Braunton Parish Council

Rural Community Energy Fund

Stage 1 assessment

Hydro Generation

This assessment considers the feasibility for community hydro energy projects in Braunton.

Headings

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Hydro power

Hydro power uses moving water to generate electricity. The potential for hydro in and around Braunton falls into the category of micro hydro. Micro hydro is generally considered to be schemes under 100 kWp.

There is tidal generation potential near to Braunton, however at present this technology is not commercially viable at a small scale[1], and has many inherent ecological considerations and risks which are beyond the scope of this project.

[1] http://www.theecologist.org/blogs_and_comments/Blogs/2985189/floating_turbines_could_harness_the_awesome_power_of_the_tides.html

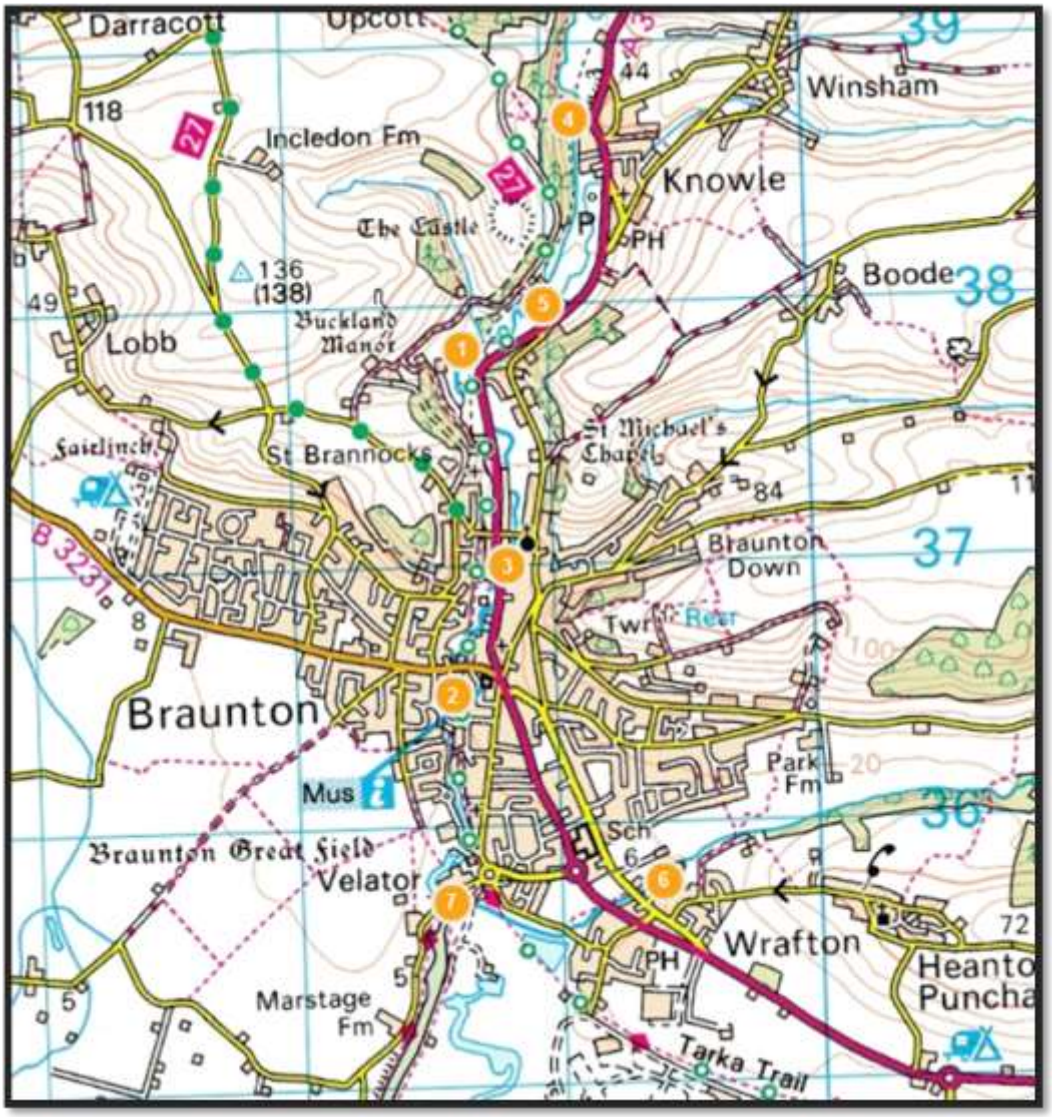
There are several water courses that run through or close to Braunton. They are small but there is historical use of the resource[2]. Such water bodies were ideal for hydro development and provided reliable motive power from early historical periods.

