THE SATTERTHWAITE VILLAGE MICRO HYDRO SCHEME PROJECT DEVELOPMENT STUDY REPORT

PRODUCED UNDER THE COMMUNITY SUSTAINABLE ENERGY PROGRAMME

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1 Executive Summary

Satterthwaite Parish lies in a central part of the Cumbrian Lake District and is a sparsely populated rural community suffering from a loss of key local services. In large part this is due to a decline in the resident population as a result of second and holiday home ownership, and with very limited resources to help alleviate this trend the Parish Council is exploring opportunities to generate investment income for the community that could be derived locally from sustainable energy projects.

A potential site for a small hydro power scheme was identified on the Farra Grain beck, approximately 1km west of the main village. The area is on land owned by the Forestry Commission who have expressed an interest in assisting in the scheme development, with the outline proposal to install a small hydro power scheme to export power direct to the grid.

In discussion with installers, two potential system options were identified. Both proposed the use of the same 'Pelton' style turbine with the first option creating an intake weir to provide a head of approximately 35m with a penstock (pipe) of approximately 150m to the turbine housing, while the second allowed a head of 55m with a penstock distance of approximately 400m. The turbine settings would be adjusted to operate at differential speeds depending on the final system design selected. The alternative system options would generate an estimated peak output of 10kW and 17kW respectively.

The technical and economic appraisal for the scheme is highly dependant on the available water flow and the rate of abstraction permitted by the Environment Agency. While there is no detailed flow data from the Farra Grain catchment, data has been extrapolated from a nearby Environment Agency gauging station on a neighbouring catchment and scaling this to the Farra Grain suggests an estimated 100litres/s^{-1}. Output figures were based on a permitted abstraction rate of 50litres/s^{-1}. A suitable grid connection point has been confirmed with United Utilities.

The output appraisal suggested annual outputs of 60,000kWh for the 10kW system and 110,000kWh for the 17kW system, although in the absence of detailed flow duration data these are of necessity estimates only. Based on these figures, the projected annual income of the 10kW system was between £15,000 - £16,200 and the 17kW of £22,000 - £24,200. Both systems had a projected simple payback period of around 5 years with the 10kW system projected to produce carbon savings at a cost of £121/tonne and the 17kW version at £104/tonne.

While both options appear to be technically and financially viable, there are significant uncertainties. While there remain some elements of the final price that cannot be finalised at this stage, the key areas of uncertainty concern the requirement for licensing and planning permissions. While planning permission is considered a relatively straightforward exercise (although the outcome is not certain) the environmental aspects are more complex. Correspondence with the Environment Agency has highlighted the need for

detailed flow data, and while this could be gathered by volunteers from the group, the Environment Agency appears to be specifying a high level of accuracy in the figures that may require further pre application investment.

Similarly, further details on fisheries impacts and habitats surveys have been suggested as required by the Environment Agency, and while previous experience on similar hydro systems suggests the Environment Agency often relaxes conditions for micro hydro systems once the full scale of the proposed development is clear, the need for extensive and detailed pre application research cannot be ruled out at this stage.

In any event the requirement for long term flow data and limitations on construction to the June – September period are such that it is virtually impossible for the scheme to proceed through application stage to construction by summer 2010. A target installation date of June 2011 is however appropriate, subject to further discussions with the statutory bodies including the Environment Agency, Natural England and the LDNPA.

It is recommended that the Parish Council enter such discussions at an early opportunity and finalise what data would be required and whether this task can be completed by their own members or whether further professional input is required at pre application stage.

2. Organisation Details

2.1 The lead organisation behind the project is Satterthwaite Parish Council, C/o Townhead, Satterthwaite, Ulverston, Cumbria, LA12 8LS.

2.2 Satterthwaite is a rural parish lying in the undulating hills between Coniston Water and Windermere, within the Lake District National Park. Although it covers a wide geographical area, the resident population is very small, consisting of only 180 people, who mainly live in the three hamlets of Grizedale, Graythwaite and Satterthwaite. A large part of the parish comprises of the Grizedale Forest Park owned and managed by the Forestry Commission. The Parish Council is small and its only income is the precept, which for the current financial year is £2420.

2.3 The Parish has 171 dwellings, of which nearly 50% are second homes or commercial holiday lets, far in excess of the government's suggested limit of 20%, beyond which communities become unsustainable. The effect of this is very noticeable: the shop closed some years ago, the school closed within the last few years and the church and parish room are under threat. The inn remains closed for most of the winter months. The apparent opulence of the southern Lake District masks the reality of rural life for most residents, who are employed in low paid service jobs in the tourism industry, or in forestry.

