Hafod y Rhedrwydd micro-hydro scheme - construction method.

Locations

Stream works will be necessary at the extraction point and stream crossings 1 & 2 (SC1, SC2 in Figure 1). The turbine hut tailrace will also discharge through the bank but this is above water level and will not require any diversion.

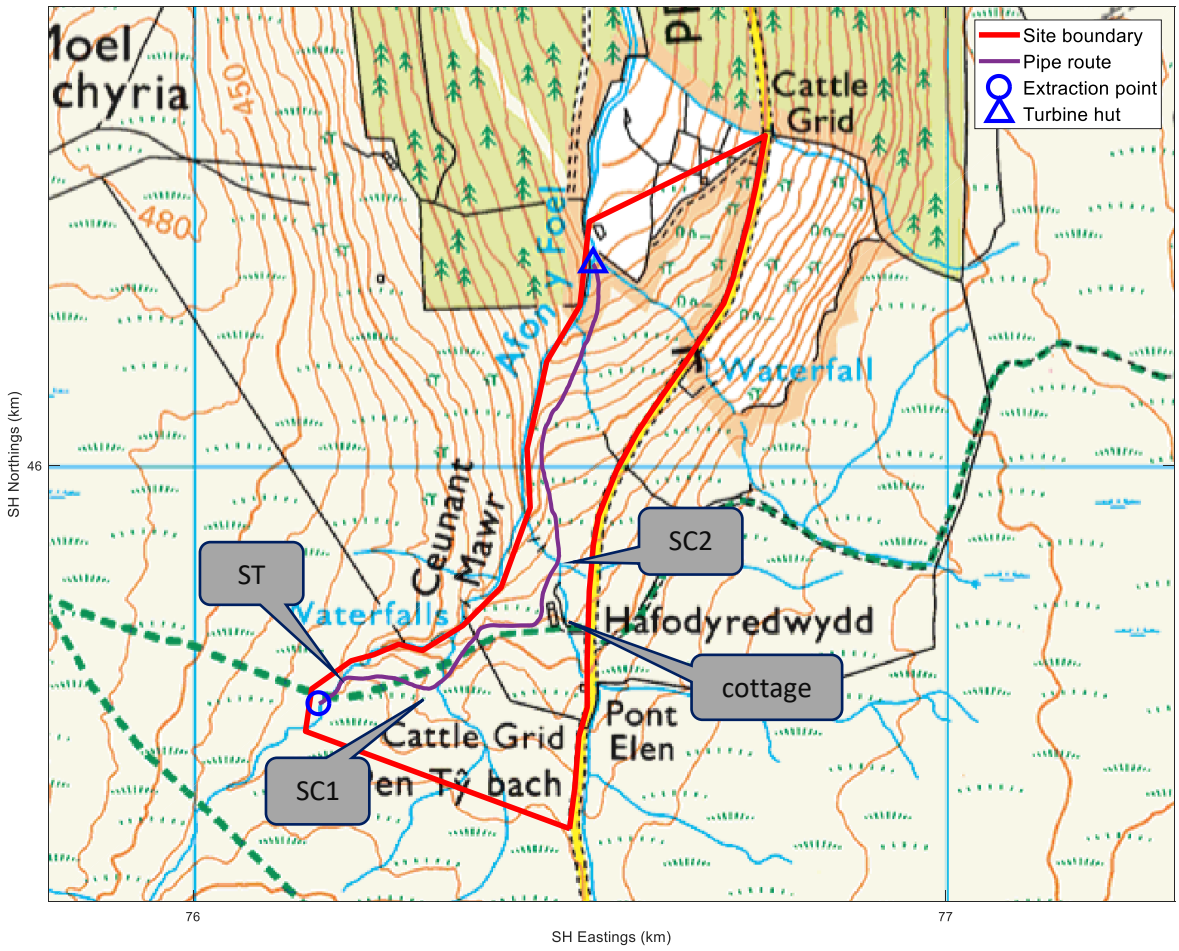

Figure 1. Map showing extraction point, settling tank, pipe route, stream crossings and turbine hut. Map scale 1: 10000 (grid squares are 1 km wide). OS map is © Crown Copyright, reproduced by permission of Ordnance Survey. (Map purchased from Blackwells Mapping Online 5/12/2018, order number BW1-899389-43094-051218).

Extraction point

The gradient of the stream at the extraction point and the presence of deep pools (Figure 2) allow a syphon to lift water above bank level and return it further downstream during construction operations. (A syphon is a section of pipe that moves water downhill without needing mechanical pumps).