Hydro study methodology

Initially sites were identified by word of mouth, desk top analysis and historical research. Initial site investigations narrowed down the number of sites to those listed below. Detailed on site assessments were undertaken and hydro feasibility work carried out for those sites considered to have community development potential.

[2] http://www.lerwill-life.org.uk/history/branton1.htm

Figure 1 Braunton potential hydro sites



Site surveying, although time consuming and often difficult to access, is invaluable because sites can appear ideal on paper but rather less so when on the ground.

A typical example was site 6 above. The site has a historic use of hydro power for milling activities. Indeed a builder's merchant occupies the site today. Anecdotal evidence suggested a 6 foot high Weir was present, so the site was surveyed.

Figure 2 Example of a poor site due to very low head

The weir was found to be around 600mm high and in a poor state of repair and thus not suitable for hydro power.

Figure 3 hole in the weir - poor condition

The site might have powered a breast or undershot waterwheel which was powerful enough to drive a saw or mill stones, possibly developing one horse power. Historically (and today) this was a useful amount of power but far too low for to be exploited commercially.

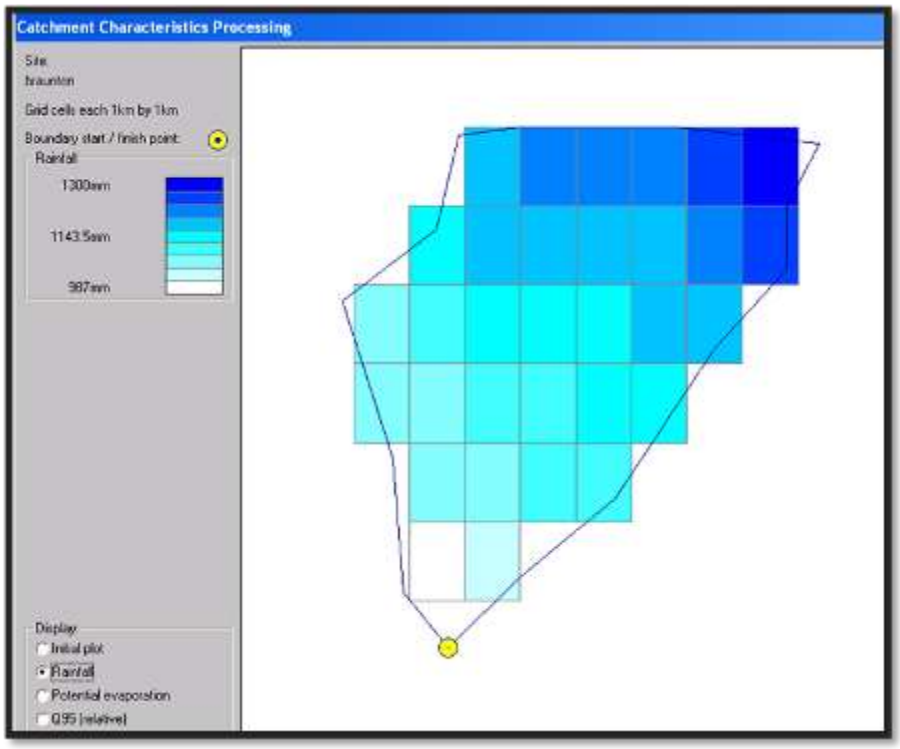
Other reasons not to progress with sites included:

- that the water is already being used,
- the site is unsuitable due to ownership,
- site not suitable due to flood defence works
- site not suitable due to flooding risk,
- site deemed uneconomical due to being too costly to develop.