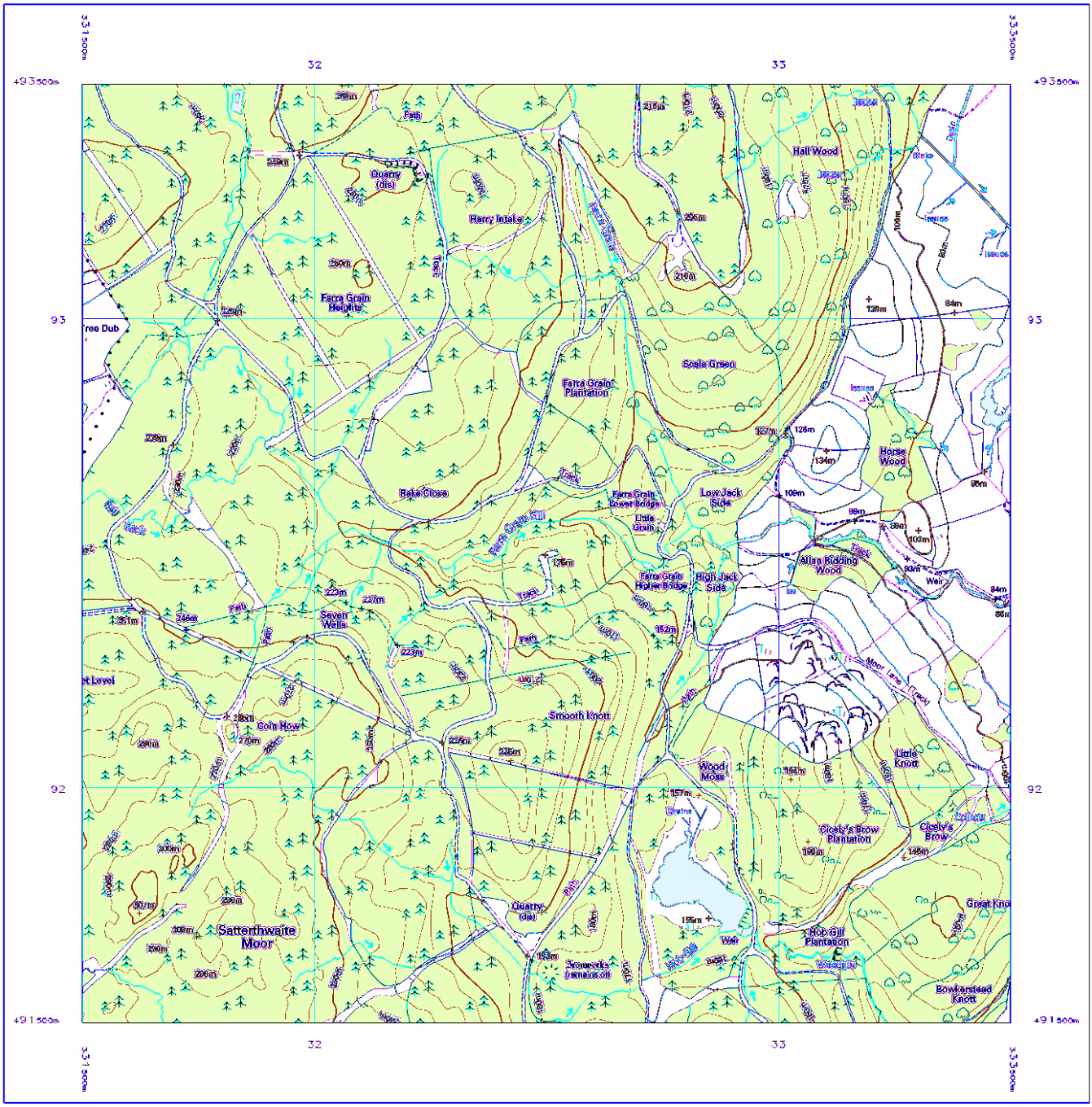
2.4 The overall purpose of the project is to develop a low carbon renewable energy source that will generate a long term income for reinvestment in further projects that will provide lasting benefit for the parish and it's residents.

3. Site Details

3.1 The project is proposed at a location close to the village of Satterthwaite, Cumbria. It is a small scale hydro power installation located on the Farra Grain Beck, grid reference SD 331 925 (see map on page 5)

Ordnance Survey

OS Landplan® Data



100 50 0 100 200 300 400 500
Metres

3.2 The intention is to install an intake weir on the northern tributary of the Farra Grain, connected via a penstock (pipe) to a turbine located in a suitable housing just downstream from the confluence of the Farra Grain and Farra Grain Gill.

3.3 The proposed turbine housing can be located on the map at a point where the Farra Grain leaves the woodland as it flows east, between High and Low Jack Sides.

3.4 Two possible sites for the intake weir have been identified. The lower intake is at a point approximately 150m upstream from the point where the lower track crosses Farra Grain, giving a head of approximately 35m.

3.5 The second potential intake site is a further 250m upstream, located just below the point where the higher track crosses the Farra Grain. This intake site would provide a head height of approximately 55m.

3.6 The site itself (both the proposed location of the turbine house and the intake weir and penstock route) is on land owned by the Forestry Commission.

3.7 While formal agreement from the Forestry Commission has not been finalised for this project, detailed discussions have taken place and the Forestry Commission have indicated their strong support in principle for the project. A letter from their local Area Land Agent has been supplied and can be found in the 'Additional Information' on the accompanying CD Rom.

3.8 The turbine would include a direct three phase connection to the grid supply to enable exports of all the power output. The nearest available connection point is a small village sewage works (see photograph X in 'Photographs' folder) approximately 650m east of the turbine location (not on the accompanying map).

4. Renewable Options Appraisal

4.1 The specific brief provided and the location and characteristics of the site are such that the Project Development Study was restricted to the single technology of hydro power.

4.2 The initial options appraisal was therefore restricted to a preliminary assessment of the potential viability for a small hydro system and involved an assessment of likely average flow rates, identification of potential locations for the turbine housing and intakes collection points and a preliminary assessment of the viability of a system based on the assumed flows and head arising from the initial appraisal results.

4.3 The identification of possible location sites for the various elements of the installations was relatively straightforward and these have been described in Section 3. In the absence of long term flow monitoring in the Farra Grains catchment area, assessing flow rates was more problematic.

