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Permitted development rights and small-scale, low risk hydropower

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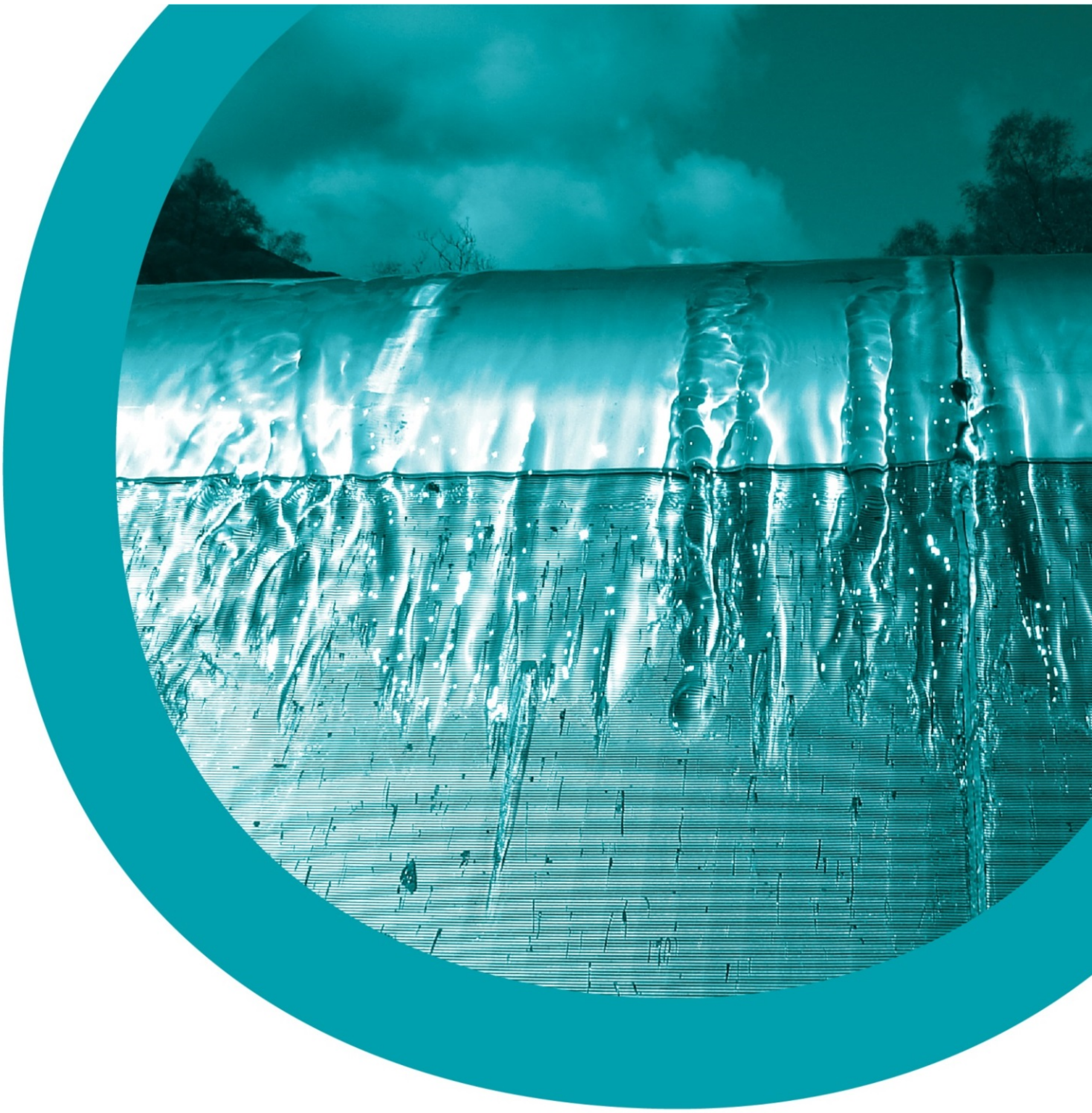

*Illustration only

Permitted Development Rights and Small Scale, Low Risk Hydropower

Research Study: Final

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1. INTRODUCTION

1.1 Background to the Research Study

1.1.1 Welsh Ministers established a Hydropower Task and Finish Group in 2016, comprising representatives of the British Hydropower Association, Natural Resources Wales (NRW) and the Welsh Government. The purpose was to develop and recommend a package of specific measures to support the hydropower industry in Wales following reductions in the Feed-in Tariff (FIT) and to facilitate the further development of the water resource in Wales in decarbonising the energy sector.

1.1.2 The Group presented their findings to the Cabinet Secretary for Environment and Rural Affairs in January 2017. Recommendation 3 of the report was for NRW to look at ways of reducing the complexity of licencing for low risk hydropower schemes. Recommendation 7 was for the Welsh Government to investigate whether planning application requirements can be simplified for engineering works associated with low risk, small scale hydropower schemes.

1.1.3 The Welsh Government's Planning Directorate and Energy and Decarbonisation Division are now working with NRW to investigate how the consenting regimes for low risk small scale hydro schemes could be simplified through the introduction of permitted development rights and an amended licencing process.

1.1.4 Please note that permitted development rights referenced throughout this report are often abbreviated as PDR.

1.1.5 Of further note, references to the 'licencing process' pertain to the necessity for both abstraction and impoundment licences from NRW and the Flood Risk Activity Permit (FRAP) (formally land drainage consent) from the local authority.

1.2 Objectives of the Study

1.2.1 The Welsh Government appointed research consultant, Dulas Ltd, in June 2017 to assess the potential for changes to permitted development rights specifically in respect of low risk, small scale hydro-electric projects in Wales. Wales is recognised by the Welsh Government as having considerable land-based water resources that could be exploited further as a sustainable energy source. The current absence of permitted development rights and the licensing process for water abstraction may be seen as barriers to the broader deployment of hydro-electric potential for Wales in line with its carbon reduction ambitions as set out in the Cabinet Secretary's statement in October 2017 (for 70% of electricity generation to come from renewables), the *Environment Act 2016* (80% reduction on CO2 levels by 2050 based on 1990 levels) and *Energy Wales: A Low Carbon Transition 2012*.

1.2.2 The objectives of the research study are to:

- Examine the planning issues associated with permitted development rights;
- Undertake field research to determine the effects of existing or in-construction small scale hydro schemes;
- Inspect planning/abstraction applications for such developments to determine where permitted development rights may be applicable;

- Conduct stakeholder consultations with industry, local authorities and regulators on their experiences of hydro schemes; and
- Formulate recommendations on the potential applicability of permitted development rights to small scale, low risk hydro in Wales and make suggestions on associated guidance or best practice.

1.3 Current Permitted Development Rights for Renewable Energy in Wales

1.3.1 At the present time the development of hydro schemes, whatever their size, requires full planning permission. The only permitted development rights conferred to hydro schemes are set out in *The Town and Country Planning (General Permitted Development) (Amendment) (Wales) (No.2) Order 2012*, and relate to developments on agricultural or forestry land. These state that permitted development rights apply to buildings to house micro generation equipment, in particular hydro-turbines.

1.3.2 Other forms of domestic and non domestic micro generation already fall under permitted development rights; such rights are covered under the *2012 Order*, allowing the installation of certain forms of domestic micro generation equipment (Part 40).

1.4 Research Methodology

1.4.1 The research study is required to deliver outcomes on two parts:

1.4.2 Part 1 for the identification of planning issues related to low risk, small scale hydro development, including field research, planning / licensing application review, and stakeholder engagement to ascertain issues. Integral to the study is a stakeholder consultation exercise to seek opinions on the applicability of permitted development rights, associated planning issues and any additional observations on simplifying the planning process. These aspects would enable the detailing of individual planning issues and how these may impact on the planning processes alongside the identification of links to emerging changes to licencing processes undertaken by NRW.

1.4.3 Part 2 for recommendations to changes to permitted development rights, entailing making specific and detailed recommendations for future permitted development rights for low risk, small scale hydropower developments in Wales.

1.4.4 In summary the stages of Dulas' research strategy are set out in the following diagram:

Part 1:

Inception

- Inception meeting with Welsh Government team : x2 Dulas personnel
- Agree research strategy and parameters
- Confirm Terms of Reference in writing
- Confirm stakeholders, main first contact and arrange interviews/meetings
- Project management tools in place, including file sharing facility with client

Evidence Base

- Review historical planning issues with Hydro Electric Power
- Collate information on typical environmental impacts with existing schemes
- Field research - research design and operational standards in existing HEP fleet, and record incidents of good / bad practice
- Stakeholder consultations with experience of authorities and regulators: learning from their experience and building consensus on commonalities
- Review of NRW emerging guidance on reducing licencing burdes for small scale hydro

Part 2:

Confirm applicability of PDR and draft conditions recommentations

- Evaluate and risk appraise potential environmental impacts in accordance with a range of scale typologies, i.e. pico, 5 - 20KW, 20 - 40kW, 40 - 50kW
- With contracting client confirm, following initial findings, applicability of the award of permitted rights and definition of 'low risk'. Includes mid-term client meeting.
- Evaluate impacts and the design/construction/operational measures by which small scale hydro can be controlled
- Draft research results
- Final stakeholder comments/reviews and report update

Reporting / project conclusions

- Issue draft report to contracting client for review
- Client review meeting and confirmation of required amendments
- Report completion and submission

1.5 Report Structure

1.5.1 This report is structured as follows:

Chapter 2: Summary of the Evidence Base on Hydro Planning and Environmental Issues;

Chapter 3: Stakeholder Consultations;

Chapter 4: Defining small scale, low risk hydro;

Chapter 5: Options on Permitted Development Rights for Small-Scale Hydro.

2. EVIDENCE BASE: HYDRO PLANNING AND ENVIRONMENTAL ISSUES

2.1 Introduction

2.1.1 Part 1 of the research study comprises this Chapter (Evidence Base) and Chapter 3 (Stakeholder Consultations) in seeking to identify the specific individual issues pertinent to small scale hydro schemes and how such issues have relevance in planning. Chapter 4 appraises these findings with an aim to understand what can reasonably be defined as small scale, low risk hydro which may then potentially fall under a permitted development category in planning terms. Such a definition is evaluated in the context of emerging work from NRW on possible simplification of licencing requirements for hydro under the Water Resources Act 1991 and associated regulations.

2.1.2 This Chapter therefore presents the results of the field evaluation of 13 in-construction and operational hydro sites in Wales along with the outcomes of an environmental impact assessment matrix conducted in respect of 10 sites submitted for planning permission under the Town and Country Planning Act 1990. The field research evidence, including photographic illustrations, is included in Appendix 1 to this report. The environmental impact matrix forms a background technical appendix to this report.

2.2 Field Research

2.2.1 A number of site reconnaissance visits to small scale hydro schemes throughout Wales were conducted by a Senior Hydro Engineer for Dulas Ltd in the period July to August 2017 and augmented by his further intelligence gathering on such scales of scheme over the past several years. The field research covered 14 medium and high head schemes ranging from less than 1kW up to 100kW. The majority of schemes were operational, whilst three were under construction. Low head schemes were excluded from the field research as they present significantly different issues to the more common medium and high head schemes.

2.2.2 The purpose of the field research was to evaluate the construction practices and operational parameters of hydro schemes delivered in recent years, and hence ascertain examples of good and bad practice, and the recommendations that consequently arise from such evaluation.

2.2.3 From the outset it is essential to understand that hydro schemes are entirely bespoke and every potential site will have different characteristics that will affect the design, depending not only on the available resource (head, flow, grid capacity, etc.) or nominal power output, but also on the topography, ecology, existing structures, access, etc. Such site-specific, unique characteristics make the challenge of defining ‘low risk’ hydro, which is part of the objective of this study, more problematic. This is particularly the case given that the power output of given scheme, which might more readily lead to a definition of schemes that would fall with permitted development criteria, can have limited relevance to the *scale* of the development. This differentiation is crucial in determining the preferred method by which PDR is to be apportioned. To explain, a 1kW low head scheme that depends on a relatively high flow rate may have a significantly bigger intake structure, and hence potentially greater environmental risk, than a much larger capacity 100kW scheme running off a 200m head with a lesser requirement for construction activity and materials.

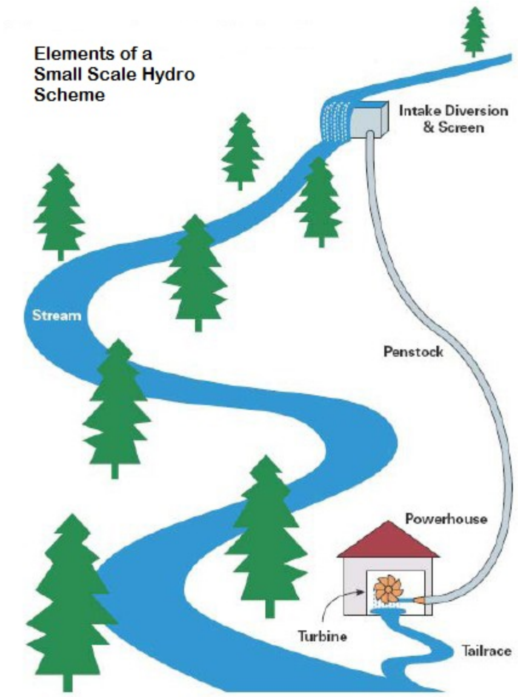
Accordingly, the risk to the environment from small scale hydro power is not dependent necessarily upon the capacity of the scheme but the flow requirements, which in turn influence the size of, for example, intake structure and pipeline, and often the nature of the construction activities. In essence smaller schemes can be more environmentally risky than larger schemes.

2.2.4 To further complicate matters, the Feed-in Tariff (FiT) power bands have resulted in some schemes being built to match the resource, but then registered and operated at a lower power output in order to attract higher rates, with the possible intention that, when the 20 year FiT expires and income arises solely from export, the operator may have the generator replaced with a larger one with the remaining infrastructure already in place to increase generation (NB. this generally applies to schemes registered as “15kW” and “100kW”). Such factors have been taken into consideration in this research study and have, as such, strongly shaped the recommendations on potential options for ‘softening’ potential planning requirements for small scale hydro.

2.2.5 The schemes investigated range from domestic ‘DIY’ schemes through farm-scale and up to small-scale commercial schemes. Current guidelines (Section 4: Microgeneration Certification Scheme) on the categorisation of schemes that are ***small scale*** lead one to determine that any scheme <50kW falls within this definition. However, for the purposes of this study schemes up to 100kW have been considered because, for the reasons explained in paragraph 2.2.3 above, schemes of this size include elements that are low impact and low risk.

2.2.6 It should be noted that construction practices can vary significantly depending on the competence of the contractor involved (if any) and the available budget, regardless of the scale of the scheme. By way of example, it can be difficult to make a 100kW scheme financially viable whilst complying with, and incorporating costs for, full site H&S requirements (as per the CDM Regulations 2015) and comprehensive environmental management requirements. In reality, many small scale installations involve agricultural / groundworks contractors who may not have previously installed pipelines or carried out in-river works.

2.2.7 For the purposes of comparative analysis of good and bad practices, the remaining sections on field evaluation have been divided into the functional elements of typical hydro schemes, with a final section covering implementation. The content summarises the field research report presented in Appendix 1. A simplistic diagram of typical hydro power components is shown alongside.



Access Tracks

2.2.8 Hydro scheme developers will typically make use of existing tracks, whether farm tracks, forestry harvesting tracks or other access routes where available. This not only reduces construction costs, but also reduces the potential impact of new track works, whether permanent or temporary. Improvements to such tracks may be necessary to enable construction vehicles to navigate the site.

2.2.9 However, on occasions new tracks may be required where there are no existing access arrangements to afford access to the hydro components.

2.2.10 The evidence acquired during the field research informed the following general observations:

- Use of existing tracks will reduce the impact of the development in almost every case;
- The impact of a new track depends primarily on location – commercial forestry (particularly clearfell) is unlikely to create significant issues, whereas a new track across upland pasture / moorland / broadleaf woodland could potentially have both ecological and visual impacts;
- Where new tracks are required, detailed consideration of siting and working with the topography to avoid excessive scarring and cut/fill is suggested along with attention to the proper restoration of disturbed ground;
- Track drainage needs to be well designed to prevent wash-out and sediment runoff, particularly if close to a watercourse;
- Bridges or culverts may be required, and these need to be of suitable design / quality (noting that there is now an environmental preference for non-piped culverts);
- Visual impact needs to be considered in both a local and overall landscape context, and locations sensitive to visual impact should be avoided.

Intakes and Header Tanks

2.2.11 Intakes generally encompass the incorporation of the following categories: Coanda screen; Perforated sheet screen; Drop-bar screen; Side intake (submerged screen), sometimes with an automatic screen cleaner; Submerged ‘strainer’ on the end of a pipe.

2.2.12 Concrete is generally required for installation with the exception of some strainer intakes. This may be limited to a base slab and main weir wall (although sometimes this can be pre-cast), however there may be a requirement for a concrete screen sump, intake chamber and /or wing walls, and also boulders set in concrete to provide downstream scour protection. Sometimes the screen is fixed to a prefabricated steel sump.