Once sites were deemed suitable for further investigation a more detailed site survey was undertaken. This involved accurate measuring of the site with lasers levels / theodolite to establish the ‘head’ available as well as further potential ‘head’.

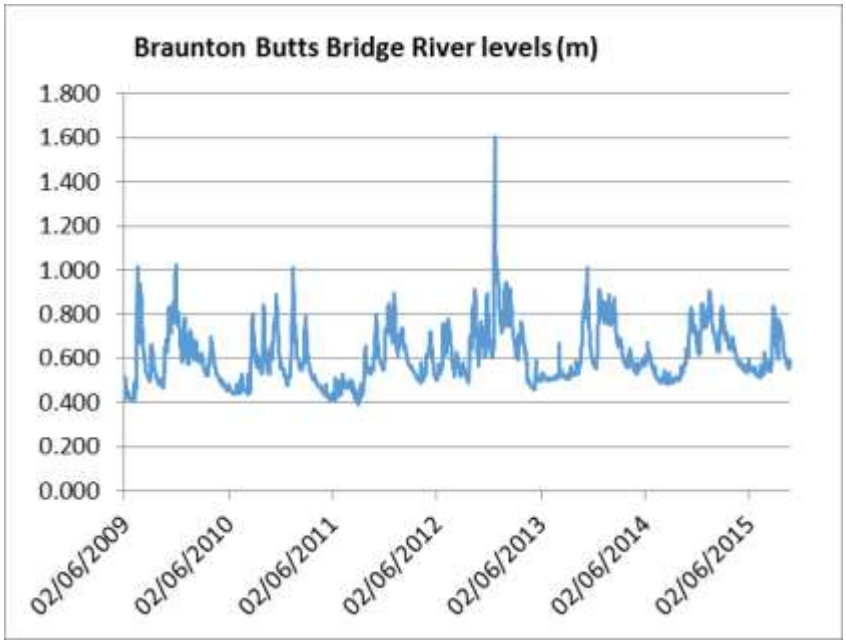
The catchment area up stream of the site was then established, which allows the rainfall, run off and evaporation to be modelled using industry standard software. This in turn can be used to model the amount of water in the river at that point at any given time.

Figure 4 Iron Mills catchment area precipitation



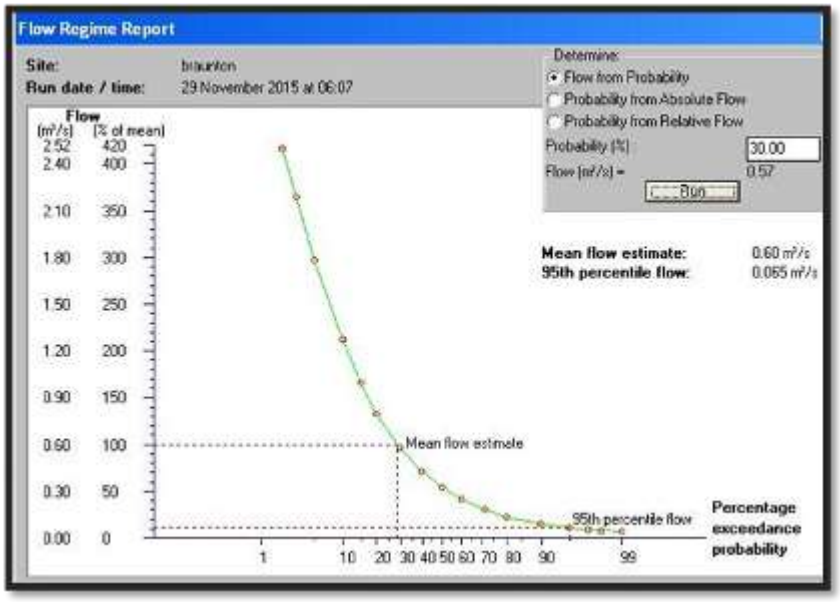
The data can then be cross correlated with any river flow data from the Environment Agency and on site measurements. This establishes a more accurate model of the rivers flows, taking human factors into account such as land drainage or commercial abstraction.