4.4 Some very limited calculations of flow rates at the turbine site (not the proposed intake sites) were provided and have been included in the 'Additional Information' folder on the accompanying CD Rom. Due to the very sporadic and limited nature of these readings they are of limited use and have not been used as the basis for any flow calculations.

4.5 In order to generate flow data, measurement data from a nearby Environment Agency (EA) gauging station has been used and compared to the Farra Grain catchment. The gauging station is at Eel House Bridge at Cunsey Beck in the Winderemere catchment area (grid reference SD 369 940).

4.6 The National River Flow Archive (NRFA) data for the Cunsey Beck gauging station has been reproduced in the 'Flow Data' folder on the accompanying CD Rom. This shows a catchment area of 18.7km^2, mean annual rainfall of 1900mm and a mean flow of 0.92m^3/s^{-1} (920 litres/s^{-1}).

4.7 To derive approximate flow data for the Farra Grain, the Cunsey Beck data was scaled to the approximate size of the Farra Grain catchment with flow calculations made on this basis.

4.8 The Farra Grain rainfall data provided (see Flow Data folder) indicates a slightly higher average rainfall of 2000mm that observed at the Cunsey Beck site. The Farra Grain catchment area was measured from OS maps at approximately 2.0km^2.

4.9 While two possible intake sites have been identified, as there are no stream tributaries diverging from the main water course between these two points the same flow rates have been adopted for both sites. In reality there would be a small reduction in flow for the higher site, but this is not thought to be significant.

4.10 Multiplying the catchment area by the average rainfall gives the total precipitation which for Farra Grain catchment is therefore 4,000,000m^3. This would suggest an average flow rate of 0.127m^3/s^{-1}.

4.11 However, evaporation and transpiration from plants means that total rainfall does not equate to total river flow. In order to adjust for this, aggregate data from the Cunsey beck system was used to calculate the proportion of measured flow to calculated rainfall. Multiplying the catchment area by the average rainfall indicates total rainfall equivalent to a mean flow rate of $1.126m^3/s^{-1}$. The actual measured flow of $0.92m^3/s^{-1}$ is therefore 81.7% of the total precipitation, suggesting losses of approximately 18%.

4.12 Applying this figure to the Farra Grain catchment suggests a net mean stream flow of approximately $0.104m^3/s^{-1}$ or 104 litres/sec^{-1}.

4.13 On the basis of these calculations the options appraisal indicated that a hydro system on either of the identified intake sites was potentially viable.

4.14 It should be noted however that these figures are mean annual flow rates only, and do not take account of seasonal variation and flow duration times. These variations are examined in greater detail in the Energy yield Section below.

5 Overall Project Concept

5.1 The project concept is straightforward, and can be summarised as seeking the installation of a community owned small hydro system as described above, in order to produce low carbon energy for direct feed into the grid network.

5.2 This is intended to provide a regular and stable income stream from a fully sustainable source that can provide urgently needed funds to enhance the well being of the parish and local residents.

5.3 A number of potential investments have been identified, including the possibility that the income raised will be used to develop further hydro and other renewable energy investment opportunities within the parish.

5.4 The technical aspects of the project involve the installation of a notched weir and intake arrangement at one of two potential intake points identified in Section 3. These would provide an impoundment point to supply water to a seal penstock that would transport the water to the turbine housing site.

5.5 The notched weir would be designed to prevent any water abstraction once the flow drops below a level agreed with the Environment Agency. Normally this is the Q95 level (the level exceeded by the water course 95% of the time).

5.6 Initial enquiries to the Environment Agency have been made and while the response does not constitute a formal decision they have indicated that for this kind of water course they would seek to protect the Q85 level (the flow level exceeded 85% of the time).

5.7 Copies of EA guidance documents and email exchanges has been reproduced in the 'Environment Agency Information' folder on the accompanying CD Rom. A fuller discussion of all regulatory issues and the EA response is included in the Uncertainties Section of the Project Development Report.

5.8 The lower intake site would provide a total head of 35m and would be suitable for a 10kW pelton turbine, while the higher intake would provide a head of 55m and could sustain a 17kW pelton turbine.

5.9 In both cases the turbine housing would be located at the site identified in Section 3, with a metered connection to a three phase supply at the Sewage Works some 650m from the housing site. The cabling and metering would be included in the project installation, while the three phase connection point would be supplied by United Utilities acting for the District Network Operator (DNO) with the cost of this connection being covered by project funds.

5.10 As part of the project concept it is proposed that some of the manual labour involved in the installation is completed by local volunteers. Some of the major civil engineering tasks, such as trenching the cables and carrying penstock and equipment by hand to the installation site, are labour intensive and can add considerably to the costs. It is therefore proposed that some of this work is completed by volunteers under the direction of the installers as a means to reduce the installation costs and enhance the projects overall community profile.

6 Project Management

6.1 A Project Management Team has not been appointed to date as it was decided that this step was not required until a viable project was identified.

6.2 Following the successful conclusion of the feasibility phase it is understood that the intention is to create an organisation representing all parish parties to manage the project. This organisation will be responsible for the financial management of the project including the use and disbursement of the funds generated.

7 Community Involvement

7.1 The parish community is small, and consultations have largely been conducted via informal avenues and through the formal business of the Parish Council.

7.2 The landowners and tenants affected have all been consulted and have indicated support for the scheme, and wider consultations with Neighbourhood Forums and National park authorities is also underway.

7.3 Once a fully developed project proposal is finalised full local consultations will be undertaken.

8 Establishing Need

8.1 Depopulation and the challenges of maintaining strong local services in remote location have placed the parish organisation under serious practical pressures. The limited finance available to the parish also severely restricts the opportunity for effective action to mitigate such problems.