2.2.13 In some cases a formal or semi-formal fish pass may be required, which can increase the scale of the structure significantly.

2.2.14 Depending on the location, the exposed concrete may need to be covered with stone facing or timber (hardwood) cladding to improve the visual integration into the environment.

2.2.15 Where an intake chamber is impractical (or too expensive) to build in-river, a header tank (usually buried) situated downstream of the intake creates a collection chamber where air can escape and provides a 'control volume' for turbine operation. Header tanks allow for reduced in-river works and therefore are a method of reducing construction risk, although they are not always required.

2.2.16 The evidence acquired during the field research informed the following general observations:

- There are numerous types of 'standard' intake; however each 'standard' intake needs to be individually designed to meet site-specific requirements;
- Functional design must meet NRW requirements to minimise impact on the river environment;
- The scale of an intake is determined by the abstraction requirement and type of construction, rather than the scheme power output;
- With the exception of certain strainer-type arrangements, all intakes rely on concrete to a greater or lesser extent, which creates a pollution risk during construction;
- Pre-cast concrete weirs and / or prefabricated steel sumps can be used in some cases to reduce the extent of in-river works and minimise the amount of concrete mixed and poured on site;
- Intakes built in areas with bedrock require significantly smaller structures, as only limited scour protection is required;
- Visual impact, such as large areas of exposed concrete, can be mitigated with stone facing, but this adds complexity and cost, and may not be suitable for watercourses subject to high flood flows. Visual impact can be lessened where: i) the engineering solution has been sited and designed to fit the natural qualities of

the site and to minimise the extent of new structures necessary, ii) the use of concrete upstands and wing walls are minimised and merge with the natural forms, and iii) natural materials are used and good workmanship is evident in the finished scheme;

- Health and safety is often neglected from intake design, whether public protection or the provision of safe access for maintenance – this is particularly true for domestic schemes, where budgets are tight and the risk is borne by the developer themselves; however it is also often true for commercial schemes;
- In some cases, safety can be compromised by planning requirements for minimising visual impact (wooden handrails, no permanent access, etc.);
- Intake ancillaries need to be considered in addition to the structure itself;
- Use of header tanks can reduce in-river works and therefore reduce construction risk (assuming they are installed sufficiently far away from the watercourse);
- A buried header tank will result in minimal visual impact.

Pipelines and Leats (open channels)

2.2.17 Pipelines convey the water abstracted at the intake to the turbines at the powerhouse. By far the most common pipeline material is polyethylene (PE) which can be welded together to form a continuous string. At higher pressures (generally above 16bar) ductile iron pipes are used, but these require concrete anchor blocks to restrain any bends.

2.2.18 Alternatively, open watercourses called leats have been used historically to conduct water from the abstraction point to the powerhouse. Such leats are less used in modern times as they are more costly and more damaging to the environment due to the larger excavations required. Open channels also permit the introduction of grit, soil and vegetative matter which may affect the performance of the water turbine(s).

2.2.19 Pipelines can be fully buried, part buried, or surface laid – or a combination of these depending on the terrain. Full burial is usually in a trench of the order of a metre deep, and protects the pipe from freezing and mechanical damage (although PE can generally cope with freezing). Surface laying has the least environmental impact, but can be visually intrusive; in Snowdonia it has been allowed (to date) through forestry and quarry sites, but not across open countryside. Part-buried pipes are usually laid in a shallow trench, or with the trench depth varying depending on the terrain. The excavation may be done by hand through areas inaccessible to plant, or in woodland where damage to tree roots can be avoided. Excavated material can then be used to partly cover the pipe, and in some cases hessian is wrapped around it – in both cases vegetation often quickly obscures the pipeline. Smaller diameter

PE pipe sections can be carried by one or two people, and by using electro-fusion couplers some pipelines can be installed completely by hand without any need for plant.

2.2.20 The diameter of the pipe is determined by the flow rate and overall length, and is chosen to balance the material cost with the head lost as friction (essentially capital cost vs. generation revenue). As with intake size, pipe diameter is not directly related to the power output.

2.2.21 The evidence acquired during the field research informed the following general observations:

- In general, overground pipelines are ecologically better (less disruption and reduced risk of root damage) and have lower construction risk, but have higher visual impact;
- Buried pipelines can essentially become invisible if reinstated well;
- Part-buried pipes can be a good compromise;
- A single pipeline can consist of overground, underground and part-buried sections;
- Pipeline ancillaries need to be considered in addition to the pipeline itself;
- Leats are generally not used for new schemes, but if so they introduce issues similar to those for upland drainage ditches, including construction damage and potential pollution from sediment run-off, need for greater maintenance, and introduction of foreign matter into the watercourse (leaf matter, soil, etc) that needs removal before introduction to water turbines.

Powerhouses

2.2.22 The powerhouse needs to protect the turbine, generator and control system (if relevant) from the elements. The size of structure required depends on the dimensions of this 'electro-mechanical' equipment, also taking into account ancillary items such as isolation valves, metering, ventilation, etc. As with the other scheme elements, the powerhouse size is only nominally related to the power output. Even flow rate, which often determines the physical size of the turbine and associated pipework cannot be relied upon as different types of turbine can have very different footprints, as can similar turbines that have different numbers of jets.

2.2.23 The evidence acquired during the field research informed the following general observations:

- Power output is not an absolute indicator of powerhouse size;

- Pico-hydro turbines may not need a 'powerhouse' at all, or can be contained within existing buildings;
- Typical powerhouses consist of a concrete base slab that acts as a foundation for both the electro-mechanical equipment and the superstructure. This only introduces significant construction risk if in close proximity to the watercourse;
- The superstructure is usually either blockwork (a 'garage') or timber (a 'shed'), with timber generally only used for the smaller schemes;
- Blockwork can be stone or timber clad, but timber is cheaper and more common;
- Roofs are usually profile sheet or turf, with slate only used if specified by the LPA;
- Consideration needs to be given to ancillary items such as pigging chambers, parking / turning areas, local site drainage, satellite communication dishes, etc.

Outfalls

2.2.24 After passing through the turbine and into a sump below the powerhouse, water is usually returned to the watercourse via a buried 'tailrace' pipe, which discharges via an 'outfall'. As with intakes, NRW have specific functional requirements relating to outfalls, such as screen spacing, energy dissipation and minimal attraction to migrating fish.

2.2.25 The evidence acquired during the field research informed the following general observations:

- The scale of an outfall is dependent on the flow rate rather than power output;
- Functional design must meet NRW requirements to minimise impacts of construction and operation on the river environment;
- The outfall is usually connected to the turbine sump by a buried tailrace pipe;
- Turbine noise can be transmitted via the tailrace and outfall, but this can usually be mitigated by submerging the outlet;
- Installation will require work to be carried out in the river bank, and sometimes the river bed;
- The energy in the discharged water should (in general) be dissipated to prevent scouring of the bed and opposite bank;
- As with intakes, safety of both the public and of scheme operators is often neglected.

Grid Connections

2.2.26 The infrastructure associated with the grid connection is directly related to the power output, unless the energy is wholly or partly used on site. Assuming all generation is exported:

- Pico-hydro schemes can usually be connected to an existing domestic supply with no additional equipment;
- Schemes around 25kW may require the transformer to be upgraded, but it is likely to remain on a single pole;
- For 100~200kW, the transformer would be mounted on an H-pole;
- Schemes over 200~250kW usually have an HV connection and will require a ground-mounted substation.

2.2.27 The evidence acquired during the field research informed the following general observations:

- The infrastructure required will be determined by the maximum export power.
- The Distribution Network Operator (DNO) will specify the equipment needed and will usually obtain the necessary consents and wayleaves up to the point of connection (which is not necessarily at the powerhouse itself);
- New HV cables can be installed either as overhead lines or buried in a trench, with the former significantly cheaper but more visually intrusive;
- Consideration needs to be given to the location and appearance of any metering cabinets or other enclosures that may be required.

Implementation

Construction

2.2.28 Construction can often constitute the greatest environmental risk, whether from silt discharge to the watercourse, pollution from cement, fuel or hydraulic oil, or direct damage to ecology from the operation of plant and machinery. Good scheme design is essential to minimising risk, as incomplete or impractical design can lead directly to problems on site, but the method of construction is a risk factor that all stakeholders in hydro development should be able to address satisfactorily.

2.2.29 Construction practices vary significantly depending on the competence of the contractor(s) involved and the available budget. Selecting a competent contractor with relevant hydro experience is fundamental to minimising the construction risk from technical, financial, and environmental perspectives. Larger commercial schemes generally can afford to employ higher quality contractors, but the smaller the scheme, the lower the revenue and the less budget available for suitable contractors, high quality environmental management and good health and safety practices.

2.2.30 Poor construction practices can be very damaging to the environment and cause public dissatisfaction with the industry. A recent high profile pollution incident in Snowdonia highlights the risks from poor management of construction activities carried out in mountainous areas. This extreme example of poor construction practice is fortunately a rare occurrence, but it has led to a significant backlash against small hydro development in Snowdonia. It should not be forgotten, however, that most hydro schemes have been sensitively installed and operated by developers and landowners without harmful impacts to the environment.

Operation and Maintenance

2.2.31 Once a scheme is commissioned and operating, activity on commercial schemes is usually limited to weekly powerhouse checks, monthly intake inspections and annual maintenance visits, plus response to faults. Remote access can drastically reduce the number of site visits required. For smaller commercial schemes the relative overhead of site visits can be significant, which is one of the reasons that schemes such as the ones in this report are generally owner-operated (whether domestic or farm-scale).

2.2.32 Following reinstatement, assuming it has been carried out to an appropriate level, most hydro schemes quickly settle into their environment. Noise, in the form of generator 'whine' or turbine noise transmitted via the outfall, may only be an issue under certain conditions – for example a river at high flow often masks noise from a turbine running at full power, whereas this can become an issue once the flow reduces, resulting in a lower background noise, but the turbine continues audibly to operate.

2.2.33 Schemes that then operate in accordance with their abstraction licence requirements should not present a risk to environmental parameters, including river geomorphology, fisheries, river ecology and local residences.

2.2.34 The highest operational risk is usually from pipeline 'pigging' (cleaning the inside of the pipe by flushing a foam swab or 'pig' through it). This can result in the discharge of water containing sediment or peat fibres, which needs to be managed prior to returning it to the watercourse. For schemes with non-peaty upland intakes with good screens pigging may never be required, however some schemes need pigging annually or more to prevent significant pipeline headloss – this can be exacerbated if the pipeline has been undersized. The traditional method is to undertake such operations during spate flows, when the watercourse is often already laden with sediment, and where the pigging discharge can be significantly diluted. There is currently no best practice guidance from NRW, EA or SEPA regarding pigging; following the withdrawal of the pollution prevention guidance (PPG) NRW has introduced a series of Regulatory Guidance Notes (RGNs) but none appear to address this matter.

2.2.35 One issue from a planning perspective can be the retrofitting of maintenance, safety or other infrastructure omitted during the consenting and construction phase, and the subsequent deviation from consented drawings. This can also apply to repairs made during the lifetime of the scheme, for example if scouring occurs at an intake or outfall. Environmental damage that may arise from such activities is difficult to control through the planning system; newly introduced PDR and planning enforcement are unlikely to provide the safeguards needed, and often the activities referred to above will go unnoticed unless a serious incident arises. One potential means to addressing it, and hence encouraging the necessary safeguards, would be through publication of a guide to operational standards and practices, which could be set out in a Good Practice Guide to hydropower schemes.

Decommissioning

2.2.36 Decommissioning is not always considered at the planning stage, and in reality most schemes are refurbished rather than decommissioned. However, consideration must be given to whether the scheme could be returned to a 'natural' state. Whereas a buried pipeline could potentially be left in place, the most obvious issue for small scale hydro schemes would be the removal of a concrete intake structure from a watercourse. This is addressed in the proposed wording of potential conditions set out in Section 5 of this report.

Observations on Scheme Implementation

2.2.37 Field research and a long-standing history of witnessing operational schemes informed the following observations:

- Noise, disruption and visual impact will be significantly higher during construction than during operation;
- Red line boundaries can be underestimated, particularly regarding working areas and site compounds;
- Contractor competence is key to a safe and environmentally benign construction site;
- Good design and preparation, quality contactors, provision of suitable materials and good intentions are not always translated into action on the ground. This is particularly true if tight deadlines (especially FiT commissioning deadlines) are involved or if budgets are tight;
- Silt management is probably the least well implemented mitigation measure, but this is often the same for larger schemes;
- Site inspections for smaller schemes are rarely carried out by regulators, and therefore in reality there is reduced incentive for compliance;
- Other than for pigging, operational impact / risk is generally low (assuming compliance with NRW licences);
- Noise may be an issue for poorly designed schemes, but can usually be mitigated;
- Retrofitting and repairs can lead to deviation from consented drawings;
- Decommissioning has similar impact / risk to construction.

2.3 Environmental Impact Assessment Matrices

2.3.1 An evaluation of planning applications for hydro schemes in Wales formed part of the research study in order to understand the typical environmental impacts associated with this type of development; such an evaluation was coupled with the consultant's experience in the field of hydro EIA that has been accumulated over many years. Such an understanding of typical environmental impacts, along with knowledge of best practice hydro design and good quality construction practices, was central to the comprehension and subsequent definition of 'low risk' hydro which is a central tenet of this research study.

2.3.2 The majority of hydro schemes falling within the remit of this research study, i.e. sub 100kW, are not defined as 'EIA development' as categorised under the *Town and Country Planning (Environmental Impact Assessment (Wales) Regulations 2016 [2016 No.58 (W.28)]*. Schedule 2, Part 3 (Energy Industry) defines the thresholds of schemes that may require EIA as part of planning validation requirements. Section (h) identifies that installations for hydroelectric energy production where the scheme would produce more than 0.5 megawatts are likely to require EIA, subject to review against the Schedule 3 criteria. The scales of developments covered by this study would not therefore typically be classed as EIA development where potential adverse environmental impacts may arise, although the locations of such schemes in 'sensitive areas' (i.e. national parks, Special

Areas of Conservation) may trigger the requirement for EIA due to their potential for harmful and deleterious effects within protected areas.

2.3.3 On the grounds that a significant number of hydro schemes have been proposed, and subsequently installed, in such sensitive areas, it was worthwhile for the study to undertake a review of planning applications for hydro schemes in order to comprehend their impacts and how they can be controlled.

2.3.4 Initially 22 planning applications across Wales were reviewed as part of this exercise; subsequently 10 were selected for an analysis of environmental impacts based upon the sufficiency of information presented in the planning applications. The full analysis of these schemes is presented in the technical appendix 2 to this report, and the findings are summarised below.

2.3.5 Each hydro scheme planning application was analysed in terms of its core components: intake / access tracks / pipeline / powerhouse / outfall / grid connection; for some schemes the proposed temporary construction compound was also addressed. An environmental impact matrix was formulated to classify whether these components were expected to impact on the environment at scales ranging from Negligible and Low to Moderate and High.

2.3.6 The typical potential impacts associated with the components of hydro scheme applications are summarised as follows:

Table 2.3: Typical Components of Hydro Schemes and Potential Associated Environmental Impacts

Typical Hydro Components						
Potential Environmental Impacts	**Intake**	**Access Track**	**Pipeline**	**Powerhouse**	**Outfall**	**Grid**
Ecology	✓	✓	✓	✓	-	-
Landscape and Visual	✓	✓	✓	✓	-	✓
Archaeology	✓	✓	✓	✓	-	-
Hydrology & Geology	✓	✓	✓	-	-	-
Built Heritage	-	-	-	-	-	-
Recreation & Access	-	-	-	-	-	-
Flooding	-	-	-	✓	-	-
Noise	-	-	-	✓	✓	-
Traffic	-	-	-	-	-	
Aquatic Environment	✓	-	-	-	✓	-

2.3.7 Note that the above evaluations are predicated upon permanent and not temporary impacts (the latter of which are often remediated fairly rapidly), and an understanding that good siting and design, alongside good construction and operational standards, are upheld.

2.3.8 From the above it can be deduced that the components of hydro schemes that have a higher overall risk associated with them against multiple environmental parameters are the intake, access track, powerhouse and pipeline. However, it should be borne in mind that single issue environmental impacts to very sensitive receptors, for example a poorly constructed outfall, can have devastating effects to, for example, the aquatic environment.

2.3.9 The research has found that, despite the potential for harmful, higher risk impacts as highlighted above, the nature and scale of hydro schemes covered by this research is such that only Negligible or Low impacts were assessed in the planning documentation for the schemes analysed except on one occasion.

2.3.10 In the case of the Gors y Gedol scheme *Medium* adverse potential impacts were predicted in relation to the hydro-geology of the intake location. On this occasion a Construction Method Statement was submitted with the application to provide assurance that the effects could be mitigated to an acceptable degree. Additionally, noise impacts of the construction of the access track to the intake were predicted to be *Medium* adverse in relation to a nearby Byway Open to All Traffic (BOAT). However, potential effects were mitigated as the BOAT was very rarely used, thereby substantially lowering the sensitivity of the route to the short term effects of access construction. On this occasion the applicant has been involved in planning in a professional capacity for a number of years, and was therefore more familiar than most with the planning process and meeting requirements.