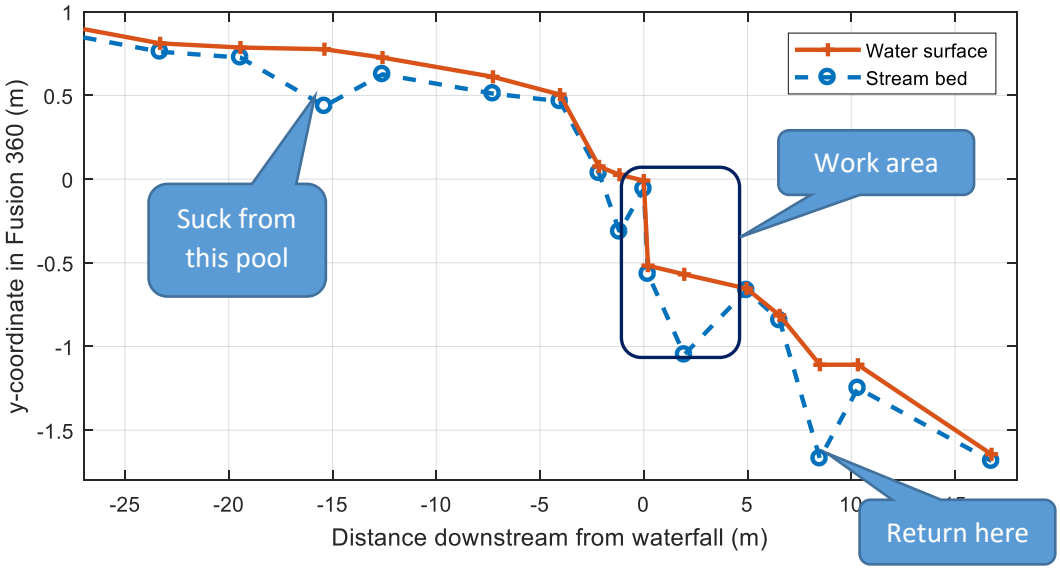

Figure 2. Stream bed and surface levels.

Reducing the water level in the top pool by 15 cm will prevent any flow out of that pool to the work area. The syphon will need to bypass 25 m of stream and operate with a surface-surface drop of 1.7 m. A battery-operated butterfly valve will restrict the flow rate to prevent the upper pool level falling so low that the syphon sucks air (controlled by a float switch in the upper pool).

Stream works will be carried out in dry weather with stream flow rates of 6 litres/sec or less; the syphon has been designed to handle 10 L/s. It will use 160 mm flexible corrugated drainage pipe (135 mm bore); the exit nozzle for 10 L/s is equivalent to 47 mm diameter.

The syphon will be started by sucking at the highest point using a vacuum cleaner. The vacuum cleaner can suck a 2 m head so a pipe will be passed over a ladder to avoid water passing into the vacuum cleaner. Once the syphon is full of water the vacuum cleaner line will be closed with a ball valve to allow continued operation without running the generator.

The syphon intake will be covered with a 6 mm mesh to avoid sucking fish or debris.

Figure 3 (a, b) Syphon route past working area.

The stream works at the extraction point will include:

- Carving pockets into bedrock for the screen fairings and plunge pool (Figure 4).
- Small concrete in-fill under fairing 3 (Figure 5).
- Bolt plunge pool wall, screens and fairings to bedrock using stainless fastenings (Figure 6).
- Core-drill a hole 160 mm diameter beside the stream for stilling well. Cross-drill through to stream (alternatively it may prove possible to cast this as part of the downstream weir). Figure 6.

- Clean up stream bed and cut 60 mm deep slot as rebate to avoid any possibility of weir slippage.
- Cast weir using concrete and plywood forms, temporarily bolted down to rock (Figure 7). **n.b**. concrete will be mixed as close as possible to the weir (a few yards) using a small portable cement mixer, then carried by bucket and poured into the forms. This will be done with no stream flow (100% bypass, as above) to avoid any possibility of wet concrete washing away downstream. Sacks of sand, gravel and cement will be carried from the road using a powered wheelbarrow, as is common for micro-hydro schemes of this size. All spare construction materials will be removed from site at the end of the build.