8.2 In addition, and development opportunities that may generate additional finance face potential restrictions due to the planning constraints arising from the National park designation.

8.3 As such, the parish community is urgently seeking environmentally appropriate and sustainable avenues to develop and independent financial basis for enhanced social and environmental improvements for the community.

9 Public Profile and Promotion

9.1 The project will be promoted through the local press and media. Partner organisations will be briefed via third sector media and details of energy generated and carbon savings will be recorded to help promote the success of the project to other similar organisations.

10 Project Longevity

10.1 The project will help achieve an ongoing income through energy sales and Feed in Tariff income. This will generate sufficient income to meet ongoing running costs.

10.2 As such, the project aims to become economically self sustaining and will serve as a permanent means to provide community income and reduce carbon emissions.

11 Energy Efficiency

11.1 As a free standing electricity generation project there are no efficiency aspects to this project.

12 Energy Yield and Performance

12.1 Energy yield from small hydro systems can be difficult to predict with accuracy due to the dependence on variable rainfall patterns and how individual watercourses respond to any given rainfall levels. These issues can be particularly acute in streams with no long term flow monitoring data.

12.2 The lack of flow data on Farra Grain may also cause some issues with the Environment Agency in terms of the amount of water permitted for abstraction. Conversations with EA representatives have indicated that they would prefer some longer term flow data to be sought to enable a better judgement on available flow for abstraction. Full discussion of flow data and related issues is contained within the Uncertainties Section of the Project Development Report.

12.3 Based on the estimated mean flow data of c $0.104m^3/s^{-1}$ calculated in Section 4, this would suggest an available water flow of between 0.05 – $0.075m^3/s^{-1}$ could be available for abstraction subject to agreement and licence conditions.

12.4 The Q95 level (the flow rate exceeded 95% of the time on average) is generally the level of flow that abstraction license conditions seek to protect. Without accurate long term flow data it is note possible to conclusively identify the Q95 for this watercourse, but using the proportionate method previously employed fro the Cunsey beck data to derive average flows would indicate a Q95 level of $0.0034m^3/s^{-1}$.

12.5 Based on these figures, and assuming the lower permitted abstraction rate of $0.05m^3/s^{-1}$ is permitted, it is estimated that the two proposed options for 10kW and 17kW systems (depending on which intake site is selected) would yield an estimated 60,000kWh – 110,000kWh pa respectively.

12.6 It should be noted that these figures are thought to be generally conservative estimates, but that more definitive energy yield predictions cannot be made in the absence of more detailed flow rate data.

13 Value for Money

13.1 The treatment of the VAT element incurred on the installation costs is a significant variable in assessing the value for money of the project as a whole. At present, as no formal structure has been decided for the operating group for the system, it is not possible to conclusively assess the VAT position. Is likely however, that any sales income generated from the contract supply of electricity to the grid are unlikely to pass the VAT threshold, currently set at £67,000pa.

13.2 However, as part of the Project Development Study enquiries have been made to the HMRC VAT helpline. Advice has been supplied that as

the organisation would be expecting to generate a tradable income, even if it below the VAT threshold, it would be able to register voluntarily for VAT and therefore be able to reclaim these costs on installation.

13.3 In these circumstances VAT would be liable on any income derived, but a future deregistration from VAT may also be possible in due course although full financial advice should be sought on this matter.

13.4 On this basis, the Value for Money projections have been based on the ex VAT installation costs.

13.5 A local (Cumbrian) registered installer, Turbine Services Ltd, was approached to supply system design and cost details. Following initial discussions and site visits two potential systems were proposed to reflect the two intake locations identified in Section 3.

13.6 Based on the site characteristics and the mean flow data calculated in Section 4, the system proposed was for a Pelton turbine with an installed capacity of 10kW for the lower intake site and 17kW for the higher site.

13.7 Both systems would use the same turbine but with the turbine set to a different generation speed to maximise generation output from the two intake sites. The main cost differential between the two design options is largely due to the different length on penstock and the requirement for 315mm penstock rather than 280mm for the 17kW system.

13.8 The proposed turbine is on the MCS approved list (see www.microgenerationcertification.org) but the precise make and model has not yet been supplied by Turbine Services. As the Project development deadline was approaching at the time of writing the final report draft these details have not been included and will be forwarded to the group as soon as they are available.

13.9 10kW Pelton Turbine (Lower Intake Site) The Turbine Services quote for the 10kW system gives an equipment cost of £58,059 with an additional £28,625 installation costs, a total of £86,684 (ex VAT). A full quote breakdown is provided in the 'Turbine Services' folder on the accompanying CD Rom. [Please note – item 25 'Mechanical and electrical installation of complete wind turbine system' is a typographical error and should read 'hydro turbine system'. The quoted costs have been queries and are accurate for the design in question].

13.10 In addition to the turbine system costs there are additional costs to provide a three phase grid connection point. Enquiries have been made to Brian Harrison, Terms and Conditions Section, United Utilities (Brian.Harrison@uuplc.co.uk). The response has confirmed that a three phase connection would be possible at the sewage farm. This would be provided by United Utilities.

13.11 The quote provided includes options for a connection point and kiosk to house the meter that crosses the track from the sewage works to the north side of the track for £3,000, or an alternative option with the connection point remaining on the sewage farm (south) side of the track for £1,300. There would also be a charge of £1,240 for a standard generator system study.