2.3.11 Whilst it is possible that there is some under-estimation or under-reporting of potential environmental impacts at the application stage, it is reasonable to expect that, where schemes are sensitively constructed and thereafter operated in accordance with planning and licencing approvals, they should have a low level of adverse impact and should therefore be classified as low risk. This is confirmed by the findings of the impact matrices for the schemes analysed.

2.3.12 However, the field research and anecdotal evidence of documented cases with NRW and some planning authorities show that the level of adverse impact is, in reality, much higher, and that such schemes are more risky than should in fact be the case. These adverse and risky impacts generally pertain to hydro developments irrespective of the installed capacity of the schemes; instead, the research has found that the more harmful impacts relate more to the standard of installation and subsequent operational practices.

2.3.13 Of further note is the variability in acceptable / validation criteria of the local planning authorities. Whilst some applications submitted substantial supporting information, other applications, although accepted for determination, provided only the very leanest of details, often of poor quality and perhaps insufficient to really determine the acceptability of the scheme and the proposed control of potential impacts.

2.4 Learning Outcomes

2.4.1 Whilst a proportion of hydro schemes in Wales have been installed and are operating without apparent harm to the environment and continue to contribute to renewable energy and carbon reduction targets, anecdotal evidence shows that some schemes have been delivered and continue to operate at risk to the environment.

2.4.2 Incidents that are risk factors to the environment tend to occur where schemes are not constructed within planning boundaries and where practices are poor or uncontrolled. Further risks arise where schemes are not adequately reinstated or where operational standards deviate from the approved licences or standards.

2.4.3 The environmental impacts of small scale hydro schemes, even in sensitive areas, should theoretically be low risk as long as good design, construction practices and operational standards are applied. Typically, detailed method statements, watching briefs and ecological monitoring, which entail additional costs to schemes with limited revenues, should not be a requirement of planning, although they should be welcomed where the schemes are sensitively located to provide planning assurances on suitable controls to environmental impacts.

2.4.4 Commercial and domestic 'low risk' hydro schemes have been implemented on multiple occasions for more than a hundred years in Wales and there is no reason to believe this cannot continue into the future where the financial, regulatory and planning parameters are supportive. Developers and landowners should, however, be cognisant of the necessity of developing schemes that are sustainable, inclusive not only in terms of commercial operation but also environmental and residential protection.

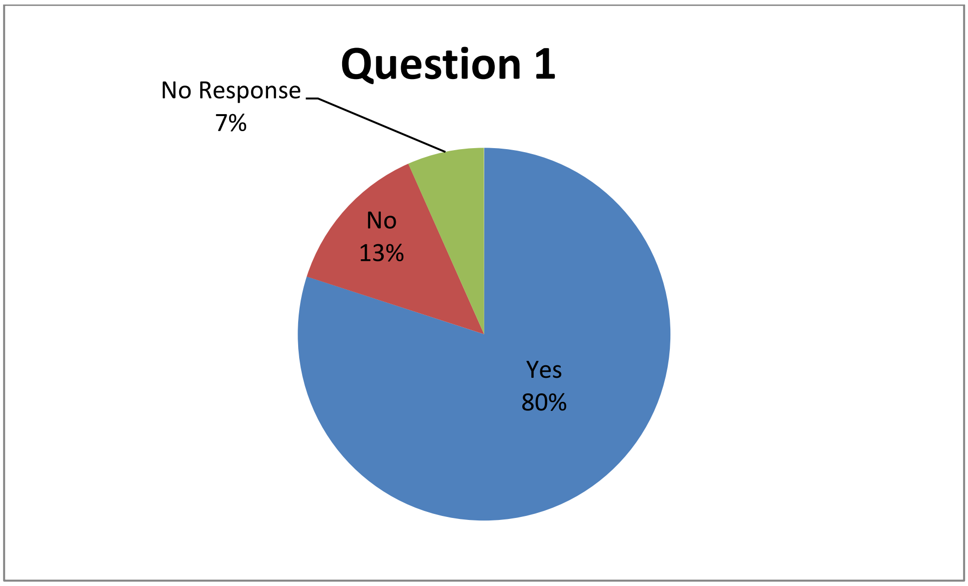
3. STAKEHOLDER CONSULTATIONS

3.1 Introduction

3.1.1 The research consultant conducted stakeholder consultations with relevant organisations, including hydro developers, regulators and planning authorities from July through to mid-August 2017. The purpose of the consultation exercise was to seeks views from, and understand the likely support for, potential small scale hydro permitted development rights; the consultation exercise also enabled an opportunity to understand from consultees the planning and environmental issues that would inform recommendations on potential conditions that may be attached to permitted development rights should any amendment order ensue from the research.

3.1.2 A total of 45 organisations were contacted for the consultation, including a mailout to the entire membership body of the British Hydropower Association. Responses from 30 organisations were received including 7 planning authorities, the latter of which were sufficiently experienced in hydro power applications; these responses were made either via an online form or through the submission of electronic / hard copy questionnaires. The consultant has collated and analysed the responses. The full details of the consultations form a technical appendix to this report. A summary of the responses is presented below, along with a synopsis of the comments made by recipients that give additional explanation to the Yes / No answers in the questionnaire.

Question 1: In principle would you or your organisation support the introduction of Permitted Development Rights (PDR) for small-scale hydro-electric schemes where design, construction and operation are controlled through adherence to PDR locational, design and operating criteria?



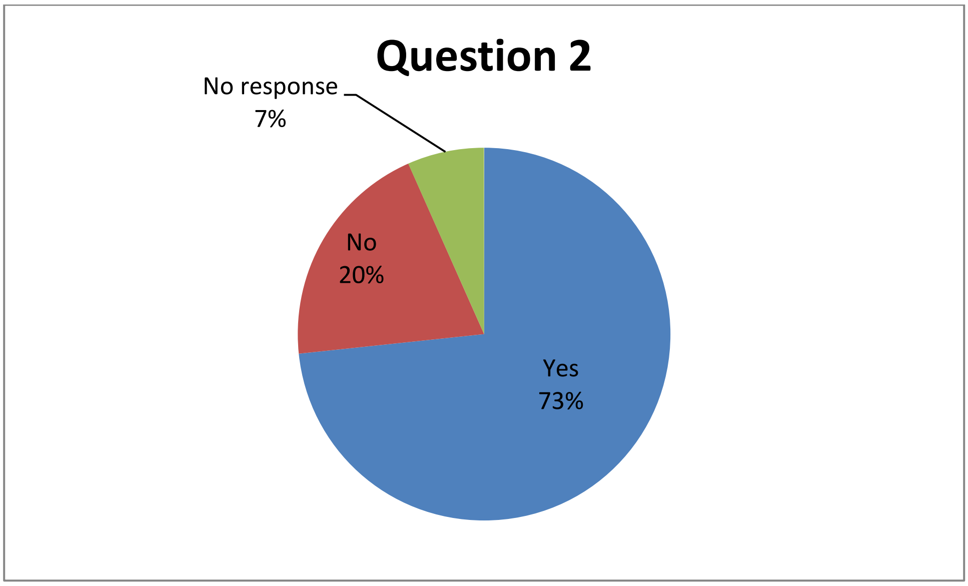
3.1.3 Of relevance to these statistics is the proportion of local planning support for permitted developments rights. 4 of the 7 planning authorities responding were against the introduction of such rights. The reasons against introducing these rights are evident from the responses given in the tables to the questions below.

3.1.4 The following table summarises the comments and observations from consultees:

Table 3.1: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Ecological concerns.	Ensure conditions or controls are not so tight as to undermine permitted rights
Standard design for high head schemes is not possible and each site has to be assessed on its own merits.	NRW licencing regulates schemes well and so permitted rights should be encouraged.
Potential support for such rights so long as sufficient restrictions are in place in sensitive areas and controls can be applied on above ground structure.	Supportive in principle but the criteria are crucial. There is a risk that simplistic or generalised criteria might be adopted, which then create perverse incentives to develop schemes to meet PDR criteria while not prioritising other benefits.
Each hydro scheme and location is unique and the choice of materials and construction methods can be risky if undertaken poorly.	Up to 25kW would be reasonable as a cut-off and in some circumstances a higher ceiling would be reasonable. Medium and low head schemes may need a lower limit due to the greater volumes of water required.
Wales protected landscape should not be included under such rights.	There should be no need to limit PDR to a particular capacity. Some high head schemes up to 100kW would have negligible impact on the environment.
Planning has not been a deterrent in our experience.	Licencing process has no proportionality based on the size of scheme.
Necessity to define 'low risk' before further consideration can be given.	Keep the rules and process simple whilst ensuring that NRW licencing is still a requirement.
Prior approval would enable potential issues to be assessed and the need for a detailed application to be considered.	
How would PDR ensure that Flood Risk Management Strategies are not compromised by development along watercourses?	

Question 2: Do you think that introducing PDR for small scale hydro schemes would enable more schemes to be developed given the recent policy and regulatory changes on renewables?



3.1.5 5 of the 7 planning authorities did not agree the PDR would enable more schemes to come forward for the reasons cited below. One other consultees agreed with the planning authorities whilst 22 believed it would be beneficial to the realisation of further schemes.

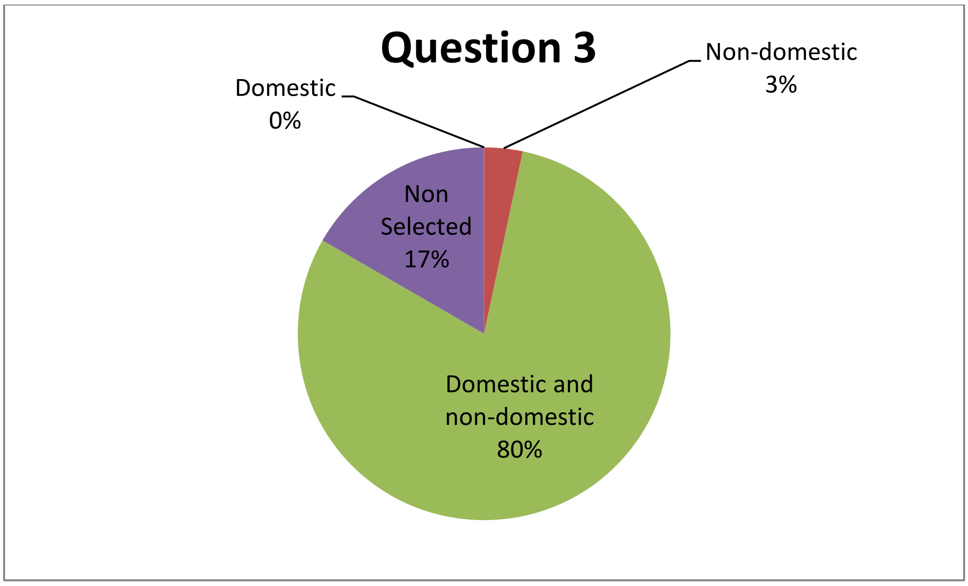
3.1.6 The following table summarises the comments and observations from consultees:

Table 3.2: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Recent FiT reductions have seen a significant reduction in schemes at all scales.	Schemes have been installed 'below the radar' due to the complexity of the permitting process. Some developers put off proceeding due to the application process. In these experiences revenue has not been the cause but rather the 'love of it'. Schemes would be more likely to proceed if PDR were introduced.
Costs of implementing such schemes will still be too prohibitive and landowners will still apply for a Certificate of Lawful Use to have certainty they can proceed.	PDR would help small scale hydro and would provide a lifeline until subsidisation returns.
FiT changes appear to have 'killed off' all renewables energy schemes. Funding is the barrier to development not planning.	Costs associated with consenting are disproportionate to the benefit realised at a domestic (sub 5kW) level. With the FiT at a very low level there is a substantially reduced incentive for an individual to go though both the process and cost of consenting and planning approval. It is possible therefore that a number of schemes will be developed in rural areas without consent given

	they are unlikely to be “discovered”.
PDR changes would only affect the planning process which represents a minor development cost in comparison to the environmental/habitat/ hydrological assessment costs alongside the reduction in FiTs, increased business rates and grid connection cost.	Welsh Government has some control over Business Rates, which are a major concern for existing schemes and worse for new schemes, which are often assessed on the basis of the high 2015 FiT rates and are not eligible for any transitional relief. *(The consultee is advising that business rate relief for small scale hydro may be a better or additional incentive.)*
The planning application cost is likely to be outweighed by the cost of the development. Viability of the development would likely be determined by other environmental factors, such as land ownership, water flow rates, water levels of the watercourse and mitigation costs.	The officious process is off-putting to self-developers and carries a bad reputation. The devaluing of the FiT is also a significant driver. Costs associated with installing a scheme have increased (e.g. abstraction license fees) and hydro costs are not dropping. This is stifling innovation.
	Although reduction in tariffs has reduced interest, many potential schemes are both environmentally and economically viable. *(Perhaps the inference here is that PDR would encourage more schemes to come forward.)*
	PDR would greatly reduce the risk capital requirement of potential schemes. The high cost of consenting is putting off potential development.
	PDR will reduce cost burden, delay, and uncertainty for small and low-impact schemes more typically pursued by private householders. However generally the highest burdens will continue to be incurred by more complex or larger schemes outwith what we imagine will be likely PDR criteria.
	PDR would enable permitting costs to be reduced if strict rules were followed in their stead. *(This infers that PDR should be strongly underpinned by conditions or required criteria.)*

Question 3: To which type of property – domestic, non-domestic or both – should PDR apply?



3.1.7 1 of the 7 planning authorities felt that PDR should apply to non-domestic properties whilst 3 authorities stated they could apply to both, resulting in 2 authorities stating that PDR could apply only to domestic properties. 24 respondents believe that PDR should be applicable to both domestic and non-domestic properties.

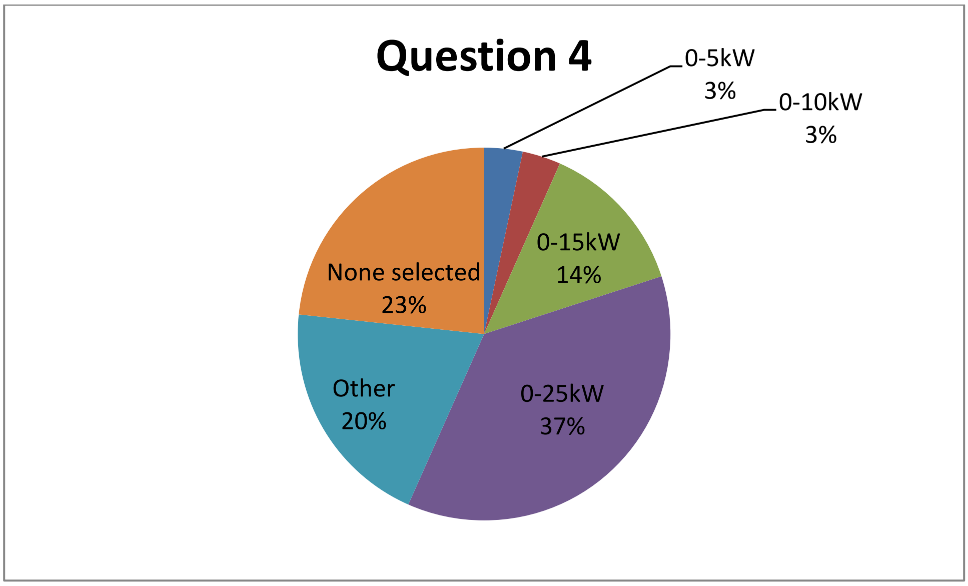
3.1.8 The following table summarises the comments and observations from consultees:

Table 3.3: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
There could potentially be other forms of Rural Enterprises or Country Parks/Nature Reserves/National Trust properties that have access to high head watercourses or a low head leats to try and be energy self-sufficient. N.B. there are no PD rights for hydro schemes even on agricultural or forestry enterprises. *(NB this second opinion appears to be contrary to the General Permitted Development Order.)*	If the hydrological / gravitational resource for installing a small hydro exists, there should be no clause which debars it from PDR because of the type of property it is situated in
Cannot see how domestic PDR would [work] unless as a stream within the curtilage? Would inevitably need to use land outside of residential curtilage. Issues of noise / impact on residential amenity more likely to occur in residential settings.	Domestic hydro barely exists and as farms etc are non domestic then it has to include non domestic, it can still be very small scale if this is desired but making it domestic only would be a mistake.
Non-domestic properties may require greater energy needs and this should be considered when setting the PDR threshold.	In line with the guidelines for Solar PV and HMRC the definition should be aligned to the use of the generation. “Where the resulting electricity

	generation supports an on-site activity rather than being sold for commercial gain". This applies equally to a farming enterprise or a rural domestic property.
There are likely to be limited circumstances where small scale hydro scheme can be incorporated as part of a domestic property. Potential for hydro scheme to impact on residential amenity. There is already provision for non-domestic hydro schemes on agricultural land, which can support existing rural enterprises. It is unclear how this would extend to other more commercial businesses i.e. is the intention for energy companies to provide such schemes in any viable location? How is suitable rural location defined and would such a scheme need to be associated with an existing rural enterprise?	Applicant status (domestic, business) is not an indicator of the affordability of a hydropower scheme. The scheme will be dependent on the quality of an existing resource (river or stream / hillslope / weir). The development barriers faced are likely to be similarly challenging for schemes of a scale likely to be covered by PDR. If the intent is to reduce barriers to hydropower, the given sites that exist must be exploited through the motivation of their landowners regardless of their business status.
Unlikely to be many domestic [schemes].	The existing use of the property is almost irrelevant.
	This distinction does not relate to the risk so it should not affect regulation
	WG should always support the deployment of low carbon technology, where appropriate.