Figure 5 Environment agency levels data



This model can then be used to identify the likely level of abstraction the Environment Agency would allow with a view to protecting the ecology and biodiversity of the river. This will be based on a flow duration curve produced from the data.

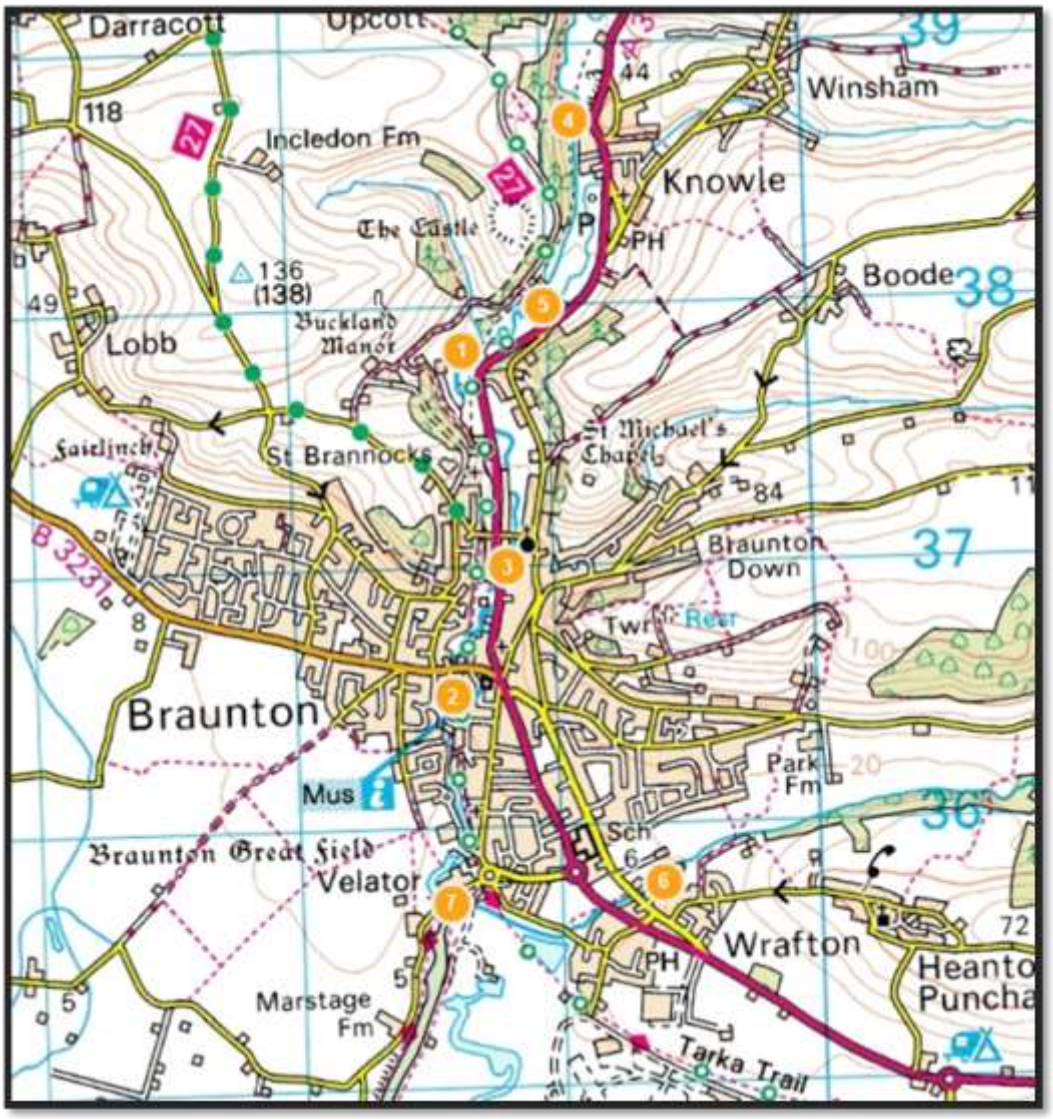
Figure 6 Flow duration curve



This figure combined with the available "head" already identified can then be used to model various turbine sizes and types and the power they would produce, given the flows available. These figures are site specific and vary according to many local factors, although economics dictates that the turbine is sized so that it produces power for as long as possible while there is demand for the power.

Site assessments

Figure 7 Site map



Sites 1, 4, 5 – These sites were ruled out due to a combination of wayleave issues, insufficient head, flooding issues and ownership.