13.12 As the turbine house is on the south side of the track the easiest and shortest route would not require the cross road option, so the lesser cost of £1,300 plus generator system study costs have been used, giving a total price for both turbine capacity options of £2,500. A copy of the full email exchange with United Utilities is reproduced in the 'United Utilities' folder on the accompanying CD Rom, along with an application form should the project progress to the grid connection stage.

13.13 The total overall projected cost is therefore £89,184.

13.14 Three elements of the projected costs (marked in red on the quote) contain significant elements of uncertainty. These are the cost of the turbine house (£3,000) and the civil work in laying the penstock and installing the intake (£18,000) and burying the cable connecting the turbine to the grid connection point (£3,900).

13.15 The turbine housing costs will be subject to the detailed design approved by the Lake District National Park Authority (LDNPA) Planning Department. Ideally a design incorporating a concrete base with lightweight timber low walls and simple felted roof that could be removed for maintenance access would be acceptable. However, more expensive stone faced and slate roof designs have been required at some previous sited within the LDNPA area. This substantially increases the cost as the heavier roof requires door access meaning a much bigger structure is required.

13.16 These costs cannot be determined fully until a full planning application is submitted and so the provisional cost has been retained in these calculations.

13.17 As previously noted, discussions with Turbine Services have indicated scope for cost savings through use of volunteer labour for some of the installation tasks. Discussions have suggested that as much as 75% of the labour costs for the remaining two red listed items could be offset in this way if sufficient volunteer workers are available. This could potentially reduce installation costs by £16,425. However, given the uncertainty over the level of volunteer time available a more prudent approach to budgeting at this stage may be to assume a 50% cost reduction in these elements, generating a saving of £10,950. The project team may then wish to reassess this figure in due course however and may feel the higher level of volunteer involvement is possible.

13.18 An abstraction licence would be required at a cost of £135 along with an impoundment licence at a similar cost. The licensing process also requires formal advertising and a cost of £200 has been assumed for this, producing a total additional cost of £470.

13.19 Assuming the required level of volunteer support is available, the final projected installation cost, albeit with the above caveats, is therefore £78,705.

13.20 As part of the Project Development Report a full system design has been commissioned from Turbine Services. The cost of this is included within the original quote and provision of full designs should help to eliminate some of the uncertainty regarding the installation costs. At the time of writing the final Project Development Report this additional information has not been completed by Turbine Services and will be forwarded to the group as soon as it is available.

13.21 The projected energy yield from the system would be approximately 60,000kWh pa (see Section 14.5 in Energy Yield Section). Assuming a standard emissions factor of 0.43kg/ CO_2 for conventional power generation, the turbine would therefore provide a net carbon saving of 25,800kg/ CO_2 pa or 645.0 tonnes over the expected 25 year lifespan of the system.

13.22 This would suggest a carbon saving cost of £121/ tonne CO_2. As at 24th November 2009 there are no published benchmark figures available from the BRE website to compare the projected figures with (see www.communitysustainable.org.uk/filelibrary/Benchmarks_V1.pdff). However, this figure is below virtually all the listed benchmark figures for alternative renewable technologies indicating that the system would probably be considered a viable investment by funding bodies.

13.23 In terms of income generation, all the energy generated would be sold for export. The price achieved for the sale of the system output would be dependent on prevailing market conditions and specific contract details, and at this point it is not possible to definitively state what this price would be.

13.24 It is therefore recommended that sufficient account is taken of the likely range of contract prices available prior to final investment decisions being taken and sensitively testing of the project income and expenditure forecasts undertaking to assess the potential implications of alternative pricing scenarios.

13.25 For every 1p/kWh charged for the contract sale price an annual income of £600 would be achieved. While purchase prices of grid supplied electricity are currently between 8 – 15p/kWh on average, these prices are unlikely to be achieved by a small generator. Sale prices of 3 – 5p/kWh may be more realistic, providing an annual income of £1,800 - £3,000 pa.

13.26 In addition to the income derived from selling exported electricity, from April 2010 renewable generation systems are expected to be able to register under the Feed in Tariff (FIT) scheme. This is currently under consultation, and the government has indicated a FIT of 17.0p/kWh for hydro systems of up to 10kW capacity. This would be paid for a 20 year period on the full output of the system. *It is important to note that the FIT rates have not been confirmed and may vary above or below the level quoted here. It should also be confirmed whether the 17p/kWh rate applies to systems of 10kW or only system under 10kW. The proposals indicate a significant fall in the FIT rate for larger capacity systems, and if a 10kW system would not qualify for the higher rate it would be recommended to asses whether the turbine settings could be adjusted to deliver a capacity just below 10kW to ensure the higher FIT rate is secured.*

13.27 In addition to the basic FIT payment for all system generation, the scheme proposals also include a bonus FIT export rate of 5p/kWh for all renewable output that is exported off site. This would potentially yield a further £3,000 annually, although as noted above, the FIT rates and registering and claiming have not yet been confirmed.

13.28 At present it is understood that installations offered grant funding by the Low Carbon Buildings Programme (LCBP) and CSEP would also be eligible for FIT payments.

13.29 Based on the FIT rate above and the export premium payment, the system would yield a projected £13,200 in addition to the income identified in Section 15.25, giving a projected total annual income of £15,000 - £16,200.

13.30 While the energy sales would attract VAT, it is not clear at the time of drafting the Project Development Study Report whether FIT income would also be VAT rated income of how the income or corporation tax liabilities on this income would be assessed. However, the Treasury introduced special measures in 2007 to make householders income from Renewable Obligation Certificates (a previous financial support mechanism for renewable installations) tax exempt, and it is hoped that this precedent will be followed for the FIT scheme. This will be confirmed prior to the scheduled April 2010 launch of the scheme and should be confirmed prior to any decision to proceed.