Question 4: What scale / capacity of hydro development is appropriate in the application of PDR?



3.1.9 5 planning authorities opted not to select a capacity category whilst two stated that capacity should not be a determinant of PDR. 11 respondents selected up to 25kW, 4 respondents up to 15KW and 6 respondents selected *Other* for the reasons given below.

3.1.10 The following table summarises the comments and observations from consultees:

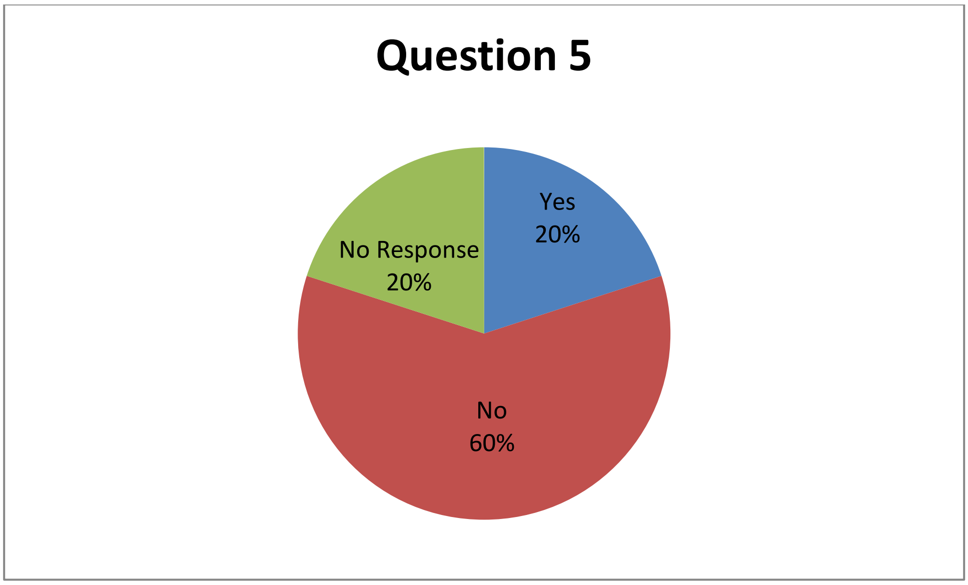
Table 3.4: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
0 - 12kW. Most small scale hydro schemes do not exceed 11kw	45kW as that is the definition of micro generation and the take up would be very low for anything below 20kW given the state of the FIT
Don't think installed capacity is a useful marker for PDR as it has no bearing on the environmental impact of the scheme – PDR should relate to the size and extent of the infrastructure required to be installed rather than installed capacity. There is also the issue of EIA Regulations - any hydro scheme of any scale within a sensitive area would automatically be Schedule 2 development, if such a scheme is PD, who is required to undertake screening exercise if no application is required?	In setting the bar for scale it is impossible not to bring in "flow take" - which is an NRW concern and not strictly a planning concern. Rather than the bar being set by the design power output, I think it should be set by a "flow take", - which for medium / high head schemes should be 10 l/s, and for low head schemes might be 100 l/s; in terms of power output, these "flow take" limits would put the bar as judged by power output in the "0-5 kW" bracket, whether high head or low head.
None, as each scheme is unique in terms of its design, location and setting.	Schemes under 34kW this is the limit for single phase areas (the connection ends up split phase and DNOs allow 34kW at this size) So a common size of small hydro is at 34kW and this seems like a sensible size for permitted developments. If this is deemed too large then suggest 25kW or 15kW as the next bandings it is very difficult to build worthwhile hydro less than 15kW as the cost of install and maintenance starts to outweigh the benefits.
It is difficult to be specific given the complexities around the scale of hydro energy generating stations	The G/83 regulations (16A/ph) provide a useful threshold which is in line with solar PV in respect of PD and connection requirements.
The amount of electricity that is generated is somewhat arbitrary. However, where grid connections are required, this may lead to greater environmental implications. The relationship between the physical scale of the development and power output needs to be assessed. Limitations on the physical scale of the development should then be restricted along with the limitations of the power output.	Until seeing the boxes [with bandings in the questionnaire] I would have suggested 100kW, again to link with FiT bands - accepting that some kind of link is desirable when setting something which, as you acknowledge, is quite arbitrary. If there are to be design, location and operational criteria set out I don't see any risk in having an output way above 25kW. I would strongly guard against a limit as low as 5kW since it is generally very hard to justify such schemes anyway.
	Micro schemes are commonly defined as 5kW – 100 kW. It would be preferable to see PDR on as high a banding as possible and then a more

	proportional approach to schemes up to 100 kW. Normal regs could kick in past the 100kW range
	There should be no need to limit PDR to a particular capacity. Some high head schemes up to 100kW would have negligible impact on the environment.
	We foresee a risk that a given kW ceiling will simply create perverse incentives to develop schemes to meet this PDR criterion while not prioritising other benefits. (We have seen this risk realised from other such arbitrary thresholds.) An example of an analogous problem is the arbitrary power bands of OFGEM's Feed-In Tariff: whereby a 100kW scheme is far more affordable than a 120kW scheme producing more electricity at no greater impact. If 25kW (or any other essentially arbitrary ceiling being considered) is not already a constraining size for any other aspect of regulation, we suggest that this may add a further distortion into the efficient exploitation of the Welsh hydropower resource. If a power ceiling is considered an indispensable metric, propose looking at other key influences, such as: a. FITs (100kW). (15kW has no implications for new schemes and is thus not a relevant influence). If 100kW is considered too high, consider other influences such as the following: b. If Welsh Business Rates currently or imminently provides exemptions or reliefs below a particular kW rating, this will be a crucial existing influence on new design decisions. c. Any "low-risk" limits being used by NRW in its licensing guidance to apply more relaxed regulation (we doubt they have such limits at present, but please check their future intentions). d. Grid connection size constraints (check e.g. with Western Power Distribution in case they have present or near future policy constraints on hydropower connection size, e.g. greater expense above 50kW) e. If a Welsh Government definition of micro-generation (45kW Energy Act? 50kW in other sources?) is already being applied in a away which is influencing design decisions, then this might also be reflected in setting a PDR ceiling f. Other authorities who impose constraints above a certain ceiling? Taking a coherent joined-up approach with other

	significant burdens will prevent the PDR threshold from adding new market distortion. We concede that the factors which you mention (and those above) have varying values. It is our opinion that restricting the PDR ceiling based on one of the lower values will artificially disadvantage applicants for schemes to which that criterion happens not to apply. For example, the impact of the 11kW limit for G83 grid connection will vary depending on what wires the landowner happens to have inherited. Hence if a kW limit is indispensable, and if you determine that it must be set lower than the most significant of these impacts, we would still urge it is set as high as is permissible, to prevent artificial distinctions which in no way coincide with planning detriment.
	It is very site dependent, as the characteristics and sensitivities of the land use can vary widely, so the PDR guidance will need to be very clear. See no particular reason to restrict on installed capacity alone, as hydro development is more about site specifics and the sensitivity of the environment in which it sits. For example a development on a large river, with a penstock through a heavily grazed agricultural field may have the capacity for >50kW with little or no sensitivities, where as a 10kW development maybe through sensitive woodland with significant ecological value. So siting is more important than the installed capacity banding.

Question 5: Should PDR be limited to schemes that do not require new grid connection works?



3.1.11 4 planning authorities provided no response, 1 authority stated *No*, and 2 authorities stated *Yes*. 18 other consultees did not support PDR for schemes that do not require grid connection whilst 6 believed PDR were applicable to non-grid connected schemes.

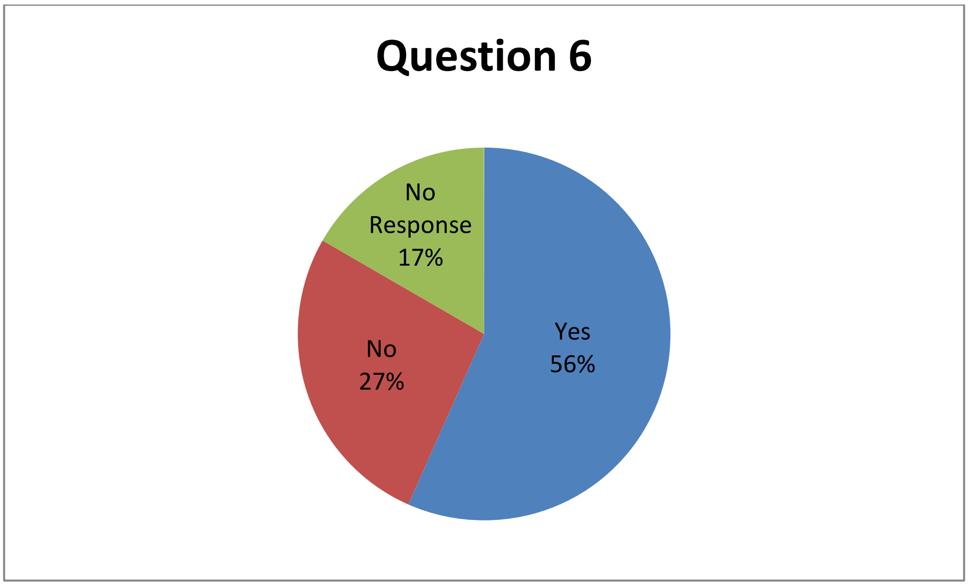
3.1.12 The following table summarises the comments and observations from consultees:

Table 3.5: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
In reality, the majority of hydro schemes will require a new grid connection, and requiring them to connection into an existing supply may be cost prohibitive (e.g. if turbine house is 1km from farm complex with an existing 3 phase supply or they can connect to 11kV line 200m away – in this scenario, it would make better financial sense to go for a new connection rather than connect to the existing 3 phase supply)	Even some grid connection works pose no planning detriment. Please do not impose this limitation without an appropriate consideration of what is involved. New overhead lines might be a clear case where planners would want scrutiny. But if a new shed containing a turbine is to be PDR, then a new shed containing a transformer is surely similar. Or would there be expected standards on the nature of finishes for sheds for turbines under PDR? And surely any such metering and infrastructure cabinets as are already permitted for other purposes should also be permitted for hydro schemes which are subject to PDR?
Even single phase schemes involve upgrades to the grid supply (e.g. bigger transformer/pole design and location) and meter cabinets for the connection equipment.	At the scale I suggest is set for PDR in the last question [0-5kW], it is pretty inconceivable that anybody would want to, or need to, have new grid connection works put in place; but should these be required in an unusual case, PDR should not be withheld from the applicant
If "No" then you are potentially giving consent to schemes that may be unviable or unable to be connected. New lines could cross more sensitive habitat therefore defeats the object and gives false hope to developers	Grid connection works [are] not related to abstraction in the slightest.
[Stating Yes] This may also limit the introduction of such schemes to areas where there is already some development.	This tends to be the case all the way up to 34kW in fact it is often the case right up at around 100kW and sometimes more.
	Wouldn't necessarily need planning permission for overhead lines anyway
	Don't confuse the position by mixing up the two constraints.
	This is an un-necessary complication which is not relevant and which would need to be further clarified in respect of off-grid schemes.
	Grid upgrades are normally separately permitted anyway, so to limit PDR for hydro schemes by grid requirements adds an extra layer of regulation for no benefit.
	Situations vary widely and being overly

	prescriptive could see perfectly good schemes remaining undeveloped.
	Although in some cases use of active network management load management, or upgrading of the network may be needed to make a scheme viable, this would be simply an economic issue.
	Depends if the cabling is underground as would be common I wouldn't see the need for planning to be sought. However, if it was above ground then it should require planning
	The Welsh Grid network is already incredibly restrictive so this would unnecessarily curtail development

Question 6: Are noise controls/limits on small scale hydro operation required for public protection?



3.1.13 5 planning authorities agreed that noise limits are necessary with 2 authorities not responding on the basis that they do not support small scale hydro PDR. 17 other consultees agree that noise limits are required whilst 8 did not.

3.1.14 The following table summarises the comments and observations from consultees:

Table 3.6: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Turbine houses, which are more likely to be closest to residential properties and are the major noise source, can be easily noise insulated but a standard db limit would be useful.	As long as it a certain distance from any nearby properties this should be able to be incorporated into any permitted development.

Need for noise restrictions is only necessary where the turbine house is close to noise sensitive receptors. Would recommend that if PDR are introduced, restrictions apply within a certain distance from dwellings (e.g. not PD if turbine house or any noise generating equipment is within 500m of a residential property).	By default there are existing control measures on any activity which may cause a public nuisance through the emission of noise. Whilst they need to be referenced, they do not need to be further defined.
Separation distances could be applied like the Agricultural PD rights. X metres from a protected building. It is advised that local authority public protection departments are contacted as part of the study.	Small scale hydro is rarely noisy but there is the odd exemption so perhaps a noise specification for all sites within 50m of residential properties. Note most hydro is much quieter than the stream they are next to hence it might be overkill to specify thresholds
Schemes close to residential properties may impact on their amenity without an opportunity for those occupants to raise concerns which could then otherwise be assessed/mitigated where appropriate. Controlling suitable separation distances may address this issue.	Appropriate to include noise level restrictions particularly in relation to adjoining properties/public out with the control of the applicant. Noise can be easily measured once the scheme is operational and compared with levels when turned off.
	Noise is not an issue for high-head schemes. Can set a maximum level constraint.
	In most cases under 15kW systems are not particularly noisy and are usually unlikely to be situated close to housing.
	PDR criteria could include reference to noise control mechanisms.
	This is already covered in the planning application under environmental health and not in the licensing aspect of a scheme. Is this PDR proposal to also negate the planning process?
	This is not a significant issue for small scale hydro (up to, say, 100kW) as turbines houses are often located away from the public or can easily be sound insulated.
	Yes, should be easy to enforce. Could also consider condition in respect of 'protected building' like agricultural PD
	[Responding Yes] Even very small turbines create a whine which is irritating to people living close by.
	It seems appropriate that hydro schemes under PDR are covered by statutory and standard requirements on noise. However again the rubric here implies that the PDR guidance risks including generalised comments about hydropower design which may

	turn out to be ill-informed or inapplicable. Even conventional hydropower schemes come in a wide range of shapes and technologies. Guidance is often helpful, but: we propose that the PDR guidance should NOT enforce inflexible generic conditions based on assumptions about scheme technologies, components, layouts and design which do not apply to some of the scenarios where the PDR would otherwise apply. Designs are often based around environmental protection – another layer of constraint which was inflexible, generic, and not design-focused would complicate this. Clear design guidance can address this issue.

Question 7: What size / nature of intake would be appropriate?

