Restoration of a Micro Hydro Scheme on the River Gynack

Variation to application 10/424/CP to add a Coanda screen, delete the lade and alter the position and construction of the turbine building.

Design proposal

A C Bell

Kingussie Community Development Company

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1. Introduction

Since 2005 Kingussie Community Development Company (KCDC), a registered charity, has been seeking to re-establish a run of the river hydro scheme that provided power to St Vincent's hospital during the 1920s. The income from the new scheme is intended to be used to support community projects and initiatives, including education. As a result of a design study carried out in 2010 it was concluded that an Archimedes Screw would be an appropriate type of turbine for this low head site.

A fund-raising exercise was carried out and a planning application (10/424/CP) was submitted. This was approved with conditions by CNPA on 1st April 2011. An abstraction licence was granted by SEPA.

Although estimates of the cost appeared initially to be consistent with the likely funds available, a number of setbacks occurred, in particular the inability to receive Feed-in-Tariff when in receipt of public (including EU) funding. Although the design was altered in early 2012 in an attempt to reduce its overall funding requirement to within the amount likely to be available of around £120000, the high cost of the turbine and its installation meant that Archimedes Screw proposal ultimately was not viable.

An options study that considered different types of turbine and capacity factors led to an alternative proposal using a Crossflow turbine. Based on the quoted turbine cost and civil engineering cost estimates this appeared to be viable within the available funding. This proposal used the same intake structure as the Archimedes Screw scheme and the turbine was mounted in a powerhouse broadly similar in design but moved closer to the outfall point. This required a buried penstock (pipe) roughly along the line of that of the 1920s scheme. A request for a variation to the planning approval was sought from CNPA and taking into account that detailed drawings had not been submitted at that stage, it was agreed that this was a Non-Material Variation.

Following finalisation of this design, tenders for the civil engineering work were sought and three offers were received in mid 2013. These were all significantly above the professionally estimated figures that KCDC had budgeted for. There was no single reason for this discrepancy but it was considered to be related to the scale of the job, uncertainty about ground conditions and schedule risks associated with work in the river. The project was at risk of being terminated at that point.

Another options study was then carried out which considered further changes that could reduce the uncertainties and costs of the civil engineering work. One of these options has been priced by contractors so there is now reasonable certainty that the scheme can be completed within budget. The revised proposal was accepted at the KCDC AGM on 11th November 2013. The current scheme is now broadly similar to the 1920s scheme but with a higher output and improved environmental performance.

This document gives an overview of the complete scheme, indicates the schedule for the work and explains the material changes from the originally approved scheme and its agreed variation. A statement is made on each of the conditions set down in the Approval

notification and subsequent correspondence. Finally a commentary on the effect of these changes on the statements made in the original Design Report is made.

Drawings and diagrams are included in this submission. These should be regarded as preliminary. Final drawings are required to be submitted to SEPA two months before the work starts. These will clarify any alternative design features that are mentioned in this document and will also be submitted to CNPA.

2. Description of Scheme

2.1 Overview

The scheme is situated at Strathlynn on the river Gynack in Kingussie. (grid reference NH7553 0107) with an area of approximately 0.09 ha. The land surrounding the site is owned by KCDC having recently been gifted for the benefit of the community. The river flows over a rock outcrop at that point via a series of waterfalls with a drop of around 4m in a short distance. The proposed intake is above the outcrop and the tailrace is discharged below it. The surroundings are mainly natural birch woodland and a public path crosses the river by a new bridge on the outcrop. Fig 1 is a 3D drawing that was submitted with the original planning application and shows the site as it is now (apart from the location of the bridge).