13.31 An annual service cost of £300 has been provided by Turbine Services, although this doesn't not include costs for any part replacements. An additional two monthly regular system check and greasing is also recommended, but this could be completed by trained volunteers at no cost.

13.32 Based on the above assumptions regarding outputs, contract supply prices and FIT rates the 10kW system is projected to have a simple payback period of between 4.9 – 5.3 years (assuming no capital grants and taking no account of any finance costs).

13.33 It should be noted that the costs and payback calculations have been based on current energy prices. Higher future prices are likely, and these would serve to reduce the payback period.

13.34 17kW Pelton Turbine (Higher Intake Site) The Turbine Services quote for the 10kW system gives an equipment cost of £89,613 with an additional £30,755 installation costs, a total of £120,368 (ex VAT). A full quote breakdown is provided in the 'Turbine Services' folder on the accompanying CD Rom. [Please note – item 25 'Mechanical and electrical installation of complete wind turbine system' is a typographical error and should read 'hydro turbine system'. The quoted costs have been queries and are accurate for the design in question].

13.35 The grid connection costs for the 17kW system are identical to the previous arrangements for the 10kW option and have been priced at £2,500 as previously.

13.36 The total overall projected cost is therefore £122,868.

13.37 Licensing costs would be £470 as with the previous system in Section 15.18.

13.38 The red listed items are again identical to the smaller system, and have been treated in the same way. The turbine housing cost is therefore assumed to be £3,000 and it has also been assumed that use of local volunteer labour would reduce installation costs by £10,950.

13.39 Assuming the required level of volunteer support is available, the final projected installation cost, albeit with the above caveats, is therefore £112,390. A full system design is also awaited for this system as discussed above.

13.40 The projected energy yield from the system would be approximately 110,000kWh pa (see Section 14.5 in Energy Yield Section). Assuming a standard emissions factor of 0.43kg/ CO_2 for conventional power generation, the turbine would therefore provide a net carbon saving of 47,300kg/ CO_2 pa or 1,182 tonnes over the expected 25 year lifespan of the system.

13.41 This would suggest a carbon saving cost of £104/ tonne CO_2 (see previous comments for BRE carbon saving benchmarks).

13.42 As with the 10kW option, all the energy generated would be sold for export. The price achieved for the sale of the system output would be dependent on prevailing market conditions and specific contract details, and at this point it is not possible to definitively state what this price would be.

13.43 It is therefore recommended that sufficient account is taken of the likely range of contract prices available prior to final investment decisions being taken and sensitively testing of the project income and expenditure forecasts undertaking to assess the potential implications of alternative pricing scenarios.

13.44 For every 1p/kWh charged for the contract sale price an annual income of £1,100 would be achieved. While purchase prices of grid supplied electricity are currently between 8 – 15p/kWh on average, these prices are unlikely to be achieved by a small generator. Sale prices of 3 – 5p/kWh may be more realistic, providing an annual income of £3,300 - £5,500 pa.

13.45 In addition to the income derived from selling exported electricity, from April 2010 renewable generation systems are expected to be able to register under the Feed in Tariff (FIT) scheme. This is currently under consultation, and the government has indicated a FIT of 12.0p/kWh for hydro systems of over 10kW capacity. This would be paid for a 20 year period on the full output of the system. (Please note the differential rate for proposed FIT levels for the two system capacity options).

13.46 In addition to the basic FIT payment for all system generation, the scheme proposals also include a bonus FIT export rate of 5p/kWh for all renewable output that is exported off site. This would potentially yield a further £5,500 annually, although as noted above, the FIT rates and registering and claiming methods have not yet been confirmed.

13.47 At present it is understood that installations offered grant funding by the Low Carbon Buildings Programme (LCBP) and CSEP would also be eligible for FIT payments.

13.48 Service costs are identical to the !0kW system and have been assumed at £300pa as in Section 15.31.

13.49 Based on the FIT rate above and the export premium rate, the system would yield a projected £18,700 in addition to the income identified in Section 15.40, giving a projected total annual income of £22,000 - £24,200.

13.50 Similar comments apply regarding VAT as to the 10kW system option.

13.51 Based on the above assumptions regarding outputs, contract supply prices and FIT rates the 17kW system is projected to have a simple payback period of between 4.7 – 5.2 years (assuming no capital grants and taking no account of finance costs).

13.52 It should be noted that the costs and payback calculations have been based on current energy prices. Higher future prices are likely, and these would serve to reduce the payback period.

14 Outcomes

14.1 The project will meet four of the CSEP outcomes, namely;

- Reduction in CO_2 emissions – by providing exports of zero carbon power
- Reduction in energy bills - by providing long term investment income for energy efficiency measures and further renewable installations with the parish.
- Reduction in the reliance of imported energy – by both enabling local generation of renewable energy.
- Increased community awareness – by developing a community renewable energy project and providing further funding for sustainable community developments.

15 Sustainability

15.1 The project is intended to promote greater sustainability by reducing energy related carbon emissions through renewable generation capacity.

15.2 It is viewed as particularly significant that this project is proposed for the Lake District National Park and will help to demonstrate that sustainable energy provision can succeed in protected landscape areas.

15.3 The project will also be used to promote a greater awareness of environment and sustainability issues within the community and will enable the spread of key environmental messages as part of the links to broader social activities.