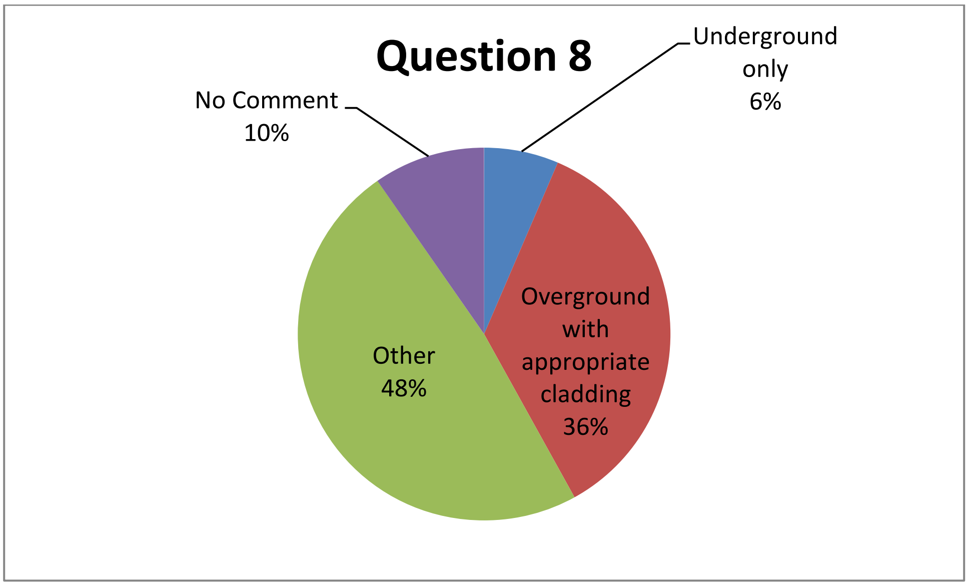
3.1.15 The following table summarises the comments and observations from consultees:

Table 3.7: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
No fixed size – some might require fish passes etc.	Small concrete weir should be acceptable for PDR.
The sensitivity of the site should be the deciding factor.	PDR should only be considered for those that do not require in-situ concrete casting.
Each scheme needs to be considered on its merits. Even small scale hydro schemes usually require the construction of an intake weir and return outfall.	All hydro schemes require some sort of diversion weir - not relevant to PDR or not. Work in Rivers (or work in / near watercourses) consent may still be used.
There would be concerns with large concrete intake structures being introduced without proper assessment of their impacts. There would also be concerns where works are required to natural streambeds of banks. Who would be responsible for ensuring the works carried out does not cause significant harm to the water environment? Alterations to stream banks should be avoided particularly where this could give rise to potential flooding issues.	"This is a difficult question to answer because medium/high head schemes with a ""flow take"" of < 10 l/s can be perfectly well served by prefabricated structures set into the watercourse with minimal engineering of the stream's banks or bed; but low head schemes taking < 100 l/s will still need the more heavily engineered concrete works (either precast or cast in-situ) that much larger schemes commonly have. Setting the bar for PDR by either power output OR ""flow take" will inevitably run counter to any stipulation about the size / nature of the intake."
	The ideal would be pre-fabricated intakes (still concreted into place but this means on significant concrete structures) and intake to be at existing steps or waterfalls with the crest no more than 500mm above the crest of the existing/step or

	waterfall. NRW will determine all this in their licencing so I would suggest the PDR does not need to specify this in any way; it is better for it to be controlled by NRW.
	Pre-fabricated screening units if possible.
	Small scale only. NRW can control the head-walls or Dams under the permit.
	Water diversions are made for both pre-fabricated and cast concrete, thus both would have limited construction risk. May be intake construction could be limited by river flow rate.
	This will make PDR infeasible. Some on-site casting will be necessary. Control through construction procedure requirements.

Question 8: What size / nature of header tank would be appropriate?



3.1.16 (NB one person selected both Overground and Underground so numbers do not add up).

3.1.17 3 local authorities selected overground whilst none selected underground; 4 authorities selected *Other*, the reasons for which are explained below. Of the other consultees, 11 selected a preference for overground, 2 selected underground, and 15 selected *Other*, again the reasons for which are explained below.

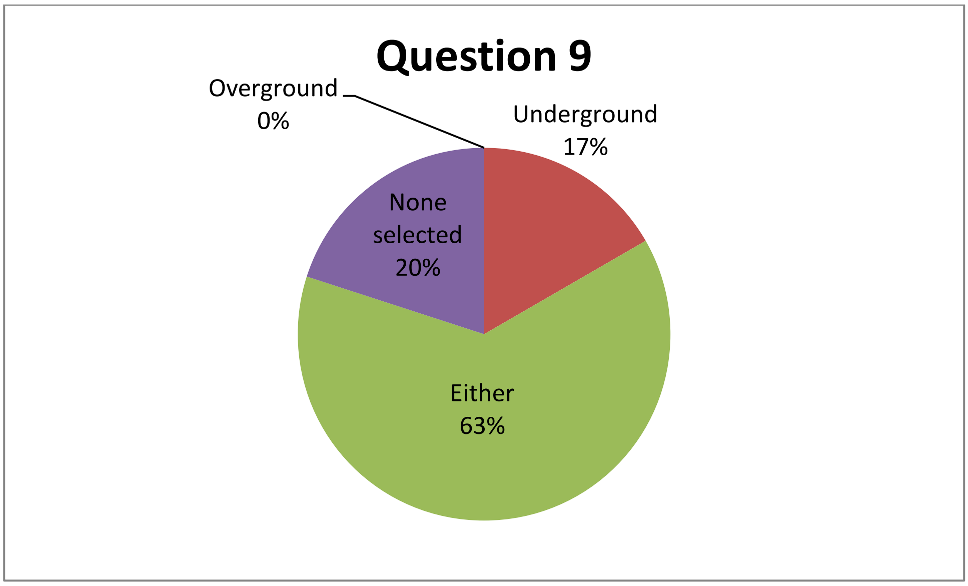
3.1.18 The following table summarises the comments and observations from consultees:

Table 3.8: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Undergrounding of forebay tanks is likely to be too expensive and/or physically impossible close to a river bed.	Not relevant if underground or above ground.
Overground pipes can have visual impact which needs to be controlled though planning application process. Impact on overland pipe may be limited to localised impact only, but issues such as need to maintain a tree clearance around overground pipes can have impact on wider views towards site. Also issues where is crosses Public Rights of Way / open access land / land with permissive rights of way etc. and overground pipes may be a barrier. [*NB this response appears to have misunderstood the question.*]	Not sure that the characteristics of a header tank need form a criterion for allowing PDR. It is pretty unlikely that such a tank will ever be unsightly or very large (because the groundworks to support the weight of a large tank would need to be substantial). The one thing that is important is that it would be safe in the event of it ever rupturing.
It is not beneficial to specify a generic arrangement for header tanks which would be permissible as ground conditions at the intake location may not allow installation (e.g. due to the presence of bed-rock). Generic permitted specifications may actually result in less than optimal schemes being installed – where a bespoke scheme could provide more generating capacity.	Both underground and overground may be acceptable dependent on location. A woodland setting may be suitable for overground when excavation would interfere with tree roots. Underground may be more suitable in open hill scenarios.
Small tanks and kiosks are PD under certain classes of the PD Rights where they relate to Water and Telecoms undertakers. These have a size limit so consideration of similar restrictions needs to be applied here. Could be subject to a prior approval type process.	There's also the option of overground without appropriate cladding. Schemes vary enormously; header tanks tend to be relatively small and are often tucked away out of eyeshot. If possible, it's preferable to not be overly prescriptive on the design of the scheme but to offer the range of options to ensure the best result.
More detail is required to answer this question and will depend on the size of a typical header tank. Introducing structures and machinery along a watercourse have the potential to adversely impact on the character and visual amenity of the countryside, particularly if located in well used areas where the water environment is a key attraction. In such areas, underground header tanks may be more appropriate. However, this may have greater implications on the watercourse environment and its embankments.	Preference to be underground but in a Coal Mining High Risk Area may need to be overground with screening/cladding.

	Either depending on location.
	Underground only is fine as the elevation of the tank (below intake) always suits it being underground and this means that there is minimal environmental impact.
	Header tanks not necessary, integrated systems better and less intrusive.
	The use of a header tank (if required) is based on site specific conditions and cannot therefore be generalised. Its siting and screening should be subject to good guidance rather than regulations.
	There should be some condition on size being within reasonable bounds for the required purpose.
	Any sort should be permitted as they will be of small scale, though most commonly no header tank separate from the intake would be required.
	Again the risk is that specific guidance would be restrictive to sensible functional design. Guidance should not inadvertently prejudice schemes which require fewer or different technical elements.
	To minimise works at the intake, a separate forebay tank can be installed away from the river (downstream), these can often be semi-buried and then clad in stone or earthed over.

Question 9: How should pipelines be installed – overground or underground? What diameter/length of pipe is acceptable?



3.1.19 4 local authorities opted not to select a preference, 2 stated a preference for underground pipelines and 1 selected either. Of the other consultees, none selected a preference for overground, 4 selected underground, 18 selected either, and 2 further consultees did not state a preference.

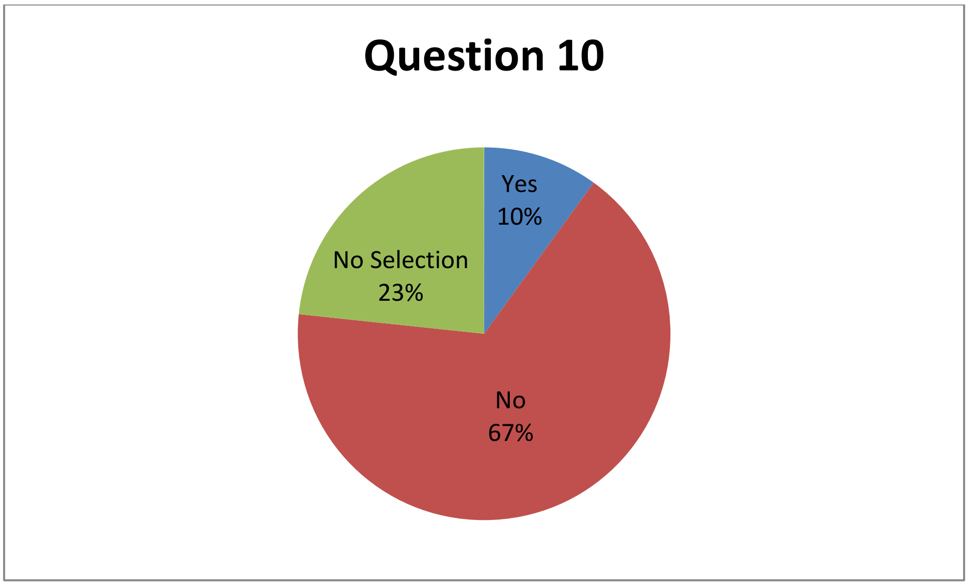
3.1.20 The following table summarises the comments and observations from consultees:

Table 3.9: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
It is very difficult to pre-determine this as pipe diameter is a function of the abstraction permitted and generating potential. Also it is not always possible to guarantee that ground conditions are such that the pipe can be buried but obviously in landscape terms this is much the preferred method of installation. What would happen if a scheme was progressing under PDR rights on the basis of buried pipework but ground conditions (e.g. bedrock/boulders) resulted in sections of above ground pipe? The scheme would then be unauthorised and require retrospective consent and dealing with this would become messy. Granting PDR to surface laid pipe would have significant landscape impacts as the pipe runs can be very visible visual intrusions on the landscape – especially when they reflect the glare of the sun.	The preference will always be for a penstock on this size of scheme to be over ground with adequate surface screening using vegetation etc. This significantly reduces both the environmental impact from excavation and greatly reduces the cost of installation. There are instances where a length of penstock needs to be underground where it crosses a footpath, track, fence line or similar. Where the generation output of such a scheme has already been defined (e.g. 5 – 10kW) then it is inappropriate to additionally try to define the penstock diameter. A high head 2kW scheme with a 100m head will probably require a long penstock of only 63mm diameter whereas a 2kW "Low Head" scheme with a head of around 3m will need a penstock of 350mm but almost always less than 50m long. The environmental impact of both these schemes is therefore proportional.
Without knowing the effect of the pipe's diameter it is difficult to constructively comment	The pipe requirements of low head and medium/high head schemes need to be born in mind. With this in mind, I am not sure that specifying requirements regarding the pipe is feasible.
The location of the scheme would determine the most suitable approach with a balance between the potential environmental impacts and visual impact. There may be cases where neither underground or above ground approaches is appropriate and such locations should be avoided.	Underground in open areas and overground in dense woodland, I have done a lot of work on both and this is best: woodlands suit overground and underground damages roots and could mean tree felling, overground outside of a woodland is unsightly.
	Whatever suits terrain - e.g. in woodland overground is better
	Max size pipe – 20 inches
	Difficult to set a limit, if the scheme is max 25kW none of the pipes are going to be that big

	500mm max pipe
	This needs to be left to the developer. Specifying will ruin fragile economics. [There are] specific environments where overground is not acceptable.
	20 inch max pipe
	In the experience of planners - what diameter is small enough to generally have been found to cause no detriment? As Q8. it seems that PDR cannot balance conflicting detriments such as visual and ecological in mandatory conditions in guidance. If PDR does not have a single clear objective, how is it to decide the method used? If pipelines are to be included under PDR at all, then perhaps best practice methods for both options should be set out - and the choice of method left to applicants/engineers.
	12 inch max pipe
	500mm max pipe
	No maximum – guide to the optimum sized pipe.
	Very large diameter pipes (say above 600mm) of more than a few tens of meters length would require considerable construction equipment to be deployed - this would rarely if ever be the case for small scale schemes.
	No specification on pipe diameter, however overground pipe if situated in woodland or earth-mounded should be considered.

Question 10: In reference to the above question, should the length of the pipeline be controlled?



3.1.21 4 local authorities opted not to select a preference, whilst 3 stated that the length does not require control. Of the other consultees, 3 believed the length should be controlled (see comments below) whilst 17 do not believe the length should be controlled. 3 further consultees abstained.

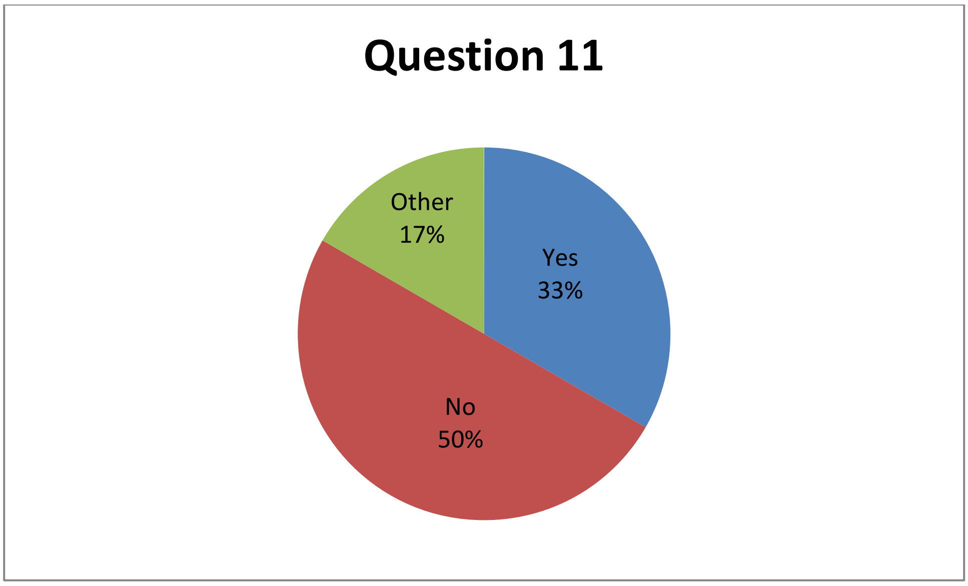
3.1.22 The following table summarises the comments and observations from consultees:

Table 3.10: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
It is not clear what the benefit of such a control would be. Grid connection costs are much more likely to limit pipe lengths as longer schemes are unlikely to be viable unless a three phase connection is close by. Intake and turbine house locations are also dictated by landscape and ground condition constraints so there needs to be a degree of flexibility regarding how long a scheme is.	Why add an unnecessary constraint? If the scheme is already under PDR for agreed reasons of power and scale – the visibility of the total length of pipeline is unlikely to ever be a detriment in itself. Ecological aspects of pipeline length (i.e. to stream resource) are already regulated by NRW.
The 'fall' regulates the length of pipeline. This is the important element rather than the length of it.	The pipe is a significant cost of the project so very long pipelines for the wrong reasons just do not happen so no need to specify the length which would be difficult to do anyway.
It need to be as long as required.	No, economics will restrain pipe length - no need to specify.
	Site dependent.

	[Yes] to reduce environmental damage
	Not where pipe crosses owners land and does not interfere with public access or visual enjoyment
	It is clearly within the spirit of PDR-type arrangements not to have open-ended rights. I would suggest a maximum of 2km.
	Most small scale schemes with a pipeline will use pipe of 355mm or less, and no control for these would be appropriate
	Length is not a significant factor.
	If the restriction on installed capacity is an adopted rule then the length of penstock for most high head- run of river schemes will be curtailed anyway.

Question 11: What types of powerhouse are appropriate under PDR such that they will meet environmental protection / amenity requirements?



3.1.23 To clarify, the *Yes* responses agree that the type of housing should be specified whilst the *No* responses do not agree that housing should be specified as long as it meets environmental standards. The questionnaire then sought comments from responders, where applicable, on the preferred type of powerhouse.

3.1.24 4 local authorities required for the housing to be specified and 1 did not. Two authorities selected *Other* for the reasons explained below. Of the other consultees, 6 agreed that housing should be specified whilst 14 did not agree that housing should be specified. 3 responded with *Other* for the reasons explained below.