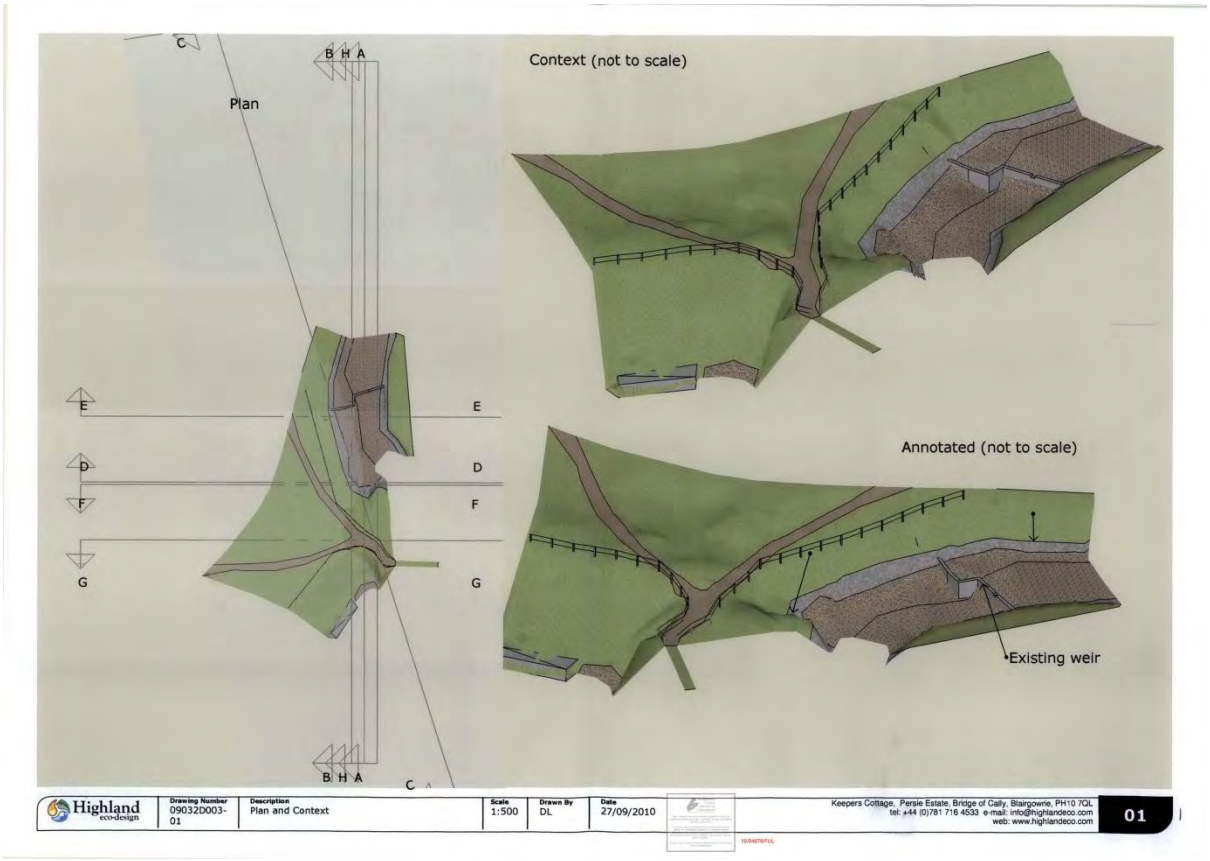

Fig 2

As a result of the option studies, the maximum output was reduced from 19kW to around 14 kW but with a higher capacity factor as a result of lower flow demand. It qualifies for the

higher FIT value that applies below 15kW and this compensates to some extent for the lower output.

The scheme can be considered in three parts: Intake, Penstock and Turbine House.

2.1 Intake

The 1920s weir and intake structure remains in place, albeit with some damage and choked with boulders. The old intake structure on the LH side in Fig 3 below will be partially removed and a new weir will be cast against the old weir and across the full width of the river. The crest level will be the same as the undamaged part of the old weir and there will be short walls at either side to ensure that the flow is directed across the weir under high flow conditions. A slot will be formed on the E side of the weir sized to ensure that the so-called "Hands off flow" (HOF) and residual flows specified in the CAR Licence are achieved. Approximately 0.5m downstream of the new weir, a concrete support wall will be cast across the river, apart from the section occupied by the HOF slot, and closed off by a wall to form a sump. An outlet pipe will be cast into the downstream side of the chamber approximately at the position of the stream side wall of the old intake structure and the space between it, the support wall and rock bank filled to avoid the risk of fish being trapped.

A Coanda screen will be mounted between the weir and support wall. Coanda screens use horizontal wedge wires to allow a portion of the water flow to pass into the sump but debris and fish to be excluded. They are self cleaning and have been used extensively in Scotland and elsewhere. Fig 2 below shows a typical installation with a bypass at the side. Although they have been primarily used for high head schemes, versions are now available that have a sufficiently low head loss to permit them to be used on a scheme such as this.

Fig 2

The existing weir and intake structure under summer conditions of low flow are shown in Figure 3. Figure 4 is a photomontage showing the Coanda screen mounted on the weir and

support wall under the same conditions. The outlet pipe can be seen. This may be encased in an additional concrete sheath and may be surrounded by boulders to protect against damage.

Fig 3

Fig 4

Under high flow the current intake structure can be submerged as shown in Figure 5. Figure 6 is a representation of the Coanda screen under these conditions with the outlet pipe also submerged.

Fig 5

Fig 6

A typical HOF slot and detail of the E bank of the river is represented in Figure 7 (This will be sized to meet SEPA and Spey Fisheries requirements). In order to permit installation of 6 Coanda screen sections, the W bank will need to be excavated as shown in drawing numbers

KCDC/13/01 and 02 in Appendix 2 which show the detail of the intake. A montage of this is shown in Figure 8.

Figure 7

Figure 8

The above photomontages above show typical screen designs. The specific design to be used is shown in Drawing no AQS-046(D) in Appendix 2 (and Figure 2). In addition, depending on the status of the proposed upstream hydro schemes, protection bars may be fitted as shown in this drawing.