Site 2 – The site in the middle of the village was ruled out because of insufficient head and the potential for flooding.

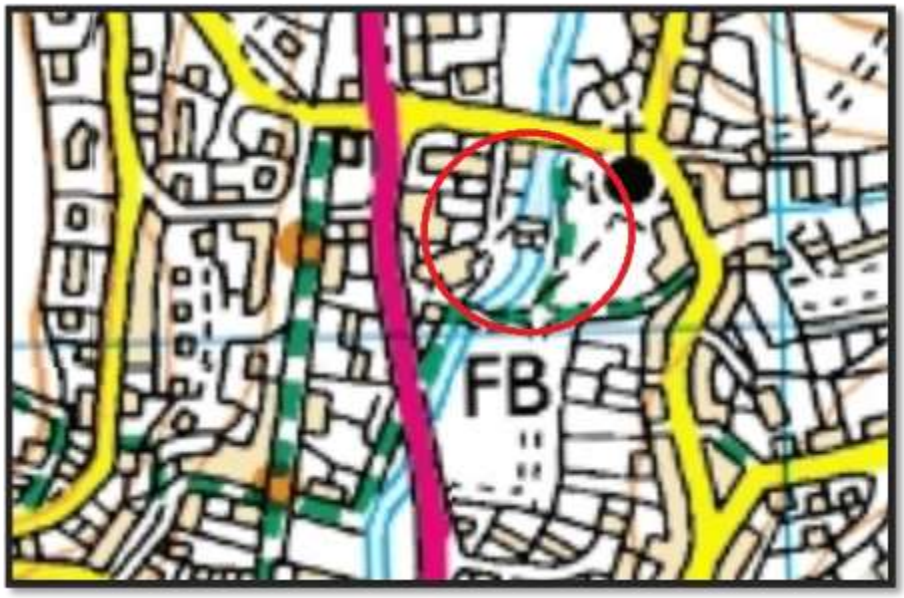
Site 6 – The site is covered as an example above. It was ruled out due to insufficient head and poor condition.

Site 3 Iron Mills

Figure 8 Iron Mills weir

Iron Mills weir, on the River Caen near in Braunton, forms part of the Parish Grounds. The weir is located within the village next to the church yard. The weir was installed to harness the energy of the Caen to power a Forge more recently, hence the name but references also exist of a corn and saw mill in the same location. Today it is a home and a spa.

Figure 9 Iron Mills location



It would be possible to extract energy from the water passing over the weir without increasing the flood risk significantly because the water is already being impounded behind the weir and further impoundment should not be necessary. However, any obstacle placed within the path of a river may, under certain circumstances, impede its flow.