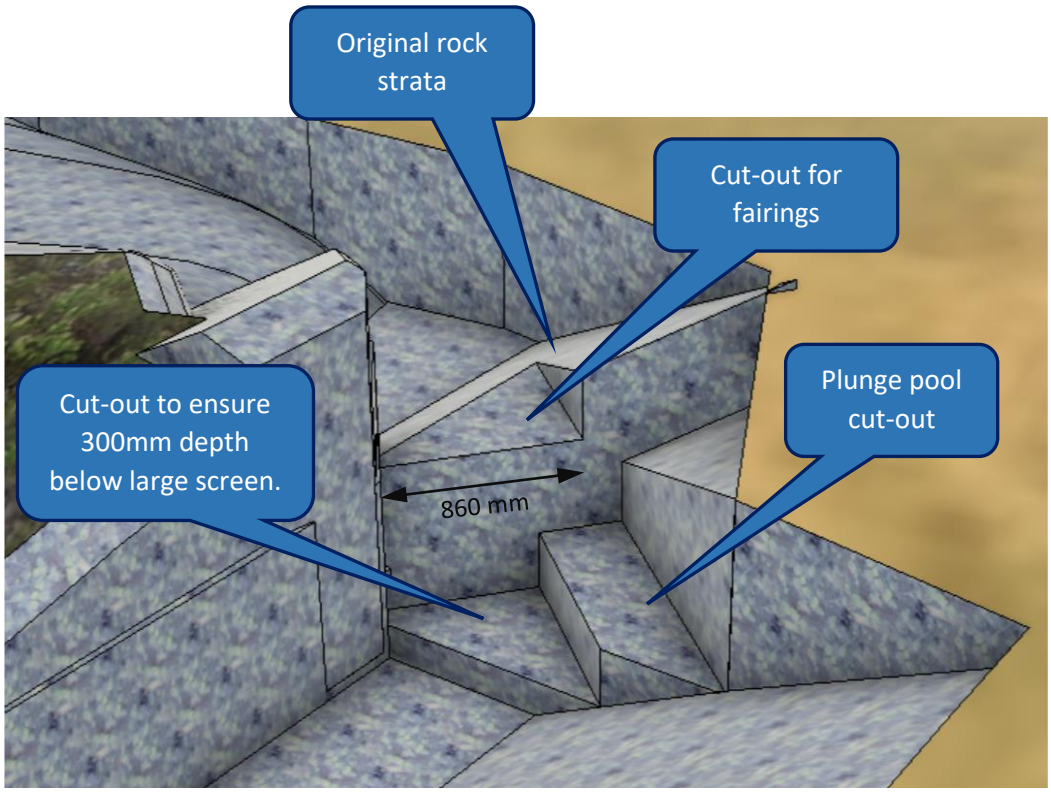

Figure 4. Stream bed cut-outs for screens and plunge pool.

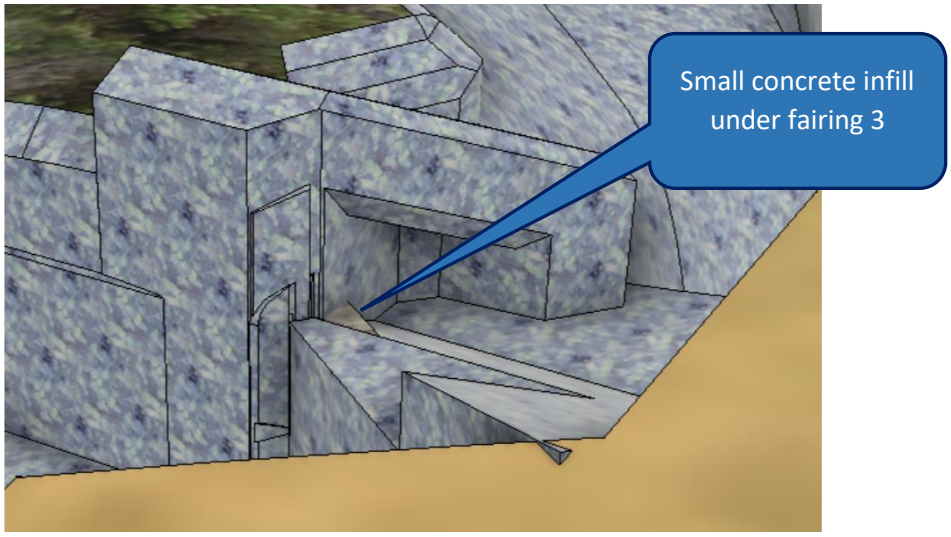

Figure 5. Supporting fillet for fairing 3.