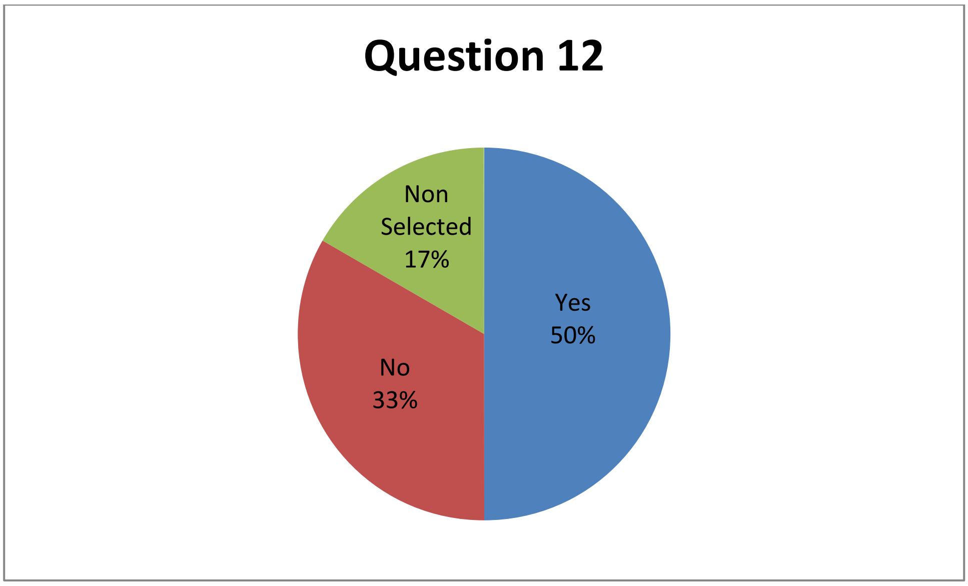
3.1.25 The following table summarises the comments and observations from consultees:

Table 3.11: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
The turbine house is likely to be close to the watercourse and automatically separated from residential properties. The design/materials to be used will depend on local vernacular and context.	Not all turbines need a power house so they should not be an enforced requirement. That said, the issue of noise nuisance and proximity to residential property does need to be addressed.
The turbine house is usually the main visual feature, and its impact will be site specific. LPA should retain control over its siting and appearance so if PDR are introduced, a prior notification application should be introduced to allow the LPA to request additional information on the siting, design and appearance of the turbine house. (design could include noise mitigation).	PowerSpout turbines are designed to operate externally and without weather protection. Where a turbine "house" is used it will be to limit noise and/or to provide weather protection to additional electrical equipment which might be co-located at the turbine site. Any such structure is generally of timber construction and should be in keeping with its surroundings.
Each scheme is unique and turbine houses can take many forms – a separate new building, an outbuilding to an existing property, or re-use of an existing building. Schemes which make use of existing infrastructure (e.g. schemes associated with existing reservoirs/water treatment works for example) without the need for new infrastructure could potentially be considered for PDR but these are likely to be few in number.	We support guidance on suitable finishes, especially if these can be related to local standards for the finishes of outbuildings of similar scale. We do not support mandatory conditions on the nature of the supporting structure – as this should depend entirely on the type and design of machinery. Perhaps make mandatory condition that machinery must be installed in accordance with manufacturer's guidance (e.g. as regards structural loads, safety features).
In existing buildings are appropriate.	Type will vary to fit in with its location.
The appropriate type of powerhouse will likely depend on the context of the site.	There should be a minimum distance between the turbine house and 'protected' buildings, and size and height limits plus external finish restrictions.
It needs to be clear what it will look like.	Will vary by site - can't specify.
	[Should be] site / location dependent.
	Could be a potential issue in national parks, moreso than elsewhere.
	Hydro powerhouses tend to be small and in keeping anyway.
	There should be a variety of allowed options rather than total free choice.
	Other than considering the flood risks, planning would consider this element.
	Small schemes invariably require powerhouses of <16m2 footprint and would have no more impact than a garden shed - a limit of 30m2 footprint might be appropriate

	The type of housing should be appropriate to the location.

Question 12: Should there be a minimum separation distance between powerhouses for this scale of development and residential properties?



3.1.26 5 local authorities specified that minimal distance should be required; 1 authority did not require such a separation distance and 1 did not select a response.

3.1.27 Of the other consultees, 10 supported the application of a minimal distance and 9 stated they did not agree that a minimal distance would be necessary. 4 did not specify a response.

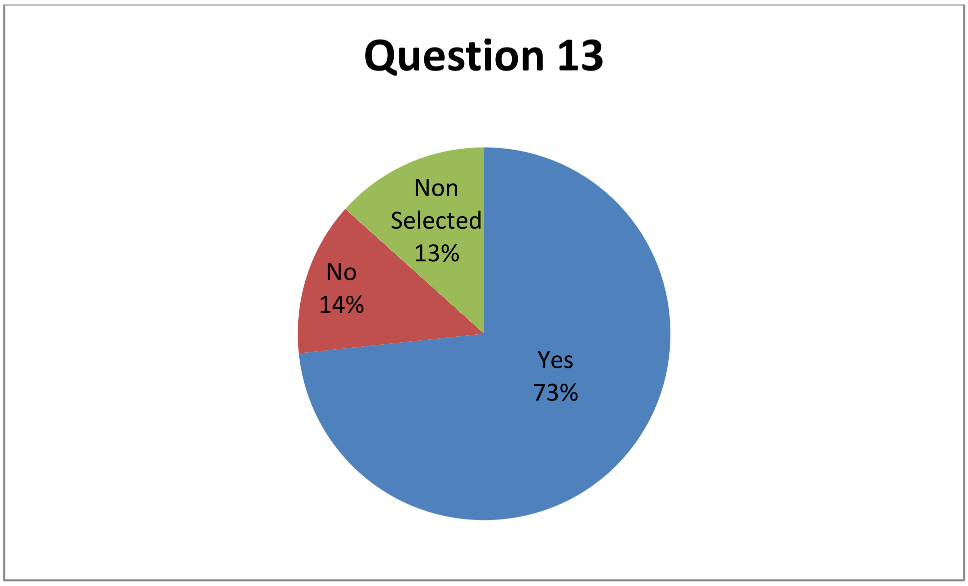
3.1.28 The following table summarises the comments and observations from consultees:

Table 3.12: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Yes, need to be able to control noise – e.g. minimum distance of 500m would seem acceptable, and any closer should require planning permission.	[Yes] But this should not include the property of the applicant/owner.
But account will need to be taken of the grid connection which may rely on a residential property for that connection. Increasing the connection distance obviously adds to the cost of the scheme.	No need to separate from residential properties subject to noise attenuation being appropriate. Small domestic schemes may well be installed in an out building which may be attached to the house.
A hydro scheme will produce mechanical/tonal noise. Noise impact will reduce with distance therefore this should be a consideration. A minimum separation	The wide range of site conditions for schemes of this size make any regulation in this respect overly burdensome. The existing noise regulations are the defining factor. Adding guidance rather than

distance applies to Wind Turbine PDR.	regulation is more appropriate.
The appropriate distance will depend on the design of the development and the level of noise generated. This needs to be investigated further.	This is difficult to answer because the frequency of the sound emitted may be very difficult to eliminate / reduce to an acceptable level even with the best sound insulation techniques. This is a specialist area and to answer the question with any rigour one really needs to know the spectrum of frequencies the turbine / alternator will emit and how effective sound insulation materials will be in mitigating noise at these frequencies.
It depends on how noisy they may be.	If yes 25m would suitable and it ideally should be possible to have a powerhouse within 25m of the site owner's house but not other residential. For example a farmhouse should be able to install hydro on its own farm with the ph [powerhouse] near the farmhouse this would be ideal.
	About 30 metres, they are not noisy.
	400m - same as agricultural PD.
	20m.
	Depends on the amenity issues - noise? visual? monitoring?
	100m
	Distance could be on a sliding scale subject to decibel level of the turbine.
	These types of schemes will frequently be for the benefit of owner-occupiers, for whom it might be important to have turbine housing adjacent to or adjoining residential buildings.
	The closer the turbine house is to a residential property, the more mitigation is needed to control impacts. Therefore no minimum distances needed.
	Small schemes invariably require powerhouses of <16m2 footprint and would have no more impact than a garden shed - a limit of 30m2 footprint might be appropriate
	Based on sound levels.
	We disfavour generic guidance dictating where the powerhouse should stand in relation to properties. Positioning of powerhouses especially for low-head schemes is often non-negotiable and is always a technical question with regard to functional design. Noise constraints are already covered in a separate question. What if anything is the other perceived detriment?
	Very site dependent and the quality of the powerhouse acoustic attenuation could be increased to further protect amenity.

Question 13: Should there be controls and guidance regarding the design of the tailrace / outfall to minimise noise / turbulence and protect fish?



3.1.29 6 local authorities stated that there should be controls and guidance and 1 did not specify a response.

3.1.30 Of the other consultees, 16 agreed with the requirement for controls on these hydro features, 4 did not agree controls were necessary and 3 did not specify a response.

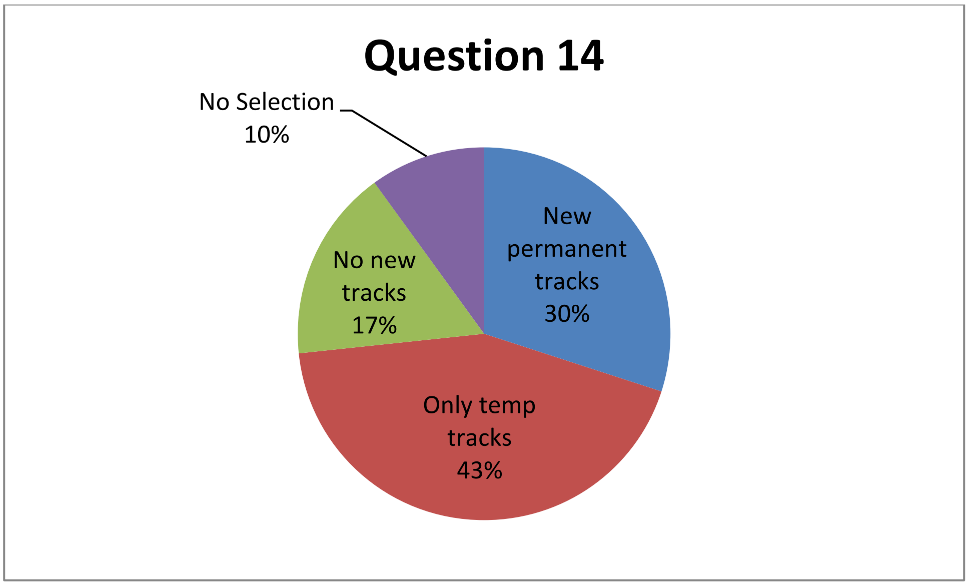
3.1.31 The following table summarises the comments and observations from consultees:

Table 3.13: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Yes – hydro schemes we have dealt with have raised a number of issues with fish, and we have had schemes which have been contentious and a number of objections from angling community have been raised. Some mechanism to address concerns of other river users needs to be built in.	As with all 'controls and guidance', some flexibility to allow for the particularities of each site needs to be incorporated: the screen I was told I needed to cover my outfall with would have been a disaster for the brash that also discharged from the same pipe after times of heavy rainfall.
How would it be ensured that a tailrace / outfall is appropriately designed and implemented? Which authority would be required to take enforcement action should a poorly designed system be put in place? Would this be NRW to address the environmental issues? Or planning to deal with the non-compliance with any PDR criteria.	Standard outfall conditions should apply utilising engineering solutions which will be subject to normal in river working practises. Noise attenuation should be stipulated if potentially adversely affecting other properties or the public.
All environmental consequences need to be addressed.	Yes but this should be done by NRW not PDR.

	Should not be an open channel as health and safety risk.
	Yes guidance can be provided.
	This falls into good practice based on appropriate guidance rather than "controls" which are difficult to both specify and interpret. Remember that the turbine outflows from these small schemes are typically less than 20 l/s.
	My experience of sub 15kW systems is that this is not a problem.
	All of these issues are already covered by NRW procedures.
	Guidance is key to developing a good scheme, as many owners will be undertaking this type of project for the first and last time.
	Yes - good practice guidance should be provided - this would not be burdensome for installers.
	Easy to manage at design stage. Simple screening for fish.
	As previous questions about restrictive design conditions which do not take into account the design or machinery being used. PDR cannot cover all such scenarios and should not attempt to impose generic restrictions which may not be appropriate to the case. Ecological aspects of design – such as tailrace impacts - are already taken fully into account by NRW being the statutory lead regulator on this. Neither PDR nor non-PDR planning needs to duplicate this regulation which is already rigorous.

Question 14: Do you think that the creation of new access tracks (whether permanent or temporary) should be allowed under PDR?



3.1.32 6 of the local authorities agreed that new access tracks should not be included under PDR whilst 3 agreed that temporary tracks could be included; 1 did not specify a response.

3.1.33 Of the other consultees, 9 felt that new permanent tracks should be included under PDR, 10 believed temporary tracks could be included and 2 did not selected a response.

3.1.34 The following table summarises the comments and observations from consultees:

Table 3.14: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Tracks required may be extensive in scale and may be more visually intrusive than the hydro scheme itself, so should require consent.	We have experienced problems with an existing hydro scheme where large tracks have been created unnecessarily. Small machinery could be used provided ground restored.
PDRs for new access tracks should not be established as the landscape and environmental impact of these is likely to be greater than that of the scheme itself. It is very difficult to define with precision the construction methods which will be employed prior to commencing works on site. Ground conditions and weather can necessitate changes in methodologies as works progress. Assumptions about different methods do not always hold true – hand digging pipe trenching can cause more localised damage than mechanically excavated trenching for	As for pipelines. Some schemes will have tracks not visible from public viewpoints, others will have short tracks… For PDR, best practice methods should simply be set out. If deviation is required, this can proceed outside PDR.

Local Planning Authorities	Other Consultees
example, but weather and time of year can have a critical impact on the environmental and landscape impact of works undertaken.	
New tracks to a certain distance are allowed for forestry and agricultural activities under their PD rights, however, they will generally be on improved land and land that is worked. There will be difficulties in enforcing the reinstatement of temporary tracks?	Most tracks green over as used only now and again, I would perhaps limit the new permanent tracks to 100m.
How likely would a temporary access track be required for a small-scale hydro scheme? There is potential for temporary access tracks to be quite extensive, which may have greater environmental impacts than the hydro scheme, particularly if they cross sensitive areas.	Most people undertaking a small hydro will naturally want to make the scheme in its entirety sympathetic to the environment; therefore a restriction to PDR based on access tracks is pretty unnecessary and an unnecessary encumbrance when there are more important issues which DO need to be included.
New permanent tracks by planning consent only	Temporary tracks sufficient.
	We have evidence to suggest that such PD rights as in agriculture are used out of context and to enable access (for other purposes) to sensitive areas - reinstatement not done.
	Remember the size of the scheme you are discussing. These issues are effectively managed within the overall context of scheme size and cost.
	I expect that limiting the PDR to sites that would not need new temporary tracks would eliminate the majority of otherwise permissible schemes. Permanent tracks are generally not required for small schemes.
	Permanent or temporary access tracks need to be permitted.
	New tracks are often not required and where they are mostly of a temporary nature.
	New tracks only to be permitted providing no significant aesthetic damage. Construction to be subject to good practise.
	In some cases new access may be required to the turbine or intake.

Question 15: Poor construction practices can be the most damaging aspect of hydro-electric schemes. What recommendations on best practice can you recommend for construction of intakes, pipelines, powerhouses and outfalls?

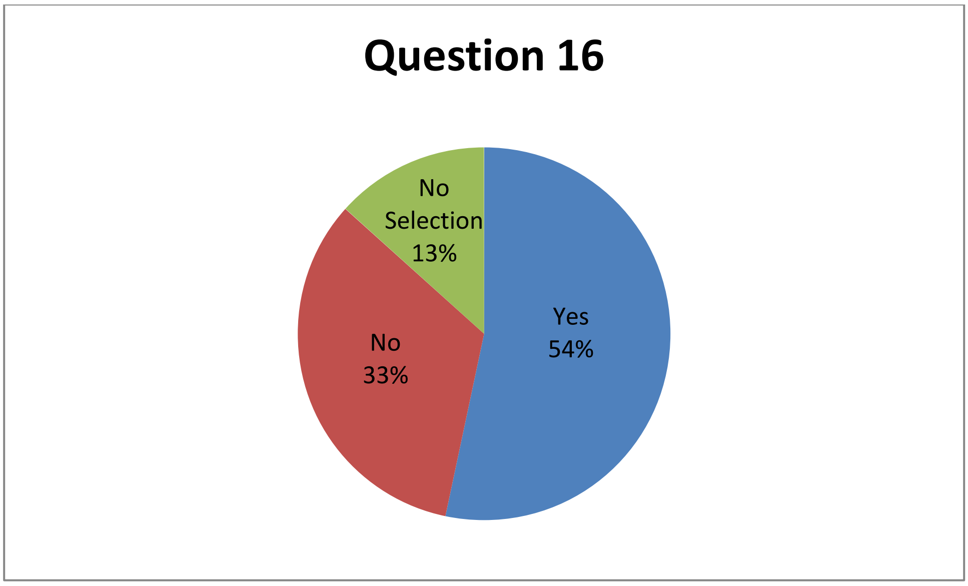
3.1.35 The following table summarises the comments and observations from consultees:

Table 3.15: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
I would recommend contacting TGV Hydro Ltd due to their practical knowledge in designing hydro schemes in remote locations.	PDR should, if introduced, be limited to schemes that do not require mechanical digging for the pipe route it should be limited to those that can be hand dug only.
We have limited experience of construction methods but a design guide promoting best practice examples would be very beneficial for the industry. Sensitive siting of pipe alignments and turbine houses along with materials choices can all help limit impacts but these need to respond to local ground conditions, local geology and landscape character.	The best "best practice recommendation" is that it stands the test of time; hydro schemes, even small ones, should be constructed with the thought in mind that the working life of the installation is upward of 30 years. If all aspects are constructed to fulfil this timescale and the passage of time shows the installation to have met this target, - it will have been well constructed.
Consider applying existing BS standards. Enforcement difficult. Work could be carried out by companies accredited by NRW or WG.	Be sensible, follow existing NRW guidelines for work in or near watercourses.
This is an area where the PDR would have little control and where there is potential for the greatest impacts on the environment. Water environments can be particularly sensitive to new development along its embankments, together with the operation of a hydro scheme. Poor construction can lead to harmful impacts which have to be dealt with retrospectively rather than preventing or minimising them in the first instance.	This varies from site to site, typically sites without buried pipelines with overground pipes can be installed very nicely using winches etc it is the burying of large pipes that tends to create the issue, Perhaps a pipe diameter constraint for PDR eg 400mm mas pipeline diameter. This limits some of the lower head projects. I would recommend max pipeline diameter of 400mm if the pipeline is more than 200mm long, this enables a compromise as it would be a shame to cut out some of the sites that are a very short pipeline and therefore limited impact.
	To have the scheme installed by a well-qualified and respected company.
	Turbine house should be small and finished with stone or render or timber to look like a typical rural building. Intakes should ideally be stone finished. Pipes should ideally be underground and the land restored to minimise their impact.

