,000kWh per year for a total annual flow through a Turgo turbine of 1,145,072m³. The Low Wood applicant has calculated their average annual abstraction from their flow duration curve. As previously mentioned they have taken into account changes in head and system efficiency for different flows and abstraction rates. They have estimated the peak power output of the scheme to be 52kW and the peak generation capacity to be 180Wh/m^3. The Low Wood applicant has estimated an overall power efficiency of 76% (excluding pipeline losses).

The Low Wood applicant has estimated that their turbine will operate at the design flow for 73 days in a typical year and at less than the design flow for 201 days. They estimate that no generation will take place for 91 days in an average year.

The Low Wood applicant states that the energy generated will be used by the hotel. Any excess will be exported to the grid and through the grid the scheme will provide energy to nearby dwellings.

The head of the proposed Holbeck Ghyll scheme is 26m. The Holbeck Ghyll applicant has estimated a total generation amount of 74,800kWh per year for a total annual flow through a Turgo turbine of 1,425,600m³ (the maximum annual abstraction rate applied for, equal to 220 multiplied by the maximum daily rate). As previously mentioned they have not taken into account changes in head and system efficiency for different flows and abstraction rates. The Holbeck Ghyll applicant has estimated the peak power output of the scheme to be 14kW and the peak generation

capacity to be 52Wh/m^3. The starter pump for the siphon intake would consume 0.05kWh of electricity every time abstraction commences. The Holbeck Ghyll applicant has stated the pump will be operated periodically. The Holbeck Ghyll applicant has estimated an overall power efficiency of 72% (including pipeline losses).

The total generation estimates provided by the applicants suggest that the proposed Low Wood scheme will generate significantly more electricity than the Holbeck Ghyll scheme. However, those figures are not directly comparable because the Low Wood applicant has taken into account variables which the Holbeck Ghyll applicant has not. The average annual (as opposed to the absolute maximum) generation is a more suitable figure with which to compare the two schemes because it gives a more realistic picture of expected annual generation over the lifetime of the schemes.

Using the Holbeck Ghyll applicant's flow duration curve, we have estimated the average annual abstraction to be 1,146,334m^3 and the energy generated in an average year to be 59,609kWh (1,146,334 m^3 x 52Wh/m^3). The Low Wood scheme is expected to produce more than three times as much electricity in an average year than the Holbeck Ghyll scheme. System efficiency will be lower when a turbine is not operating at its design capacity. In addition, head will be lower when river flows are higher. To illustrate the impact of including these variables: if the Low Wood applicant had not included them, their scheme energy generation would be overestimated by approximately 5% (1,145,072m^3 x 180Wh/m^3 = 206,113 kWh = 196,000 kWh + 5%).

Although the figures are only estimates, the difference between them is so significant that it is clear that even accounting for possible errors the Holbeck Ghyll scheme annual generation would be significantly lower than that of the Low Wood scheme.

Based on the calculations in the Holbeck Ghyll application, the turbine would be operating at the design flow for 127 days in a typical year and less than the design flow for 156 days. The number of days when no generation can take place has been estimated as 102 days.

The Holbeck Ghyll application states that all output would be consumed on site, such that connection to grid is not required.

The head and the electricity generation potential is significantly less for the Holbeck Ghyll scheme because of the significantly shorter depleted reach and slightly smaller maximum abstraction rate (75l/s as opposed to 79l/s). These factors outweigh the fact that there is less water available at the point where the Low Wood scheme will take water (hence why the Low Wood scheme would not reach its maximum abstraction rate as often as the Holbeck Ghyll scheme).

Based on the estimations using the applicants flow duration curves the Low Wood scheme will generate over three times the amount of electricity per year than the Holbeck Ghyll scheme. According to a Government Report[1] on Domestic Energy Consumption 'the average unadjusted electricity consumption per household in 2013 was 4,192kWh, which adjusts very slightly to 4,170kWh once a temperature factor

[1] Energy Consumption in the UK (2014). 2014. Department of Energy and Climate Change. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/338662/ecuk_chapter_3_domestic_factsheet.pdf

has been applied to the data.' Therefore to put the schemes' energy generation in context; using the unadjusted data, the Holbeck Ghyll scheme is expected to provide enough electricity to power 14 households per year, whereas the Low Wood scheme could power at least 46 households.

In general terms the power capacity of a turbine is increased when head and design flow are greater. The Low Wood scheme would have a larger head and would produce more energy per cubic meter of water despite having a similar sized turbine. The efficiencies of both schemes' turbines and associated systems would be very similar. Allowing for some error in the expected generating capacity of the two schemes, we are confident that the Low Wood scheme would provide a significantly higher annual energy output.