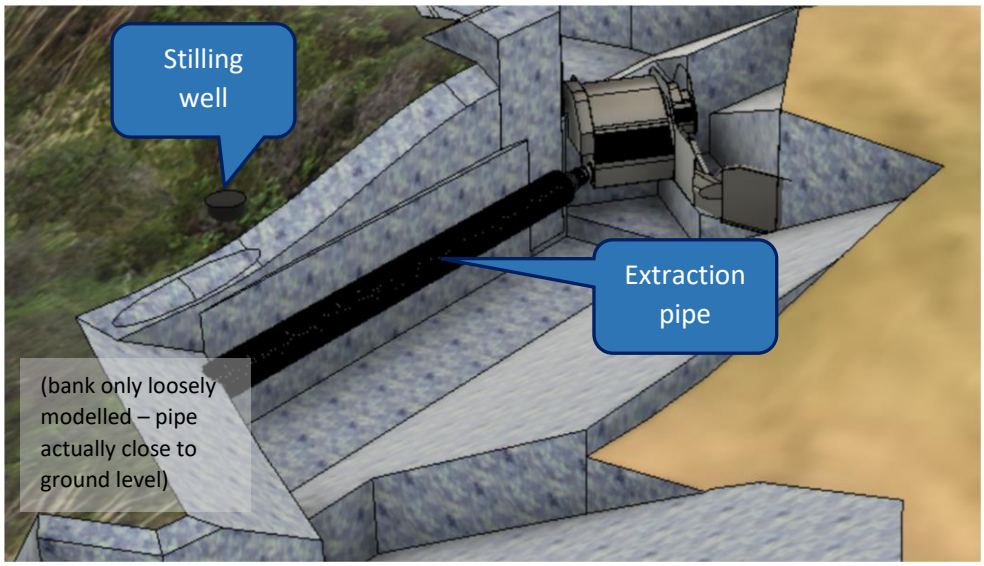

Figure 6. Screens, basin wall and extraction pipe in place.

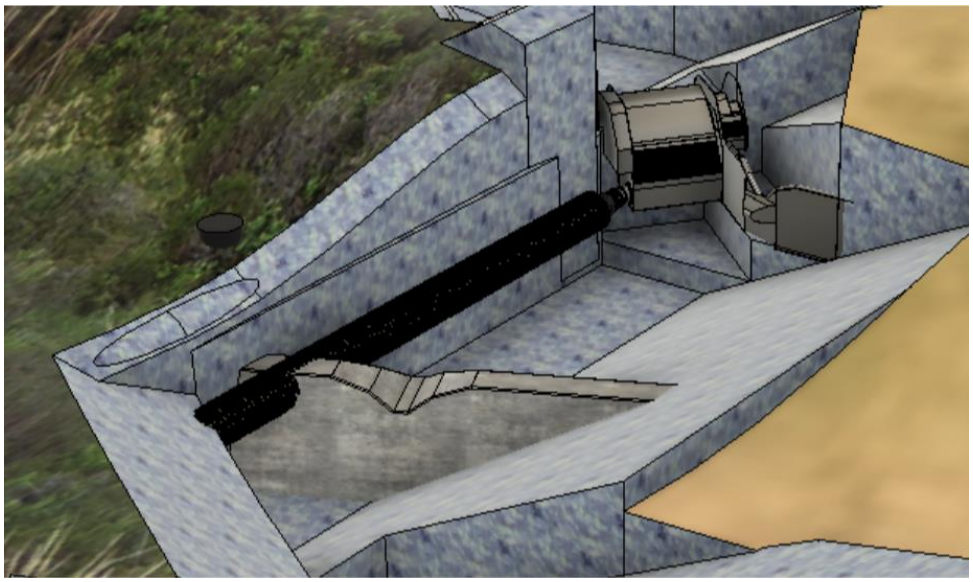

Figure 7. Downstream weir with flow-metering notch.

Stream crossings.

Stream work will be carried out in very dry weather (stream flows 1.5 – 2 litres/sec). A sheet of EPDM roofing rubber, held down by sandbags, will be placed across the stream immediately above the work location and will funnel the water into a twin-wall drainage pipe. The pipe will run horizontally until above bank level (possible because both streams have an appreciable gradient). This temporary pipe will carry the water and return it to the streambed immediately below the workings. As above, concreting will be done with zero stream flow (100% bypass) to avoid concrete washing into the stream.