Figure 10 Top of the weir at low flow, with sluice gate at the top of the leat clearly visible

The weir is relatively low at approximately 2m to be considered for hydropower, but the volumetric flow over the weir is adequate because it drains a relatively large area of land, over 32 km^2; this compensates to a degree for the weir's modest height.

The weir is in a good state of repair having been upgraded as part of wider flood defence works more than a decade ago. It is made mainly of concrete capped masonry shaped to form four pools of water to aid fish migration.

Ideally, inspection of the weir's condition should take place when the river is at its low flow (Q95) level. At the time of the site visits, the flow was too high to make a detailed assessment of condition, but some works will be required.

The old Iron mill site

Figure 11 Iron Mills leat

It is not considered feasible to use the old mill infrastructure, the leat, wheel[3] and tailrace for hydropower as they are not of a sufficient size to make it economically viable.

While the leat and tail race still hold water they are overgrown to a degree and are silted. It appears that they are maintained in the interests of drainage rather than their original function. Recommissioning Iron Mills would involve a lot of work clearing in the leat and tailrace to take the volumes of water that it once did.

The most suitable turbine for this location is probably an Archimedes screw type. Modelling the site gives a turbine size of 6kW that would produce around 21.5 MWh per year.

The site is within a built up area so the potential for grid connections is good. The modest size of the scheme and close proximity to a substation means that even with the current grid restrictions connection is probable. The Church would be a good site to supply with power from any scheme, due to the proximity and the typical demand from such buildings. Although a modest amount of power it would be enough to run a typical church and provide some background heating to keep the damp at bay.

Connection into the church would be relatively straightforward, but would involve trenching from the turbine location to the fuse box in the church. This would normally follow a path but it would only need to be 600mm deep to provide protection for the cable.

There is a significant amount of fall in the river bed after the weir. This is good because it will prevent the water backing up (reducing efficiency) on the turbine at times of high flow and high production. There appears to be around a metre of fall between the bottom of the weir and the far side of the foot bridge in to the Church Yard, where a small tributary joins the river. Around half this head might be usable if the river bed was excavated to allow a shallower fall after the weir and a greater fall across the weir. A detailed

[3] If the wheel remains

survey or the river bed would be required to cost this work accurately; it may be not be worthwhile incurring the extra cost for the extra ~5MWh per year that extra height would allow to be generated.

Figure 12 Step in the river bed after the foot bridge

Next Steps

The size of the installation is not sufficient to put forward as a project suitable for funding via a community share issue. The project might be viable if enough volunteer time can be acquired,. However unlike solar PV, if volunteers lose interest after a few years there is a risk of damage to the plant and ultimately an increased flood risk. Therefore sites of this size are not really suitable as they don't have the scale of economy such that the maintenance can be contracted to professionals to ensure the project remains viable.

If the Parish Council felt this were a project that they would like to take forward the next steps would be as follows:

- Stakeholder meeting with representatives of tall the neighbouring properties.
- Discussions with the Environment Agency with a view to submitting a pre-application for the licencing.
- Conduct a period of data logging of the flows on the weir and the water level at the foot of the weir.
- Agree the point of grid connection (end user of the power generated).
- Conduct Environmental impact assessments & Flood risk assessments