16 Building Integration

16.1 As a free standing installation the project does not involve any specific building integration issues.

17 Structural Designs

17.1 Detailed structural designs will depend on further discussions with the Environment Agency and are likely to be subject to a lengthy period of negotiation and review. It was therefore not possible at this stage to include full structural designs within the Project Development Report.

18 Electrical Schematics

18.1 An outline electrical schematic has been commissioned from Turbine Services along with further more detailed costs as described above, but this information was not available at the time of writing the Project Development Report. This will be forwarded as soon as it becomes available.

18.2 United Utilities have provided informal written advice (see reproduced email exchange in 'United Utilities' folder on accompanying CD Rom) that confirms the low voltage supply to the sewage works is a sufficient grade connection to provide a three phase connection point close to the sewage works.

18.3 The project would have the responsibility of providing the necessary cabling from the generator to this point. United Utilities did provide a cost for running the three phase supply to the turbine house, but the cost of this, along with concerns regarding the ability to maintain the statutory G59 voltage for that distance have led to this option being discounted.

18.4 In the correspondence United Utilities did refer to the fact that due to distances from local substations the supply point at the sewage works is likely to be very close to the statutory voltages already. It is therefore recommended that the grid connection point is located as close to the existing sewage farm supply as possible to ensure the system can operate within the legal G59 technical standards.

19 Project Team

19.1 No final decisions have been made regarding the project team. However, following the groups assessment of the Project Development Report the decision whether or not to proceed further with the project will be taken and a project team will be appointed as appropriate.

20 Legal Issues

20.1 Unlike other renewable technologies hydro power systems require a number of legal and statutory processes to be successfully negotiated prior to any installation proceeding.

20.2 A requirement for planning permission is common to many renewable technologies, including hydro power. All structural elements of the project would be required to receive planning consent, including the impoundment weir, penstock and turbine housing.

20.3 As the local planning authority LDNPA would need to be consulted, and while in planning guidelines are to support community based renewable schemes there will be a requirement to minimise any visual impact.

20.4 The intake sites are not visible from any public vantage point, and the route of the penstock is largely within heavy woodland that will either be hidden of covered in leaf fall over time. However, the turbine housing site is relatively exposed and can be viewed from a public track.

20.5 In terms of costs and ease of operation the preferred design would be for a small wooden hut with removable felted roof. However, it is possible that a stone built structure is required, although this would inevitably increase the height and footprint of the structure and it could be counter argued that such a planning stipulation would actually increase the visual intrusion of the installation.

20.6 Planning issues will need to be discussed in detail with LDNPA officers once a decision in principle to proceed has been taken.

20.7 Licensing from the Environment Agency is also required for both the construction and operation of any hydro power system. An Abstraction Licence is required for the abstraction of water from any watercourse in excess of $20m^3$ per day. This application requires adherence to strict procedural requirements including the provision for advertising the proposal in relevant publications and is usually determined by the Environment Agency within 4 months of receipt of the application.

20.8 The abstraction license is critical in assigning the total level of abstraction that the scheme will be allowed, confirming the minimum level of flow that needs to be protected (the 'hands off flow') and whether abstraction would be permitted year round.

20.9 A significant difficulty for the project is that while assume average flow rates have been calculated to assess likely system outputs, there is almost no empirical data for flow levels within the Farra Grain catchment. The EA have made clear their view that an abstraction licence should be based upon a reasonable level of actual measurement data from the stream affected, and lack of such data may delay any licence issue.

20.10 Given this, it is recommended that a period of regular flow monitoring takes place in order to provide some effective evidence. Clarification from the EA has been sought as to the level of accuracy in this data that would be acceptable and whether they would accept volunteer members from the group supplying this information. It has been suggested that once weekly approximate readings taken by depth, width and flow speed assessments may be a suitable level of information that could be recorded by group members.

20.11 The full response from the Environment Agency is contained in an email reproduced in the 'Environment Agency Information' folder on the accompanying CD. The relevant section is as follows; "**Flow data - if they take a scientific approach and use proper equipment and take expert advice it is possible they could do the flow measurements. They would need to provide measurements on a range of flows over a period of time and would therefore have to find a way of recording levels and producing flow calculations which is the**

complicated part but it could be done using Excel if they know how. It's unlikely they would be able to do this unless they have some professional expertise. Also they would have to consider the site and stability of the control, if there is one, and if there isn't they may need to do some ground works or install a pre fabricated weir such as a v notch, which would be dependent on river width, max head, and approach. If the latter were possible they would have to ensure the design was appropriate, install it and then measure levels and use appropriate weir equations for flows. I would add that from experience where applicants have tried to undertake such work themselves it has resulted in the quality of data not being sufficient which in turn has caused delays and extra cost due to an appropriate expert being belatedly employed to provide the necessary data."

20.12 This suggests a level of data collection that while not necessarily expensive to generate, would require a lengthy time period and level of expertise. Turbine Services may be able to develop these detailed measurements, but it should be noted that previous successful micro hydro installations in the Lake District have proceeded without such detailed flow assessment requirements and that detailed discussion with the Environment Agency may permit a less exacting flow measurement regime to be used.

20.13 An Impoundment License will also be required for the construction of the intake weir. This would normally be assessed at the same time as the abstraction license.

20.14 Subject to advice from the Environment Agency, Flood Defence Consent may also be required. Advice on this would be provided once the agency received full design details and a firm development proposal.

20.15 Protection of fisheries is also an issue for hydro schemes, and the EA response has suggested that a fish pass may be required subject to formal application to the National Fish Pass Panel. This is stated with particular concern regarding brown trout and eel within the river system, although no formal habitat survey data is currently available.