	Track/pipe route should have max width.
	Over ground pipes require less excavation and thus less impact on the environment.
	PDR on sub 4kW solar PV defines certain limitations in respect of the way the solar array can be roof installed. E.g. below the ridge line, inside the gable ends and above eaves etc, and does not extend to specific areas such as Conservation areas etc. Similar but relevant guidelines need to be defined in respect of PDR for small scale hydro. This document is not sufficiently expansive to expand on this which should be the subject of further informed discussion.
	PDR should be conditional on adherence to general good practice methodologies to be published with reference to the proposed new PDR rules.
	A guidance doc could be developed giving the range of designs, construction techniques and best practices available.
	Whenever possible construction to be carried out when ground conditions and weather is suitable. Scheme design and working methods to endeavour to reduce the likelihood of issues arising. Prefabricated components to be utilised whenever possible. There are substantial existing penalties available to the relevant authorities should constructors transgress.
	If this assertion is correct, why has this not been taken up with NRW? NRW's consenting regime for works in rivers is robust. They prosecute if damage occurs due to non-compliant works. NRW guidance is available online. PDR should simply be conditional on applicants obtaining the mandatory consents from NRW (Flood Defence Consent/Land Drainage Consent; perhaps now Environmental Permit for works?)
	Well established construction methods for hydro development exist and should be adhered to. SEPA guidance is excellent. Sediment management of penstock route is important and consideration needs to be given to this. The timing of in-river works for the protection of aquatic species.

Question 16: Do you agree that there are some locations in which PDR should not apply? If so where and why?



3.1.36 6 of the local authorities agree that some locations for PDR should not be permitted. 1 did not specify a response because they do not support PDR for small scale hydro.

3.1.37 Of the other consultees, 16 agreed that some locations should not be included and 4 stated that all locations should be included; 2 did not specify.

3.1.38 The following table summarises the comments and observations from consultees:

Table 3.16: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Additional conditions/criteria for protected building/areas would be a reasonable way forward. It is also unlikely that any abstraction would be acceptable in the rare instances where the watercourses travel in an east to west or west to east direction due to the impact of the depleted reach on bryophytes etc.	I agree with the first three [listed building, conservation area, WHS, SSSI, SAC, SPA]. However, the landscape designation restrictions should not apply. Given the very low visual impact of micro hydro and particularly following the thread of my comments above there should be no real landscape risk in implementation using the proposed new PDR rules.
Hydro development within a sensitive area of any scheme will be Schedule 2 development under EIA regulations and needs to be screened accordingly. Therefore PDR should not apply to sensitive areas to enable LPA to conduct screening exercise.	Wales is a rich landscape and often a very large part of the uplands is designated for its ecological value, however this should not preclude well designed, managed and constructed low carbon developments in these areas. These small scale schemes can complement and benefit the wider designations and make a small but useful contribution to reducing carbon emissions.
PDR should not apply within National Parks and AONBs, designated nature conservation areas (SSSI, SPA,SAC etc.). Schemes might	I think there should be as much of a "legislative hands-off" approach to PDR as possible, - in other words it should NOT be hemmed in with too many

be appropriate within Conservation Areas, WHS and the grounds of listed buildings. Indeed a hydro-electric scheme might support the sustainable conservation of the latter. But PDR should not be used to overcome the existing planning protections for these designations.	"it doesn't apply here" clauses. This is one such clause. There is a saying "trust is not found where responsibility is not given" and in respect of the specific situations given above, I would say "trust people to do the right thing in these sensitive areas; don't take away their responsibility to do the right thing by not trusting them".
Agree that PDR in SACs and SSSI should not apply as they could result in impact on features of these designations. Feasible locations for hydro schemes will often be located in rural areas, therefore there is the possibility they will be within high value nature conservation and landscape designations. Further controls on PDR could be introduced so there is some flexibility in schemes being developed. Prior approval approach for national parks, SAC.	PDR should not cut out sites within a National Park, Snowdonia for example is the place in Wales where the mountains and high rainfall mean that hydro should be encouraged. SSSI and SAC, a lot of good hydro land is within SSSI or SACs and often the designation is not relevant to the watercourse or the area that the hydro effects, perhaps the rule should not be PDR if the hydro is within a designated area and the designation is relevant to the site footprint.
All of the designated areas highlighted in the notes should exclude hydro scheme. It should also exclude landscapes that are designated for their outstanding or special interest.	Yes - flood sensitive areas or areas known to have experienced surface water flooding issues should be avoided.
Yes - also where the setting of a listed building may be affected.	Formal applications in places with conservation designation [presumably SAC, SSSI etc] can be excluded [from PDR]. NP and AONB should allow PDR.
	Yes - protected landscapes,- National Parks, AONBs and nature conservation designations.
	PDR on sub 4kW solar PV defines certain limitations in respect of the way the solar array can be roof installed. E.g. below the ridge line, inside the gable ends and above eaves etc, and does not extend to specific areas such as Conservation areas etc. Similar but relevant guidelines need to be defined in respect of PDR for small scale hydro. This document is not sufficiently expansive to expand on this which should be the subject of further informed discussion.
	Any scheme whether in a protected area or not must be suitable for the landscape in which it sits. To remove NPs from the list would take out many potentially viable schemes and adversely affect the residents of those areas.
	No - however, additional requirements may be included such as design of housing etc.
	Climate change needs to take prime consideration, as without any radical mitigation action today (we

	haven't had any radical action in the previous 25 years of the IPCC), there won't be any heritage, reserves, AONB etc in the near future. Well-developed schemes blend in to the background as penstocks tend to be buried, powerhouses / intakes are small. It should be possible to mitigate aesthetic concerns in more sensitive areas after dialogue with the relevant authorities. One possible outcome could be that the scheme isn't designed at an optimum size.
	Where schemes traverse an SSSI, special conditions may be appropriate.
	Yes - within a statutory nature conservation designation (e.g. SSSI, SPA, SAC) and within a conservation area or world heritage site.
	All locations should be considered for renewable energy generation. The test should be specific ie would the proposed scheme specifically detract/destroy the item being protected.
	We are very sympathetic to applying extra scrutiny for development in such areas. To clarify: As NRW (incorporating former CCW) must already fully scrutinise every hydropower application in relation to SSSIs/SACs, it is duplication to require the LPA also to do the same; so such designations should not also be a bar to PDR in planning. The option of still allowing PDR subject to conditions does seem superficially attractive. But in practice (as discussed above) the more complexity is added into PDT the more restrictive it becomes on development and the less it differentiates itself from non-PDR. On balance: we think that avoidance of planning detriment would better be served by a HIGH ceiling for PDR in non-sensitive sites, and no PDR at all in sensitive sites other than those already regulated by NRW.
	Yes - can build hydro schemes in SSSI's and similar without undue impact - depends on reason for SSSI status.

Question 17: Do you have any recommendations on further simplifying the planning process for small scale low risk hydro?

3.1.39 The following table summarises the comments and observations from consultees:

Table 3.17: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
Running the scheme side by side with the abstraction licensing regime with NRW.	Once an abstraction license has been granted LA planning permission should not need to be applied for.
Much of the issues raised during the course of a hydro application relate to environmental concerns, which are addressed under abstraction licence / permitted regimes, so if the planning process could be stripped back and make it clear that the environmental impact is being assessed through the licencing / permitting process and planning process can then focus on visual / amenity impacts.	In general NRW must scrutinise the ecological aspects of all hydropower schemes. Please allow LPAs to not duplicate scrutiny already being applied statutorily by NRW. As above, this includes (among other things) geomorphology, fish and fisheries, terrestrial ecology, impacts on SSSIs/SACs. At present, burden is pointlessly increased by having two authorities (NRW and the LPA) require separate submissions and conditions on the same themes.
It is not the planning process which needs simplifying. Being able to work with DNOs more effectively to share data to identify potential scheme locations and access grid connections would be helpful. A risk based screening approach for abstractions permitting could be beneficial. But a review of the FITS and business rates regimes are urgently required to make more schemes more financially viable.	Clear guidance about the range of development techniques is crucial. Developers could then select from these options (type of intake, header tank or not, buried or surface mounted penstock, turbine house location/footprint, tailrace type) and submit this info. Deviation without prior approval could then run the risk of closing the scheme or expensive reparation works.
Consideration could be given to creating “local development orders” for hydro schemes within certain river catchments and of a specified scale. Consider adopting a sifting approach used in TAN8 where SSA where developed as the most appropriate location for wind turbines. The same could be done in relation to certain river catchments. Also consider constraint mapping.	I am strongly of the view that PDR for small hydro and the developments NRW are working toward to make abstraction consent easier for the same interest group should be "joined at the hip". If they are not, the actual process, as viewed from the owner/developer's standpoint, will not be made any easier. The two are inextricably linked but currently are managed by two completely separate legislative bodies. I do wonder if one or other body should not relinquish its stake to the other to make the process "more joined up".
There are wide ranging issues that generally need to be considered and the extent of any impact will largely depend on the context of any site. Imposing a number of conditions as part of the PDR may lead to over complication of the requirements. Would NRW be	Good technical guidelines with pictures, dimensions and clear advice suitable for the layman to understand Technical guidance to include reference to exactly what should be included as part / in support of a planning application i.e. supporting surveys, red line application site to include all relevant works

responsible for ensuring all conditions of PDR are met or would this left to the LPA's? This could raise difficult enforcements issues where there is no base line survey details to assess the degree of any environmental impacts. Environmental surveys of potential sites which are to be submitted as part of a prior approval application would be one way of assessing the risk of the development.	(including cables for grid connection, pipes, ponds etc) Clarification on the respective roles of NRW and the LPA in the development of hydro schemes. Members of the public at present do not appear to understand who is responsible for what aspects of the scheme.
	Environmental risk assessment, archaeology, survey site should all be dealt with by one authority to minimise controls subject to good practice.
	There has to be linkage and commonality between both the planning and abstraction consenting processes if this initiative is going to go forward. Failure to ensure this will result in a continuation of the existing situation where schemes of this size and simplicity continue to be installed either guidance or regulation.
	Clear understanding of hydro schemes by the Planning authorities. If they understood the minimal impact they would not be so difficult. Conditions often required are regularly ludicrous.
	Yes it would complement it well but I do think PDR should be done whatever NRW do.
	Whilst every location is unique the principles of small scale hydro from scheme to scheme are almost identical and once installed are almost invisible in the landscape. Planners should welcome the use of a natural resource and whenever possible encourage potential schemes.
	Planning is relatively straight forward - it is the abstraction and impoundment licensing process that is over complicated and not fit for purpose.
	Yes- a set of indicative designs and general binding rules. We would suggest caution, as this list can become far too precautionary and prohibitive; and therefore what was intended to be an easy tool to assist small scale low carbon development does quite the opposite.

Question 18: What planning obligations or best practice guidance should accompany the award of PDR by local authorities for a proposed small scale low risk hydro scheme?

3.1.40 The following table summarises the comments and observations from consultees:

Table 3.18: Summary of Consultee Comments and Observations:

Local Planning Authorities	Other Consultees
A certificate of lawfulness will not include conditions or obligations – it is based on the details and whether they comply with the pdr criteria. Whilst I do not agree that Hydro schemes should be a form of permitted development, any Certificate of Lawfulness could include informatives/guidance notes regarding best practice and recommended installation times to avoid disruption to residents and biodiversity.	Care must be taken that an application for prior approval does not turn into a full planning application. Water has been used as a resource for power generation for centuries and small scale hydro is the method of the day. A significant impact on the viability of high head schemes is the permitted water take. In recent years the amount has been reduced. In mountainous areas the water courses tend to be very flashy and with frequent flood flows vastly in excess of the potential scheme usage. A review of the permitted extraction guidelines may be appropriate.
Hydro impacts are site specific, so definitely a prior notification process needs to be introduced similar to agricultural buildings.	If the scheme is under an agreed threshold (i.e. PD) then planning obligations should not be required. Certificates could include best practice advisory notes.
In practice such obligations and conditions are likely to be very similar to the conditions which would have been applied to a formal application for the same scheme so the benefits of a PDR approach are likely to be limited.	It is not typical for the owner of a solar PV system which has been installed under PDR to seek a Certificate of Lawfulness. Instead the standard of installation is regulated under the Micro Generation Certification Scheme (MCS) which was originally intended to include small hydro, wind and solar. The low take up on hydro meant that the Certification bodies could not profitably operate a hydro certification scheme within MCS so it defaulted to OFGEM. The intention of this initiative is to reduce both the burden and cost of bringing small schemes to fruition for both the regulatory bodies and the owner. If low risk hydro can be defined appropriately together with good practice guidelines / regulations then a similar but simplified certification process regulated by an appropriate body such as the Micro Hydro Association, or the BHA is a far better option. Continuing to use instruments such as Certificates of Lawfulness is the sledgehammer and the nut scenario,

Local Planning Authorities	Other Consultees
Attach guidance notes like construction method statement to follow and details of reinstatement / mitigation. But as referred to above there will be Enforcement challenges here. Attach accreditation list of qualified workers. You can't apply conditions or planning obligations to Certificates of Lawfulness.	A Certificate of Lawfulness is a good measure and a small fee of say ~£50.00 to cover administration of this work should be allowed. Currently the fees associated with permitting small scale hydro are disproportionate.
This is incorrect PD is PD. No obligations can be added at this stage.	NRW hydro guidelines are OK.
	It would be sensible to make PDR dependent on obtaining the legally necessary NRW licences and consents, and submitting that paperwork as part of the grant of certificate.
	Standard risk assessments and methodology statements.

3.2 Learning Outcomes

3.2.1 The majority of respondents (80%) supported the introduction of permitted development rights although the majority of planning authorities (4 of 7) were not supportive.

3.2.2 Some planning authorities, by way of explanation, cited concerns over ecological and flood risk issues, and identified that every site is unique in nature and a standard design cannot be applied.

3.2.3 Other stakeholders, as one would expect, were more supportive of PDR and several felt that the abstraction licencing system would provide sufficient controls over developments.

3.2.4 Marginally less than seventy-five per cent of respondents believed that the introduction of PDR would pave the way to more schemes, despite the recent changes in subsidy support. The majority of planning authorities (5 of 7) however did not agree, citing other developments costs as being a prohibitive factor outweighing planning costs.

3.2.5 Other stakeholders, including the developer network, conversely felt that planning requirements were a barrier to the realisation of more small scale schemes, whereby planning costs were disproportionate for such scale of schemes. It was recognised that some schemes are installed without permissions purely to avoid the costs of planning and licencing. One respondent explained that Welsh Government control over business rates would better enable schemes to be operated viably as they represented an unfair burden on the sector.

3.2.6 80% of respondents believed that PDR should apply to both domestic and non-domestic users, with 17% not responding. There appears to be a clear bias in support of uninhibited rights to both users.

3.2.7 There was no clear consensus on the capacity of scheme that should fall under PDR. Where recommended, anything from 5kW – 100kW was suggested. Several respondents felt that an ‘artificial’ ceiling on PDR would, like the Feed in Tariff, lead to in the installation of system sizes purely to increase financial benefit without enabling the best environmental benefits of the individual schemes to be realised. Additional responses explained that the application of a capacity threshold was an inappropriate approach. As explained by one respondent: “… *a development on a large river, with a penstock through a heavily grazed agricultural field may have the capacity for >50kW with little or no sensitivities, where as a 10kW development maybe through sensitive woodland with significant ecological value*.” Siting and flow take were identified as more important considerations in apportioning PDR than the installed capacity.

3.2.8 The majority of respondents did not agree, or did not state a reply, that new grid connection requirements with a scheme should be a determinant of PDR. Grid was not felt to be a governing planning or environmental factor.