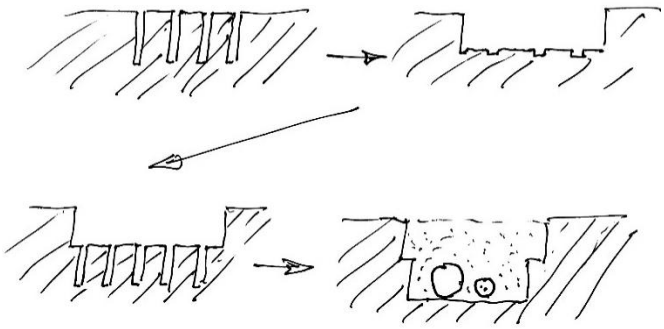

Figure 8. Stream crossings will be cut by hand, using a stone saw (petrol or electric) to make a series of grooves and breaking out the tongues using an SDS drill.

Figure 9. Second crossing point. The pipe will have a small air-release valve near each crossing point. The air valves will be provided with a conduit so that if they ever leak, any water returns to the stream and cannot not erode the surrounding soil.

Access routes and pipe burial

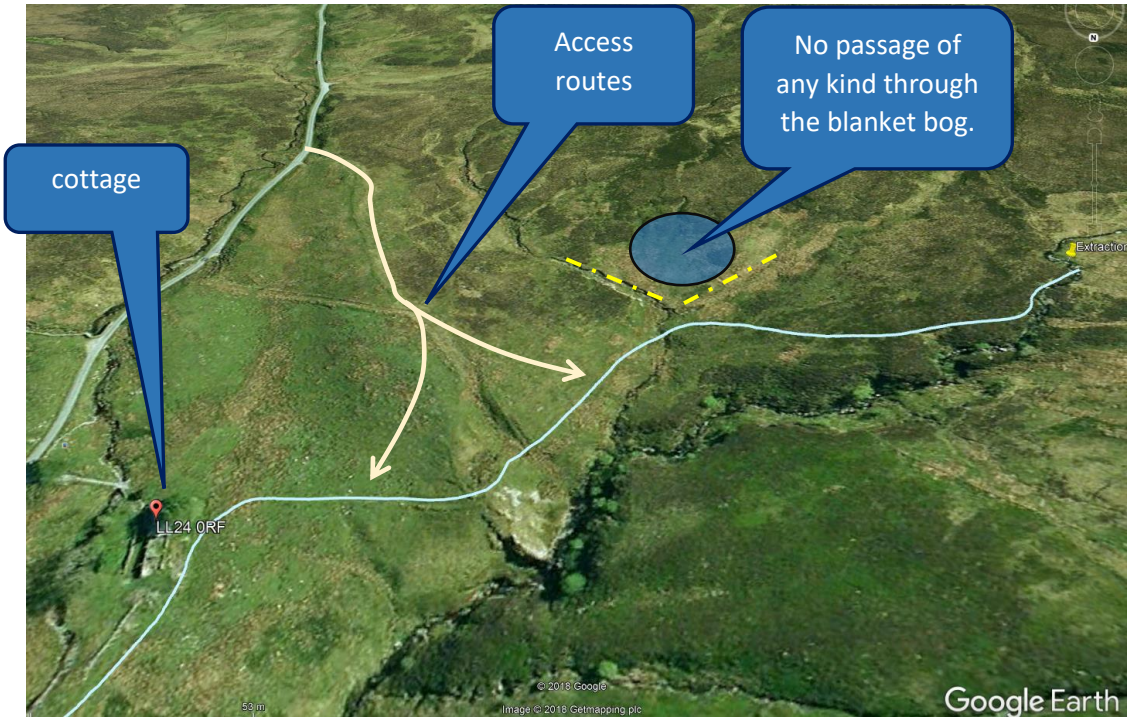

Figure 10. Machinery (mini-digger, power barrow) access route to upper section. There is an existing exit from the road at this point (used by the farmer when he used to mow this area) and it follows the hard ground along the top of the ridge. This route has been chosen to pass below the two streams (yellow dashed lines) that drain the nearby blanket bog – there will be no impact at all on this bog.