2.2 Penstock

Figure 9 shows the remains of the upstream end of the existing penstock that passes through the outcrop. To the N of that is a series of boulders lying on top of the rock that forms the river channel edge. The penstock, which is approximately 700mm diameter as compared with the original 400mm, will run from the Coanda screen chamber to a point below the derelict penstock and then run down to an exit point in approximately the same position as before. The track for the first section will be excavated as necessary into the rock edge, a concrete pipe embedded in and, as far as practicable, disguised with boulders. (As it would have required boulders to be removed, the available topographical survey does not show the underlying rock so an accurate elevation drawing cannot be done.) A trench will be excavated down to remove the old pipe and a new plastic pipe will be laid. There will be a circular or rectangular inspection chamber with a shut off valve between the two pipe sections of the penstock.

Figure 9

Fig 10 below is a photomontage that gives an impression of how the proposed penstock and inspection chamber would be seen from weir position. Figure 11 shows the track of the penstock.

Fig 10

Fig 11.

2.3 Powerhouse

Figure 12 shows the plinth on which the 1920s turbine was mounted, as seen from the interpretation board on the E bank of the river. No pictures of it survive but it is assumed that there was a small building to protect the equipment. The plinth is badly undercut and would need to be completely rebuilt for it to be usable for a new turbine. This was one of the options considered but rejected in favour of the current proposal.

Fig 12

The proposed location of the new powerhouse relative to the existing plinth and old penstock is shown in Figure 13. It is mounted on a platform and contains the turbine, generator and associated control equipment.

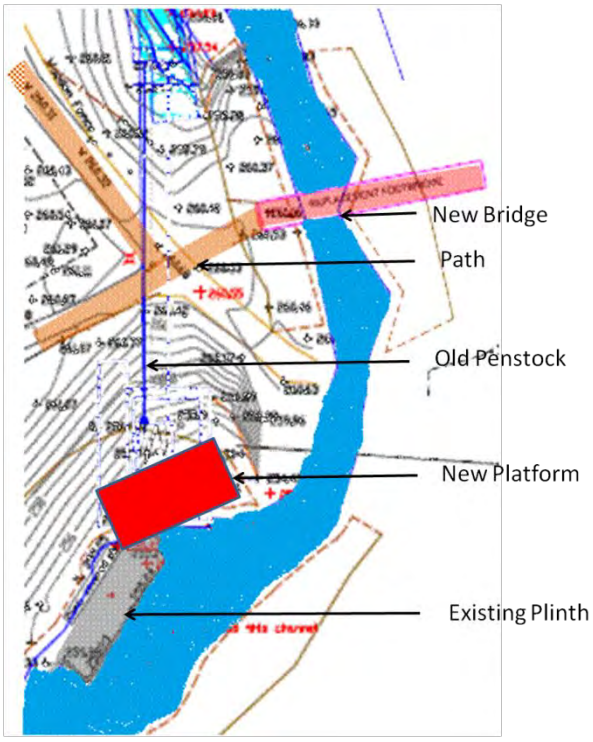

Fig 13

The external appearance will be vertical larch board/lap with a profile metal roof, typical of small buildings in the area. The penstock will be exposed for a short distance before it enters the building via a bend. Figure 14 is a photomontage of the Powerhouse as seen from just above the old plinth. This is a position currently inaccessible to the public. The building

cannot be seen from the interpretation board on the opposite bank. The view from the point at which the two paths join is approximated by Figure 15. It also shows the approximate position of the galvanised steel stairs. Handrails will be fitted, either wood or metal.

Fig 14

fig 15

A chamber will be excavated into the rock below the platform for the discharge from the turbine through the so-called draft tube. A tailrace screen will be fitted in accordance with SEPA guidance.

Drawings KCDC/13/03 and 04 in Appendix 2 show the above details.

3. Schedule of Work

In order to meet some of the funders' requirements and delivery of long lead time items some expenditure will be committed in mid January 2014. Initial site work will take place in March 2014. This will include taking cores to check ground conditions and identifying, with the contractor, trees that may need to be removed. Removal will be done by the KCDC Woodland and Biodiversity sub-group. The civil engineering contractor will mobilise his workforce in mid May and establish a temporary fenced compound in the Golf club car park in readiness for starting work in the river at the beginning of June 2014. This is expected to be complete and the ground levels reinstated by the end of July. The powerhouse platform and building will be installed during this time. Once the civil engineering work has been cleared, the system will be flushed and the Coanda screen and turbine installed. The electrical cable will be laid and the system tests then witnessed by SSE in preparation for energisation. Finally KCDC Woodland and Biodiversity sub-group will reinstate disturbed surfaces and plant new saplings as required. The KCDC Paths sub-group will reinstate the paths and fences. The expected completion is the end of September 2014.