The hands off flow protection, abstraction quantities and the influence of flow accretion in the depleted reach of the Low Wood scheme; results in the schemes having similar and acceptable impacts on flows and the environment. This is explained further in Section 9 of Appendix 1.

The Low Wood scheme is preferred because:

- It could generate more electricity;
- It will make more efficient use of available water resources, generating more electricity per m^3 of water.

2. Carbon Footprint and Carbon Savings

Helping to mitigate the effects of climate change by encouraging the development of suitable hydropower schemes is important to us.

Both applicants have provided information on the carbon footprint of their scheme design and construction, and the carbon savings of their scheme.

The Low Wood scheme has a larger construction footprint of the two schemes and is expected to generate considerably more electricity.

There are broadly three respects in which the carbon footprint might differ between two schemes such as these. They are:

- The materials used;
- The transportation of those materials; and,
- Construction costs.

The Low Wood applicant has provided a list of where materials and components will be sourced from, including the transportation mileage for each, and has stated that local suppliers will be used as much as possible. The Holbeck Ghyll applicant has stated that their turbine will be manufactured by Gilkes (Cumbria based company) and other materials will be locally sourced as far as possible, although neither the transportation mileage nor the location of these suppliers has been provided. On the information provided there is more detailed information in this respect from the Low Wood applicant than from the Holbeck Ghyll applicant, however we are satisfied that transportation has a minimal difference on overall carbon footprint. Furthermore, transportation can be given little weight given that either side could ultimately decide to source their materials locally, or much further afield. Consequently we do not have a preference for either scheme on this aspect of carbon footprint. In any event, the impact of transportation costs is relatively insignificant compared with the impact of the materials used.

We also believe there is unlikely to be a significant difference in construction costs and lifetime of components because the schemes are similar in scale and general location and would require similar components (such as powerhouses and turbines).

The main factor differentiating the two schemes is the materials used. The Low Wood scheme will require a significantly greater mass of materials for construction.

We have an online tool that developers can use to calculate the CO2e of construction projects (https://www.gov.uk/government/publications/carbon-calculator-for-construction-projects). Both applicants were asked to provide details of the type and quantity of materials they propose to use in construction of the schemes.

The table in Appendix 3 compares three main categories of materials that have a significant carbon footprint. The applicants have provided the tonnage for the proposed materials. Other materials that have not been included in our assessment are estimated to be considerably smaller in quantity and are not expected to contribute significantly to the predicted carbon footprint of the schemes.

The carbon footprint of concrete, metal and plastic to be used for the Holbeck Ghyll scheme is estimated to be 21% of that of the Low Wood scheme.

The difference in footprint between the schemes is directly linked to the different intake designs and length of the depleted reach (i.e. larger penstock pipeline and anchor blocks associated with the Low Wood scheme). The Low Wood scheme requires more than three times the length of penstock pipeline required by the Holbeck Ghyll scheme.

The carbon footprint figures provided by the Holbeck Ghyll applicant were submitted prior to the design of the intake works changing from the initial siphon design (version 1) to the current design (version 4). The design changes include a larger fish screen, larger sump area, inclusions of a level sensor and a walk over board. However we are confident that the Low Wood scheme will require more material than the Holbeck Ghyll scheme even accounting for those changes.

However, we are confident that the carbon footprint for both schemes is small in comparison to the potential carbon savings of the schemes.

The Low Wood applicant has estimated over the lifetime of the scheme (40 years) the carbon saving would be 4,032 tonnes of CO2e; and the Holbeck Ghyll applicant has estimated it would be 1,580 tonnes of CO2e. These figures are consistent with the applicant's descriptions of their schemes and take into account the carbon footprints of the schemes (so if the changes to the Holbeck Ghyll scheme have increased the carbon footprint, the difference in carbon savings is slightly larger). The Low Wood scheme could provide two and a half times more carbon saving than the Holbeck Ghyll scheme. The difference in potential savings between the schemes is linked to the differences in the total annual generation whereby the Low Wood Scheme could generate significantly more than the Holbeck Ghyll scheme.

Having regard to all the information provided, from the differences in the size of the schemes and the estimated electricity production we have concluded that the Low Wood scheme will have a greater carbon saving than the Holbeck Ghyll scheme over its lifetime.

The Low Wood scheme is preferred because:

- The carbon offset would be greater over its lifetime.

Conclusion

We have compared the two proposed schemes using our competing hydropower schemes guidance. We have concluded that overall the Low Wood scheme demonstrates the greater public benefit. Our conclusions take into account the short and long term effects of the scheme on the local and national environment and its overall desirability in the public interest.