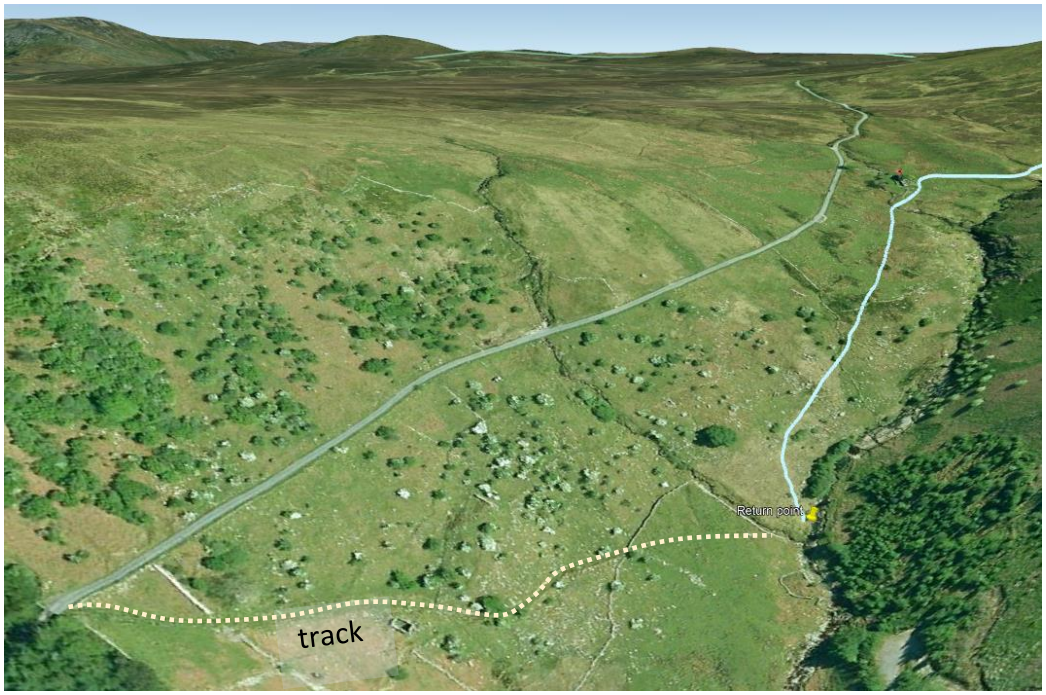

Figure 11. Access track (existing) to turbine hut location.

The trench for pipe burial will be no larger than necessary:

- pipe diameter 110 mm (typically; slightly thicker at the ends).
- cable conduit diameter 65 mm

Where possible, the top of the pipe will be 200 mm below the surface. A sheet of Terram geotextile will be laid beside the trench to separate excavated soil from the grass so that it be cleanly returned to the trench later. Turf, top soil and sub soil will each be laid out separately to facilitate the back-filling process and ensure rapid regrowth of vegetation.

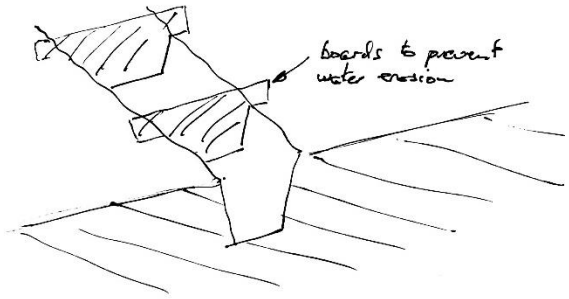

Figure 12. To avoid water erosion during construction, digging will be done in dry weather (as far as possible). If there is any risk of rain, sloping sections will have boards hammered into the trench to impede water flow and prevent erosion.

When backfilling the trench, clay bands will be packed around the pipe at 30 m intervals. These will prevent water from running downhill around the pipe and causing underground erosion. The glacial till seen in Figure 13 is suitable for this purpose.

Figure 13 (Fig. 38 from geomorphology survey). Sheep scrape showing soil characteristics.

Ecological protection

In accordance with the recommendations in the ecological survey, vegetation along the pipe route will be cut back using a brush-cutter to deter ground-nesting birds from building nests that might later be disturbed. This will be done before the nesting season starts in April.

In accordance with the pre-application conditions from NRW, stream work will not be carried out during the fish migration season October – May (may be waived for the upper section which is inaccessible to migrating fish).

Construction equipment will be cleaned before arrival on site to avoid importing any invasive species.

Construction order

- Extraction system
- Settling tank
- Stream crossing 1
- Stream crossing 2
- Pipe & conduit access to cottage
- Pipe burial over the volcanic sill (halfway between crossing 1 and the cottage)
- Burial of top 380 m of pipe and conduit
- Turbine hut
- Burial of final 460 m of pipe and conduit

I have spoken to RW Masonry about building the turbine hut and the choice of materials for it. I am expecting local micro-hydro companies (Hydrover Turbine Services and/or Nick Bard) to assist with the other work - particularly the pipe welding and conduit burial.

All works to be completed by March 2021 in time for commissioning and ROOFIT accreditation for the Feed-In Tariff.

RWM

3/1/19