4. Variations to approved proposal

The changes for which approval is being sought are:

4.1 Add Coanda screen and delete lade

The approved scheme has a 5m long concrete side weir on which is mounted a 200mm high steel boulder screen. It discharges into a settling chamber that in turn feeds a 15m long lade. This is 2m wide and has a wall facing the river which is 1.5m high in places. The lade contains a fish screen angled in order to meet the SEPA requirements for limiting maximum water velocity. The surface finish of this structure is of concern from a planning perspective. All of the above will be deleted. See plan and sections drawing nos 2096/1 and 2096/5A submitted to CNPA on 17th May 2013. An extract of this is shown in Figure 16 below with the existing weir and intake structure shown in red and the additions in blue.

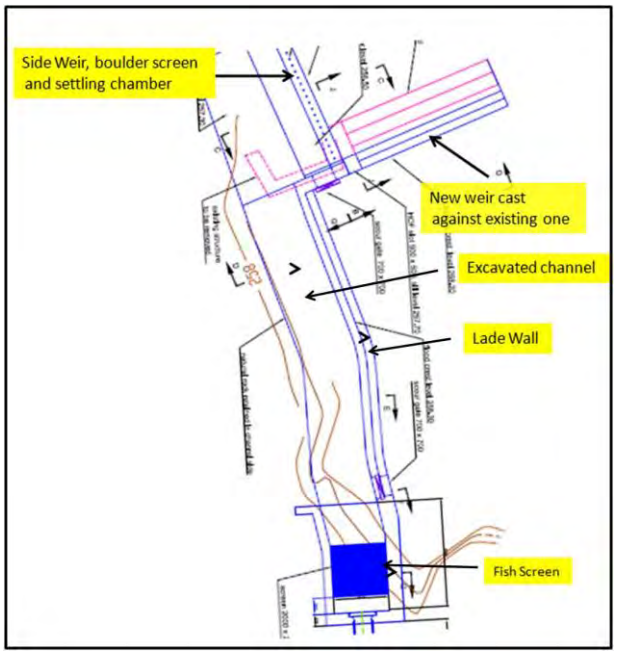

Fig 16

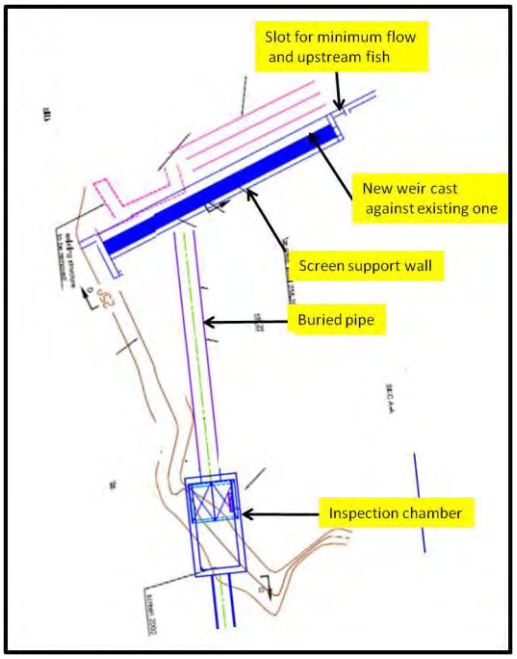

fig 17

The new weir face will be extended across the full width as explained in section 2 above and shown in the section in Drawing KCDC/13/02 in Appendix 2. A plan for comparison with the approved scheme is shown in Figure 17 above. Details of the support wall and pipe connection are also shown in that drawing. Coanda screens are accepted by SEPA for protection of downstream fish passage. The detail of the screen is shown in Drawing F-1500 HC. It is constructed in stainless steel sections 1.5m wide that are bolted to the weir and support wall. 6 sections will be installed with a design capacity of 480 l/s and head loss of 450mm. Screens can be individually removed for maintenance. Depending on the progress with the Pitmain hydro schemes that may reduce the frequency and magnitude of spates, protection bars may be installed as shown in drawing F-1500.

The screen will discharge into the existing pool downstream of the weir apart from a short section on the W side that will discharge initially into a channel that discharges into the pool.

An extra length of penstock will be added as described in section 2.2 .This terminates in an inspection chamber that connects to the below ground penstock in the currently approved scheme. Although a build up of silt is not expected in the Coanda screen sump or penstock, provision has been made for an inspection hatch to be opened to allow it to be flushed.

The amount of concrete to be used in the new scheme is approximately 50% of that of the approved scheme leading to a significant reduction in the quantity of this material transported through Kingussie. In addition there will be less excavated material to be disposed of.

The new scheme is much less intrusive from a visual perspective and there is much less bare concrete in view. Although the screen itself cannot be made to look like a natural feature, it is not unattractive and is a vast improvement over the existing derelict structure. Boulder placement over the upper penstock will be arranged to reflect the existing situation.