Site 7 Velator weir site

Figure 13 Velator weir panorama

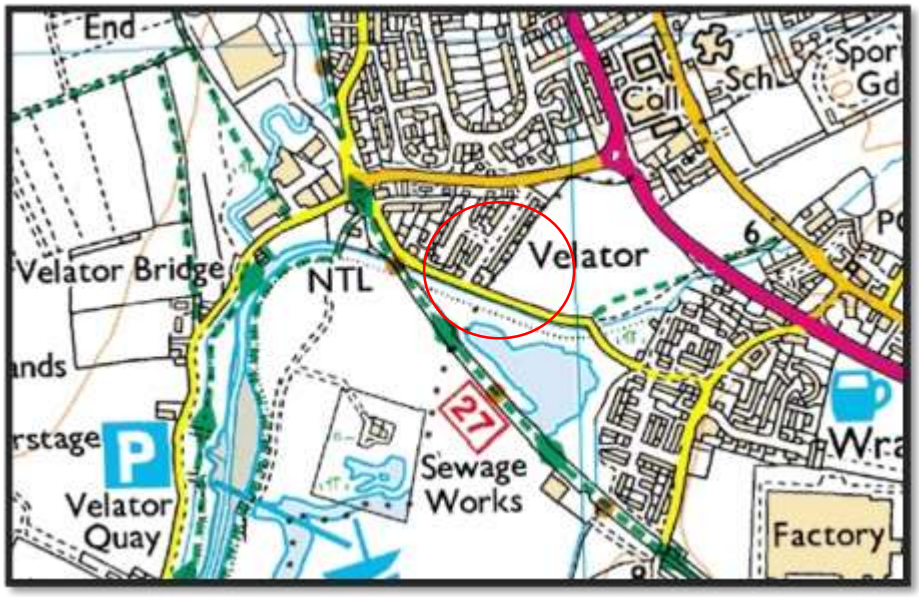
Velator weir, on the River Caen near in Braunton, forms part of the Parish Grounds. The weir was likely installed to prevent brackish water from entering the Caen and upgraded to reduce flood risks.

It would be possible to extract energy from the water passing over the weir whilst still allowing fish migration and without increasing the flood risk significantly because of the spillway, which enables water backed up behind Velator bridge to enter the river further downstream, by bypassing the bridge and weir entirely.

Figure 14 Caen and spillway - maximum river height visible on spillway

Minimal civil works would be required to the existing weir to allow an Archimedes screw turbine to be installed. If carefully sited it would allow the existing fish pass to continue to operate in parallel to the turbine.

Figure 15 Velator weir outlined



The weir is relatively low, at approximately 1.5m, to be considered for hydropower, but the volumetric flow over the weir is large because it drains a large area of land, over 34km^2; this compensates to a degree for the weir's modest height.

The weir is in a good state of repair having been upgraded as part of wider flood defence works over a decade ago.

Ideally, inspection of the weir's condition should take place when the river is at its low flow level. During the period of the site visits, the flow was too high to make a detailed assessment of condition, but some repair work should be budgeted for.

Figure 16 Velator bridge - a pinch point in the river

Potential issues

The weir has in part been maintained and upgraded to reduce the tidal fetch of the estuary into the Caen. Therefore it is inevitable that the at times of high flow and tide when a hydropower scheme should be producing its maximum rated output, this site would produce very little, if any power because the weir is at least partially submerged and fully submerged on a spring tide.

Figure 17 Spring tide the weir on a high spring tide, no part of the weir is visible

Power

The most suitable turbine for this location is probably an Archimedes screw type. Modelling the site gives a turbine size of 5kW with an annual power generation of 20 MWh per annum before the tidal nature of the weir is taken in to account. Modelling the 2014-15 tide heights including the swell on the nearest available dataset (Ilfracombe) the site would have produced in the region of 18MWh.