20.16 This response has been queried, in particular due to the presence of some small but significant falls downstream of the intake sites that may eliminate any prospect of migratory fish species. (See Photograph 2 in 'Photographs' folder on accompanying CD Rom).

20.17 The EA have also recommended a general habitat survey of the site along with identification of fish species present prior to proceeding with licence applications. Clarification has been sought as to whether the EA would accept survey data collated by local volunteers connected with the project group should sufficient expertise and experience be available.

20.18 The response is included in the reproduction of email correspondence contained within the 'Environmental Agency Information' folder on the CD Rom, but in summary they appear to accept that while migratory salmonid and eel populations will probably not be affected, a full fisheries survey would be required to assess possible impacts on resident brown trout

populations and they have been non committal on whether the group could present their own habitat research.

20.19 Should the EA take the view that a fish pass is required this could add significantly to the cost.

20.20 It should be noted that in practice hydro power schemes often require lengthy development phases while statutory and planning permissions are secured. Given the natural uncertainties involved in the hydrological and ecological systems involved this is usually to some degree an iterative process involving a level of discussion and negotiation between the developer and the various agencies, and due to this it is not possible to conclude with absolute certainty within the Project Development Report if the full required permissions will be forthcoming or what level of restrictions would be imposed on any development.

20.21 However, the initial responses received and previous experience with small scale hydro schemes within the LDNPA area suggest that with suitable negotiation and allowance for sufficient environmental protection, the scheme as outlined within the Project Development Report is, on balance, likely to receive statutory approval, although this should not be taken as a definitive guarantee of success.

20.22 It is recommended that particular attention is given to the following statement from Dale Gibbons, Environment Officer from the Environment Agency in the email to TEC sent 25th November 2009 and reproduced within the 'Environment Agency Information' folder on the accompanying CD Rom; "***It is worth making it clear to the developer/applicant that the process that needs to be gone through is not a quick and simple one. As an agency we need to ensure that any such scheme will not harm the environment and the evidence to prove this can be detailed and lengthy - I would not want to give any false impression to the contrary. The process needs to work so that all licences and permissions, including planning permission, tie together to authorise a scheme that meets all necessary legislation and protects the environment whilst providing an economically viable and sustainable renewable energy source."***

20.23 It is worth noting however, that many of the conditions imposed by the Environment Agency are standard protection measures and given the nature of the stream and the catchment careful negotiation can lead to a substantial revision of the required conditions.

20.24 A final legal issue concerns overall project timing. The detailed method statement for the scheme construction is expected to adhere to conditions of the Salmon and Fresh Water Fisheries Act and ensure in river works are completed during the dry period of June – September. Given the 4 month determination window for statutory permissions and the request for better empirical flow data it is considered unlikely that a successful project can be ready for installation by June 2010.

21 Uncertainties.

21.1 Although costs for the proposed systems have been based on installer site visits, there is an element of uncertainty regarding some of the installations costs as it is not always clear until work commences whether the terrain and ground conditions will affect project costs.

21.2 The element of volunteer input will also affect final costs, and while the total project costs assessed within the Project Development Report is based on volunteers providing 50% of the labour costs, Turbine Services have indicated their estimate that 75% of the relevant costs could be carried out by suitable volunteers, therefore potentially reducing the overall installed costs.

21.3 The statutory and planning conditions may also affect final costs. In particular, costs associated with the turbine housing and any requirements for fish protection measures may affect final costs.

21.4 All output figures are of necessity estimations. These are obviously heavily influenced by ambient rainfall patterns and will vary considerably from year to year such that while the information used here is based on the best available estimate the figures cannot be guaranteed.

21.5 The normal variation in flow levels is also compounded by some uncertainty regarding permitted abstraction volumes. In the absence of any detailed flow data this is a serious uncertainty and it is recommended that steps are taken to gather empirical flow data prior to committing to the project.

21.6 Planning permission and a range of other statutory permissions would be required before the project could commence (see ‘Legal Issues’ Section above).

21.7 All the capital installations detailed in this report are potentially eligible for funding. Both CSEP and the Low Carbon Building Programme (LCBP) can fund up to 50% up to £100,000 total project costs (LCBP funding expires April 2010). All the listed technologies are eligible under the funding with MCS accreditation.

21.8 The Feed in Tariff payments are likely to substantially alter the economics of renewable power over the coming years. The likely income from these schemes is currently projected to be greater than the income from the system outputs in terms of energy price, but at this stage the FiT levels cannot be confirmed.

21.9 Contract prices for the sale of exported power would need to be negotiated. While a provisional estimate has been made of the likely range of export prices these cannot be guaranteed and may go down as well as up.

21.10 An important area also requiring detailed assessment is the payment scheduling and income generation. Grants are often paid retrospectively, and installation costs are likely to be required for payment prior to grant allocations being received of income generated from the system output.

21.11 Clearly, for a group with limited working capital this could present some difficulties. Consideration must be given to such issues and the required finance would need to sought to cover all liabilities arising from the project development.

22 Relevant Additional Documents

22.1 The accompanying CD Rom includes outline quotations along with a number of photographs and plans taken of the site and associated information as referenced within the report.

23 Disclaimer

The information contained in this report is accurate at the time of writing and has been checked by TEC for consistency and validity. Where assumptions have been made these have been stated, and a number of areas of uncertainty have been highlighted. The results contained in this report do not constitute guarantees of performance or cost, and TEC Ltd will not be liable for any losses arising from acting on the conclusions of this report.

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14th December 2009