4.1.1 Comparison with original planning submission for the Archimedes Screw scheme.

The drawings submitted in 2010 were architectural type drawings from a 3D CAD model and approval was based on these. These show the site and sections but there is a lack of detail, including that of the water levels. Figure 18 below shows some the diagrams in the original design submission. (Note the bridge position has now changed)

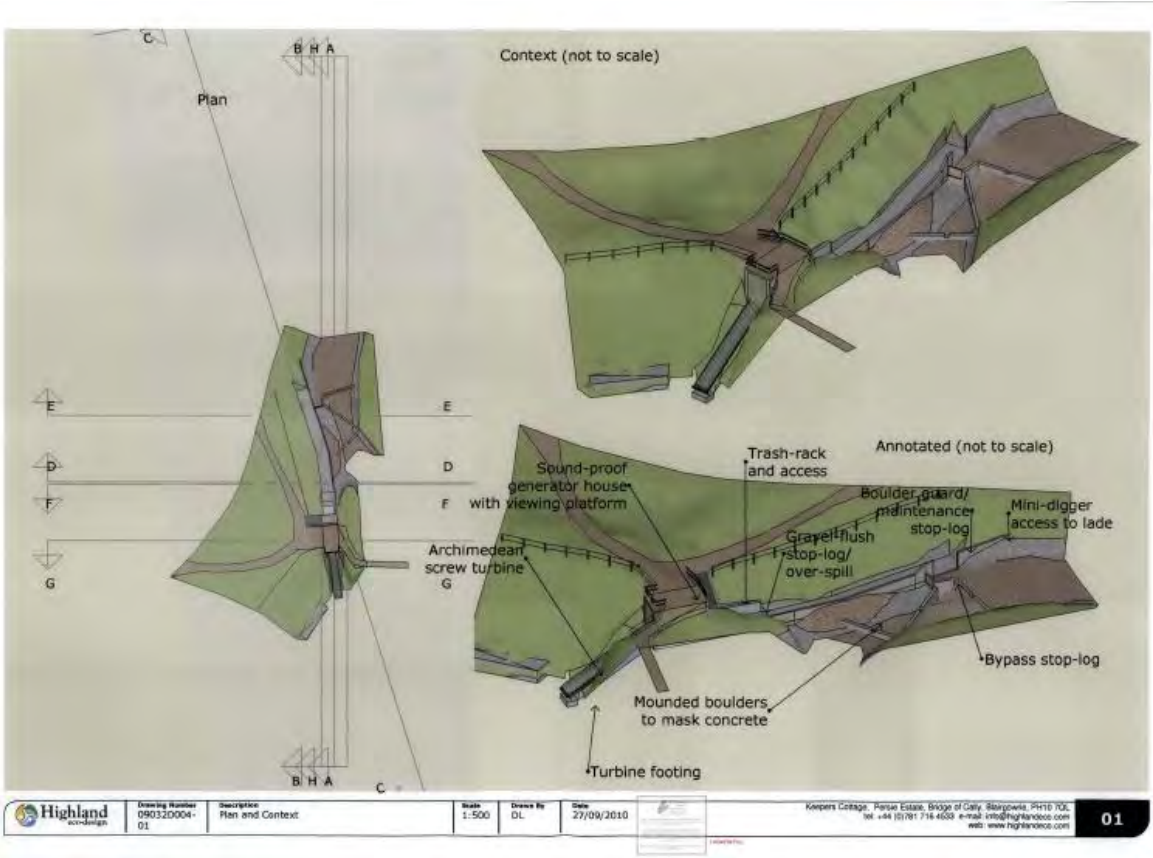

Fig 18

The undeveloped state of the site in dry conditions is shown in Figure 1. This has been modified approximately to reflect the current proposals for the intake and is shown in Figure 19.