Potential for Local and Grid Connections

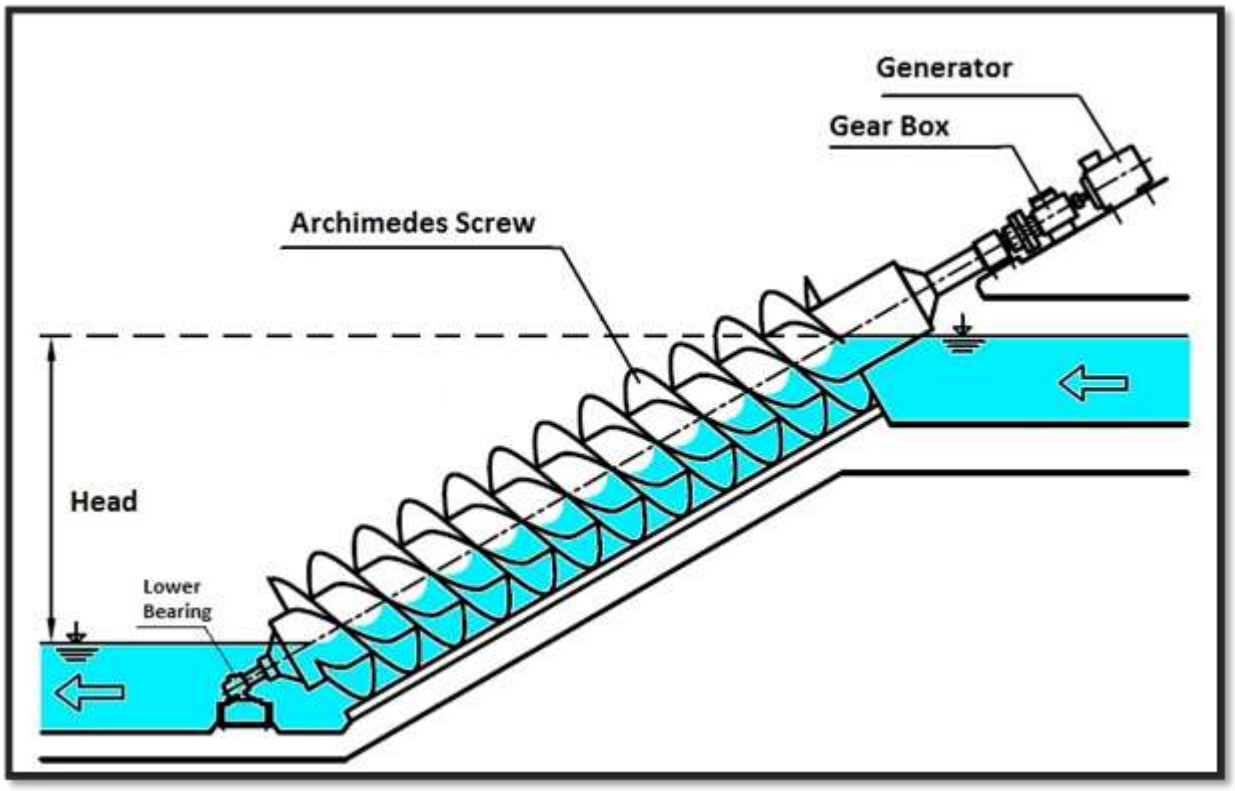
The best returns for a hydropower system often entail offsetting on-site consumption, or sales to neighbouring users. In the case of Velator Weir the prospects for local electricity sales are good with several local businesses with three phase electrical connections and reasonable demand within 100m of the site.

Further considerations

The site is highly sensitive; it forms part of the biosphere reserve and is within a SSSI. Any development of the site would have to take place with the full cooperation of all parties.

The lower turbine bearing would need to be able to tolerate the brackish nature of the water during a storm surge or spring tide.

Figure 18 Diagram of an Archimedes screw turbine with lower bearing highlighted



Next Steps

The potential production of 18,000kWh a year of electricity is not sufficient to warrant further development at current electricity prices.

If a desire exists to develop the site the initial next steps would be as follows:

- Licencing from the environment agency would need to be obtained. Initially, Impoundment and Abstraction licences would be required and the Environment Agency would advise as to further licencing requirements.
- Environmental impact assessments would need to be undertaken
- Installation of a data loggers at the top and bottom of the weir would be required for a period of time to measure the flow rates in greater detail. This will allow a superior degree of accuracy in future modelling and the effect of the high tide on any turbine installed on the weir.
- Planning permission would need to be obtained.

Conclusion

The hydro potential in Braunton is limited to small sites of relatively low head. The Iron Mills and Velator sites have the potential for development, but they would not be financially viable for a community energy project.