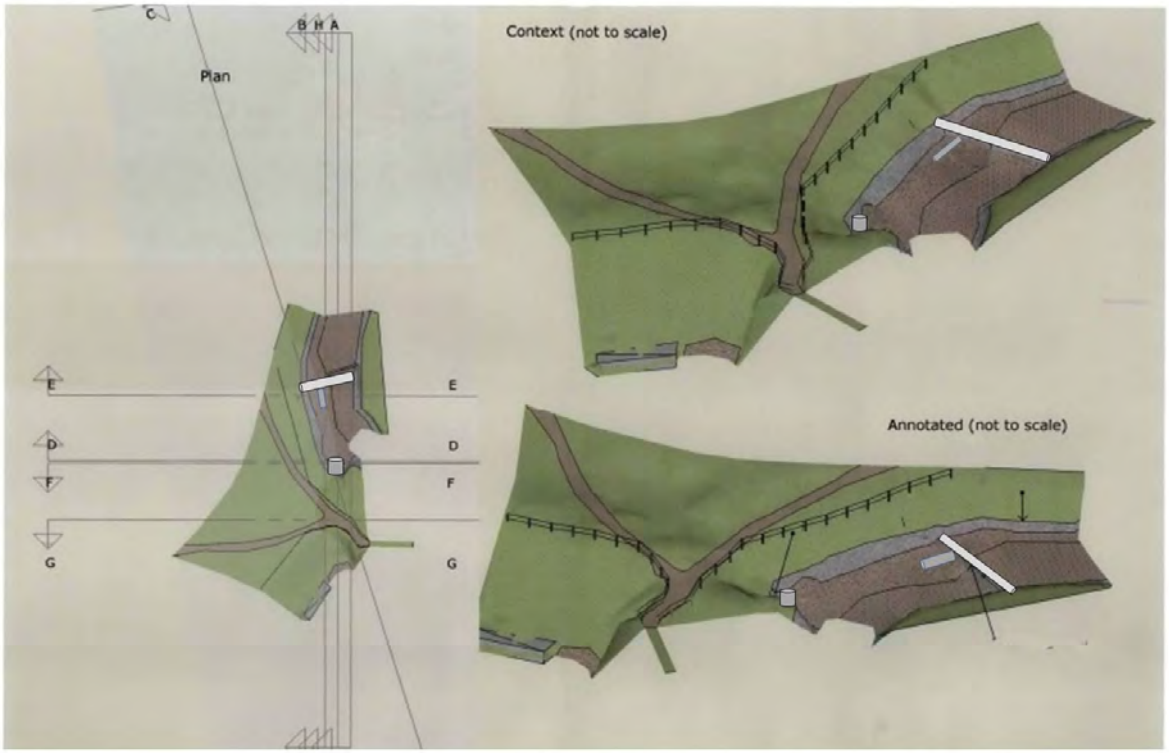

Fig 19

4.2 Alter position and construction of the turbine building

The cost of the powerhouse was a major factor in the decision to abandon the approved scheme. Significant elements of that cost, as summarised in Figure 20 below were:

- Provision of a flat roof as a viewing platform with handrails
- Natural Stone cladding of the walls
- Concrete stairs
- Significant requirement for excavation of rock
- Significant requirement for concrete to be cast below the water level.

The first item was a legacy of when the Archimedes screw powerhouse roof was at the same elevation as the new bridge and was part of the access route to it. It is unnecessary. A pitched roof clad with metal profile sheeting of an appropriate colour is proposed

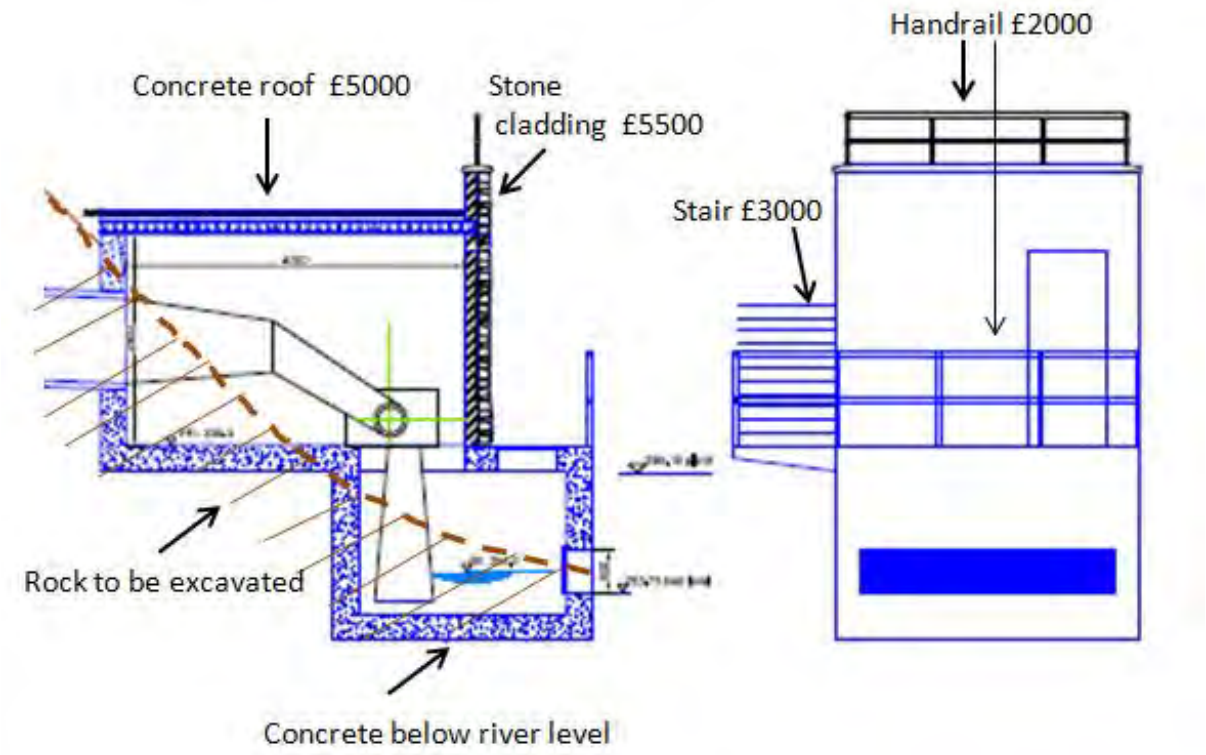

Fig 20

As far as we are aware, stone cladding was not requested by any Planning Authority and it was presumably specified by the original design consultant. The larch board/lap cladding proposed is more in keeping with such buildings in the area and uses more sustainable materials.

A cheaper alternative of galvanised steel stairs or, depending on ground stability after the works, path steps is proposed. At a later date the original path down to the old plinth may be reinstated and the SW side of the turbine house may available for educational visits.

Significant excavation of rock can only be avoided by moving the location of the powerhouse. Figure 21 shows a plan of the proposed new position in red superimposed on the position proposed for the approved scheme in blue. Note that the final position and orientation of the platform will be dependent on site conditions and requirements for matching to the turbine. The position and orientation may vary up to 1m in any direction. The final position will be shown on the drawings submitted before construction. The line of the penstock through the outcrop is unchanged from the approved scheme but an additional bend will be required. This will be visible externally.

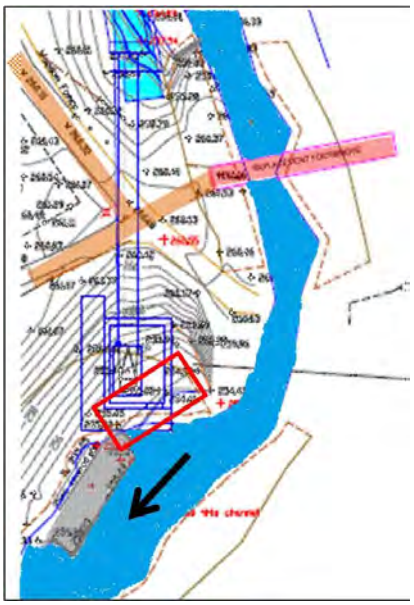

Fig 21

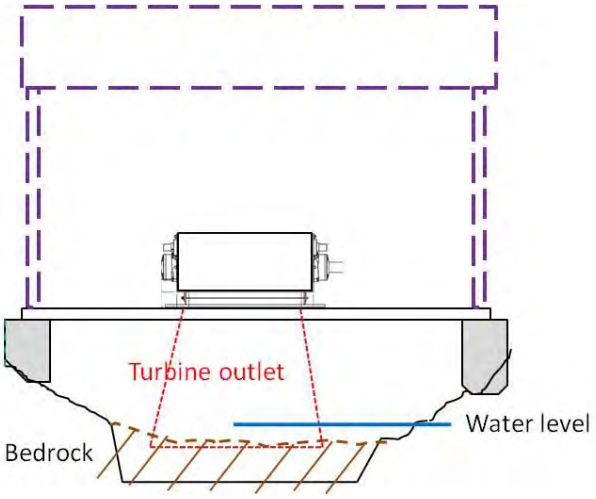

fig 22

Relocation also allows less costly design solutions to be adopted. The proposed powerhouse structure consists of two parts: a concrete or galvanised steel platform mounted on two concrete abutments; and a building mounted on the platform. The construction of the building may be insulated wood or steel framing, or blockwork. In all cases the external appearance will be the same: vertical larch board/lap with a profile metal roof. The method of construction chosen will depend on costs and a risk assessment for flooding. The turbine base will be 1.5m above the design waterline and above the old plinth base. All electrical equipment will be mounted at least 1m above floor level.

Significant savings can be made by avoiding the requirement for an enclosed concrete tailrace chamber and discharging into an excavated rock chamber that connects via a natural rock cill (if possible) to the original outwash position as shown in fig 22.

The building will only be visible to the public from the point in the existing path where it rises to the new bridge. Figure 15 is a photomontage to give an impression of the view from that point which can be compared with the approximate area of the roof of the approved design in Figure 23 below. The building will not be seen from any other point normally accessible to the public.

Fig 23

5. Method statements and Environmental management

A Construction and Environmental Management Document (Appendix 3) was prepared in March 2013 to set down the arrangements that contractors would be required to put in place. This was supplemented by a Pre-Construction Information document issued to tenderers to meet the requirements of the CDM regulations. Both these documents will be revised to reflect the changes given in this proposal.

In particular the CEMD specifies the precautions to be taken to protect wildlife as proposed in the "Otter and other protected Mammals Survey Report" (Appendix 5) carried out in November 2010. This report states that a possible otter spraint was seen but that as the area is not a preferred habitat for otters, their presence would be transitory. Accordingly KCDC do not propose to fund another survey.

In order to minimise disruption on the public road contactors will use the Golf Club car park as shown on the Location Plan in Appendix 1. The triangular area shown in Figure 24 will be used for temporary storage of excavated materials and for access to the works. Any soil and ground flora will be stored separately in order that it can be reused. A tree survey has been done and the two trees (Oak of girth approximately 2.5m and Birch of girth approximately 1m) marked in green on Figure 24 will be protected. Other small trees, which are a mixture of birch, hazel, alder and rowan will be protected where practicable. In particular it is proposed to avoid removing the trees between the path and the river shown in green on the plan unless essential. Access to the works will be as shown by the yellow arrows.

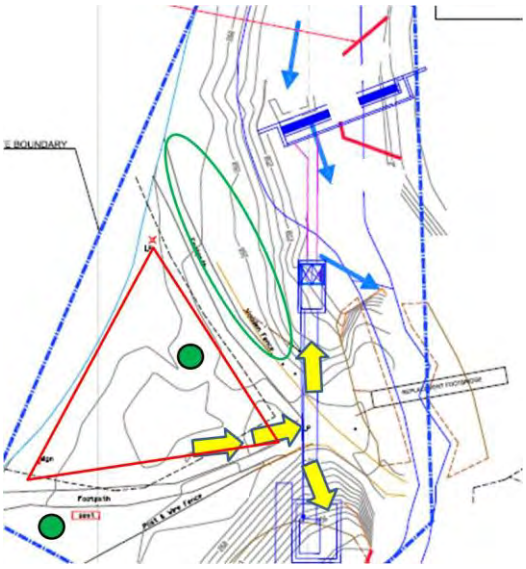

Fig 24

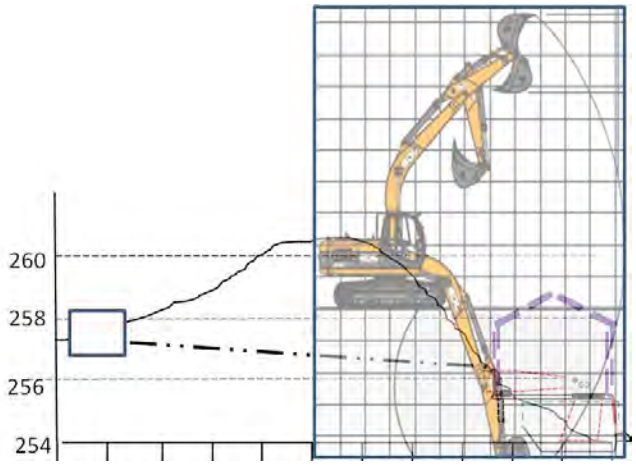

fig 25

In order to access the works safely, the disturbed ground along the line of the old penstock will be temporarily lowered to provide a platform as shown in Figure 25. Up to 40m^3 of material may need to be moved. This will be reinstated to leave the path profile approximately as it is at present and to retain accessible access. Waste disposal will be minimised as far as practicable by segregating reusable material. The Civil Engineering contractor will complete this work to the satisfaction of KCDC who will then through their Paths sub-group and Woodland and Biodiversity sub-group reinstate paths, fences and ground cover. The ability of KCDC to perform this work to a high standard can be seen in the recent improvements to the woodland downstream of the site.

Additional pedestrian access may be made during the works via the old access path to the plinth. At the termination of the work, this will either be made safe for public access or else blocked off.

7. Effect of proposed changes on conditions attached to Planning Approval and subsequent correspondence

Condition 1

The current schedule is to commence the works within the 3 year period i.e.before 7th April 2014.

Condition 2

The Construction and Engineering Management Document (CEMD) makes specific reference to restrictions in access to the river. Note that this document will be revised to reflect the latest design.

Condition 3

This condition was not closed out for the previous design. The requirements are less onerous for the new design and some details of the features linking the new construction to the river

bank have been included in this report. Bare concrete will be not be trowelled after casting and will be left rough finished to encourage growth.

Condition 4

As shown in the examples on the attached plan, specific areas will be set aside for the contractors compound, temporary storage of excavated material and plant material for re-use. As mentioned in the CEMD, the KCDC sub-group responsible for woodlands and biodiversity will be formally required to monitor the state of the site.

Condition 5

Figure 24 shows a plan of access to the site that minimises the need to remove trees. The disturbed ground around the site of the lamppost will be lowered to permit digger access and reinstated afterwards. KCDC woodland and biodiversity group will manage the restoration of this ground through re-establishing the dominant ground cover and planting native trees to replace any that need to be removed for access.

Condition 6

Measures to protect otters are included in the CEMD.

Condition 7

Signs stating that the Strathlynn bridge is temporarily closed will be placed in strategic positions on Gynack Road, Ardbroilach road and at the alternative upstream and downstream bridges. It should be noted that another sub-group of KCDC, the client for the hydro scheme, has promoted the paths network in Kingussie and will assist with this task.

8. Conclusion

The proposed variations to the scheme approved under reference no 10/424/CP reduce the environmental and visual impact, continue to provide income to the community and provide a feature of historical interest that will be a good example of a small scale community based renewable project which is easily accessible to public viewing and educational visit.

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