3.2.9 A slight majority (56%) agreed that noise limits should be applied to small scale hydro, including 5 of 7 planning authorities. Proximity to residential properties was explained as the primary reason for this opinion. Other respondents did not think noise, at this scale, to be a problem and explained that suitably insulated buildings with good tailrace design should attenuate any concerns. Good practice guidance was cited on several occasions as helpful, with consideration of a minimum separation distance recommended.

3.2.10 The majority of the developer network supported the use of pre-cast concrete / pre-fabricated intakes as the preference for small scale schemes. However, there was no consensus on the nature and size of header tanks.

3.2.11 63% stated that either overground or underground pipelines should be permissible under PDR, dependent upon site conditions; this included one planning authority. However, of the remaining 37% none supported overground pipelines, particularly the local authorities. The nature of the site was cited as justification to allow the consideration of either option, many explaining that through woodland without amenity or visual protection there should be flexibility for overground pipelines. Only 10% of respondents believed the length of pipeline should be controlled, with 67% stated that there should be no control as allowing variable consideration of pipeline lengths was an important element of enabling the viability of hydro schemes.

3.2.12 33% of respondents, including 4 of 7 planning authorities, believed the character of powerhouse finish should be controlled, whilst half did not. Many agreed that the type of powerhouse would depend upon the context of the site; existing buildings to be used where possible was supported.

3.2.13 Half of respondents, including 5 of 7 planning authorities, agreed that there should be a minimum separation of the powerhouse from residential properties, whilst a third did not support an approach. However, of those supporting a minimum separation distance there was no consensus on distance, ranging from 20m up to 400m.

3.2.14 Nearly 75% of respondents supported controls on the design of the tailrace / outfall in order to control turbulence and protect fisheries. Only 14% of those expressing a preference did not support such controls, believing that the licence process would provide sufficient controls over such features. Several respondents cited the potential for good practice guidance to enable developers to design in suitable outfalls.

3.2.15 No clear consensus on including access tracks within PDR was expressed. The majority did not support the inclusion of tracks at all, including 6 of 7 planning authorities, whilst 43% supported only temporary tracks.

3.2.16 In respect of construction practices, the majority stated that the availability of good practice guidance would enable the sensitive deployment of small scale hydro; current guidelines from NRW (note that no specific guidelines were stated) and SEPA were cited as sufficient guidance for low risk construction works.

3.2.17 A third of respondents do not believe that PDR should apply to hydro development in protected areas, including 6 of 7 planning authorities; of the remaining 54% who supported PDR in protected areas, 16 respondents agreed that some locations, including SACs and SSSIs, should not be included. However, several respondents believe that PDR could, in the right circumstances, apply in protected areas such as National Parks and AONBs.

3.2.18 Recommendations for planning authorities on further simplifying the planning process for small scale hydro include running the licencing process 'side-by-side' with planning; creating local development order for hydro within certain river catchments and of a specific scale, including a spatial allocation process akin to the SSA guidance on large-scale wind. Some authorities believe the abstraction licencing process to be a better mechanism for controlling such developments.

3.2.19 Of the other stakeholders, many felt that the majority of hydro issues would be adequately controlled through the licencing process, and that as such these matters did not require addressing in planning. The burden of both planning and licencing was felt to be an onerous responsibility for realising new developments.

3.2.20 Whilst the majority of planning authorities were not supportive of PDR for small scale hydro, three authorities explained that, should such PDR be introduced, Certificates of Lawfulness would preclude the ability to apply to conditions to the control of developments, whilst one authority believed that a Prior Notification procedure would be an appropriate control. The authorities agreed in the whole that guidance notes and best practice guidance would be beneficial to any simplified planning process.

3.2.21 Other stakeholders were equivocal on the matter of Certificates of Lawfulness or Prior Notification, stating that if PDR were to be introduced to simplify the process there should not be additional administrative controls over such schemes. Again, a regular theme was the introduction of best practice guidance.

4. Defining Small Scale, Low Risk Hydro

4.1 What is Small Scale?

4.1.1 There are several relevant factors that may be deliberated upon in the definition of small-scale hydro. These include the following:

- up to 4kW based on NRW currently thinking on the definition of *very* small scale;
- up to 15kW based on the lower FiT banding for hydro (NB whilst FiT is due to cease in 2019 it still has some relevance in informing what might be defined as small scale);
- up to 25kW based upon the majority of consultee responses to this research study;
- up to 50kW based on Microgeneration Certification Scheme; or
- up to 100kW based on slightly higher FiT banding for hydro (NB whilst FiT is due to cease in 2019 it still has some relevance in informing what might be defined as small scale).

4.1.2 A common opinion garnered through the course of this research study is that the installed capacity or output of a scheme was irrelevant in defining those schemes that may benefit from PDR. Damaging risks and impacts could arise as much from 4kW schemes as from 100kW schemes; equally, larger schemes circa 100kW in scale, and sometimes larger, could be delivered with low risk or impact to the environment.

4.1.3 It could therefore be reasonable to consider a definition of 'small scale' based upon planning considerations, whereby a scheme located in a non-sensitive area (subject to conformity with pre-determined criteria and acquiescence to agreed construction methods, remediation and operational parameters set by NRW licences) could be defined as small scale up to the threshold of up to 500kW (0.5MW), at which an EIA requirement may be determined. However, our judgement is that this would increase the threshold to such an extent that there would not be adequate controls on some schemes that would pose a risk to the environment.

4.2 What is Low Risk?

4.2.1 Evidence from the site visits and consultation responses shows that good quality schemes of higher capacity i.e. up to 100kW can be installed and operated with low risk to the environment whilst, as explained above, the converse is also true.

4.2.2 The implication is that where the characteristics of the site are such and appropriate construction practices can sensitively deliver a scheme, environmental risk is often low.

4.2.3 Similarly, power output often has little relevance to the scale and hence risk of the development. Large scale hydro will of course entail larger components and a larger construction area, including longer penstock and access tracks, which are likely to have a greater attributable risk; for small scale hydro, however, a 1kW low head scheme that depends on a relatively high flow rate may have a significantly bigger intake structure, and hence greater risk, than a 100kW scheme running off a 200m head.

4.2.4 Categorising low risk, as such, is fraught with potential difficulties and a 'one size fits all' approach may not be appropriate in these circumstances.

5. Options on Permitted Development Rights for Small-Scale Hydro

5.1 Introduction

5.1.1 In light of the evidence and understanding that has emerged through the several strands of this research study we are able to present three potential options for easing the planning requirements for small scale hydro schemes. These options are described below. In addition, we include a brief analysis of the potential relevance of Prior Approvals and Certificates of Lawful Development and a discussion on the potential aspects of good practice guidance that could be made available to hydro stakeholders in order to ease, improve and reduce the burden of the planning process.

5.2 Option 1 – 'Do Nothing' with Good Practice Guidance

5.2.1 The evidence gathered has reinforced the understanding that every potential hydro site has unique locational characteristics which need addressing in the planning and/or the abstraction licencing process. A 'one size fits all' approach may therefore be inappropriate, and the introduction of secondary legislation for permitted development rights with either an upper capacity threshold or planning specifications may lead to uncontrolled development which creates greater risk to the environment.

5.2.2 Should this be considered the prudent approach, the planning process could however be simplified through the specification of typical validation documentation relevant to such schemes that would avoid duplication with the documentation required for regulation for NRW licencing.

5.3 Option 2 – Permitted Development Rights with an Upper Capacity

5.3.1 Where Welsh Government has certainty that the effects and risks of development can be adequately controlled, secondary legislation specifying an upper capacity threshold form small scale hydro in accordance with those categories addressed in paragraph 4.1.1 above.

5.3.2 The criteria to be applied to such rights would be specified in the legislation as with other permitted development rights for other renewable technologies, and may include matters not already covered by NRW licencing:

- The exclusion of such rights to defined sensitive areas, where considered appropriate;
- Finishes on intake structures and header tanks;
- Specifications and remediation of access tracks;
- Acceptability of overground pipelines in certain circumstances;
- Proximity of powerhouses to residential properties;
- External size and finish on powerhouses;
- Undergrounding of electricity cables to the point of connection.

5.3.3 The strength of this approach would enable the clear prescription of the capacity of allowable scheme under PDR, thereby avoiding misunderstanding and complexity in the comprehension of where rights are applicable.

5.3.4 The potential weakness of this approach would be the deregulation of schemes that, although small by definition, may well be high risk and damaging to the environment.

5.4 Option 3 – Permitted Development Rights Controlled by Planning Aspects

5.4.1 Under this approach, the definition of permitted rights would focus on key planning impacts, *perhaps unrelated to the NRW licencing process*. Such planning impacts would be predicated upon those principle impacts identified in Table 2.3 which include:

- Wider, non riparian ecology;
- Landscape and visual interests;
- Archaeology;
- Residential amenity.

5.4.2 It would be expected that such rights would not apply to certain ecologically sensitive areas (i.e. SACs, SSSIs, National Parks as Welsh Government may determine) and that in such areas planning permission would be a requirement of development.

5.4.3 Potential precautionary planning principles that would influence whether a proposed scheme is categorised under PDR are described in Table 5.4 below. The authors are grateful to several BHA stakeholders who gave input into the principles / criteria; additional information was drawn from the Water Framework Directive on quality standards for watercourses and riparian habitats.

Table 5.4: Precautionary Principles for Small Scale Hydro PDR:

Precautionary Principles	Actions / requirements
A small scale hydro proposal should not:	
Be located within a European or National protected area [denote whether to be SAC, SPA, SSSI, NNR]	• link to online mapping showing relevant protected areas OR local authority interactive mapping
Create unsightly or incongruous structures in areas or places of natural beauty or visibly near to residential properties	• seek to bury structures in areas or places of natural beauty • locate structures where they are less visible and outwith the principal visibility of residences • where structures are in visible locations, use building materials in keeping with the local vernacular / character
Risk significant harm to fish populations in the river system *NB. currently addressed under NRW*	• screen the entry of water at the abstraction point and screen the outflow to avoid access to turbine

licencing	• limit disturbance of water and bed of watercourse at outflow through controlled discharge • where fish are present in the watercourse provide a suitable, alternative, NRW approved fish passage on the weir • ensure the protection of any fish spawning habitat (gravel beds, weirpools) against construction damage and any adverse change in flows • ensure a sufficient hands-off flow at all times to sustain water flows across the main river bed in order to protect habitats and species
Increase the risk of flooding upstream or downstream of the scheme *NB. currently addressed under NRW licencing and FRAP*	• link to NRW flood risk mapping • demonstrate that the net effect of raising the level of the watercourse or impoundment, and of diverting water from existing flows, does not significantly increase the potential risk of flooding to surrounding land or property • demonstrate that the point of return of the abstracted water to the watercourse does not contribute to flooding downstream of the outfall
Cause harmful residential or amenity impacts through the direct or indirect effects of construction or through operational noise	• in locations close to residential properties, ensure that construction methods are such that the rights and entitlements of the residents are preserved • locate the powerhouse and outfall in locations sufficient to avoid harmful operational noise effects to residences • during construction in amenity areas ensure that public safety is not threatened by construction practices or exposed excavations
Cause physical or 'setting' harm to listed buildings or scheduled monuments	• research and consult upon any potential historic monuments located in close proximity to the scheme • design the scheme to avoid any potential harm to such features
Cause physical harm to any Category A or B archaeological features	• research and consult upon any archaeological features within the planning boundary • where such features are present, ensure the design of the scheme avoids physical harm to such features • undertake an archaeological watching brief

	during construction in locations near to such features
Damage or cause deterioration to any land-based ecological habitats or species protected by legislation or supported by biodiversity action plans	• conduct an extended phase 1 habitat survey to determine the presence of any protected habitats or species • prepare a construction method statement that governs the protection of such habitats or species where present across the site area
Affect the rights of other users of the watercourse[1] *NB. currently addressed under NRW licencing*	• research and consult with any other users of the watercourse, including farmers, fish farms, recreational users and water companies • ensure that the rights of such users are protected from the development

5.5 Outline Elements of PDR and Associated Limitations

5.5.1 Pursuant to the above considerations and the associated outcomes of the consultation and field research, following are recommendations and associated commentary on potential limitations that may be attached to permitted development rights for small-scale hydro schemes[2], if adopted. These recommendations pertain to both options 2 (PDR with upper capacity) and 3 (PDR controlled by planning aspects) described above.

[1] Questions were raised as to whether this is a 'planning issue'. Given that new hydro schemes may inhibit the rights of other users, we have concluded that that it is the purpose of the planning system to protect such rights at the development control level and should therefore be retained for consideration in proposing criteria pertinent to the recommendations on PDR.

[2] For the purposes of this report 'scheme' refers to the access track, intake structure, pipeline, tailrace and outfall structure, powerhouse, and associated grid requirements.

Table 5.5: Outline Limitations

Limitations (other legislative provision)	Commentary
A scheme is not permitted development if –	
a) NRW licences under the relevant provisions of the Water Resources Act 1991 have not been obtained b) any part of the scheme affects a Main River, or, if it affects an Ordinary Watercourse, a Flood Risk Activity Permit from the Local Authority has been refused c) any part of the scheme is sited within, or contiguous with, or hydrologically connected to, a European or nationally protected area for habitats and species, inclusive of Ramsar sites [Special Area for Conservation, Special Protection Area] and Sites of Special Scientific Interest or National Nature Reserves, or an Important Bird Area d) the scheme falls within Schedule 2 of the Town and Country Planning (EIA) Wales Regulations 2016 and has, through a screening opinion, been determined as EIA development	Whereby all other requirements being satisfied under other relevant legislation, whilst ensuring no damage to European and National nature conservation area and where the scheme is not of scale to trigger EIA, the developer / landowner can proceed with designing a scheme that accords to the criteria and limitations set out below. Question remains as to whether such rights would pertain to National Parks and AONBs. As noted by one of the stakeholders on the Task Group: "*The sensitivities of such landscapes, the public interest in their conservation, the variability of success/failure of installed HEP schemes to appropriately integrate with natural landscapes, means that there is high risk to allowing PDR for HEP within designated landscapes. Until there is better guidance and demonstration of installed good practice, PDR should not extend to designated landscapes.*" In this context it would be noted that National Parks and AONBs offer some of the most suitable locations and resources for small scale hydro in Wales.
Limitations (specific planning criteria)	**Commentary**
A scheme is not permitted development if –	
a) the powerhouse and/or outfall locations are less than 125 metres from nearby residential properties (with no interest in the scheme)	Preservation of noise amenity. Typically noise will tail off fairly rapidly from the noise source i.e. within 50 m, but a higher figure is here proposed to guarantee amenity protection. This could however be reduced to 50 / 75 / 100m dependent upon preference. NB that Part 6 of GPDO (agriculture) states that buildings for housing a hydro-turbine must be no less than 400m from residential properties.

	We believe this would be too severe a limitation for small scale hydro to be required to comply with and may prevent schemes coming forward that may otherwise be viable.
b) any part of the scheme would be installed within the curtilage of a listed building*	NB no buffer in relation to ‘setting’, which may be a consideration.
c) any part of the scheme would be installed on a site designated as a scheduled ancient monument**	NB no buffer in relation to ‘setting’, which may be a consideration.
d) any part of the scheme would be installed within a registered historic park and garden	NB no buffer in relation to ‘setting’, which may be a consideration.
e) the scheme would be likely to harm any land-based ecological habitats or species protected under the Conservation of Habitats and Species Regulations 2011 (as amended) and other primary or secondary nature conservation legislation	Necessity to ensure that, outside of designated nature conservation assets, there is still protection for species covered by legislation i.e. bats, badger, great crested newts. Ensuring protection of such species will ensure PDR for hydro is low risk. NRW licences pertain solely to in-river ecology and this leaves the wider ecology at risk from construction, such as tree removal or damage to badger setts. However, it is noted that this may necessitate a full ecological survey prior to commencement in order to establish whether harm may arise; this may be contrary to the principle of introducing PDR.
f) the scheme would include the creation of a new metalled or tarmac access track	Access tracks can often be one of the most damaging and visually scarring elements of new schemes; however preventing the necessity for permanent access tracks may be to restrictive. The authors are therefore unsure that this should be included but we believe that metalled / tarmacadam tracks should be prohibited; some comfort would come from allowing permanent / temporary tracks that are constructed from geotextile / crushed aggregate should be suitably low risk and should enable PDR hydro to proceed.

* b) and c) consider replacing with the following: physical or visual harm would be incurred to a listed building or scheduled ancient monument;

** another criterion for potential inclusion includes [nationally important archaeological remains are not preserved in situ]

Limitations (specific technical criteria)	Commentary
Subject also to the limitations above, a scheme is hereby permitted development where the following limitations are adhered to:	Pertaining to the specific characteristics / dimensions of schemes:
a) the intake structure is fully prefabricated with no requirement for concrete or grouting works, OR if of concrete or part-concrete construction, is located where the bed and banks of the watercourse comprise bedrock, and in all cases is fully compliant with the licence(s) granted by NRW ***	Intake designs will mostly be controlled through NRW licencing. However, these requirements will hopefully prevent pollution to watercourses.
b) any header tank(s) should be prefabricated and buried underground	Pollution control / avoid incongruous features. We do not advise maximum sizes as, at this scale, such tanks would not be large structures anyway and to impose artificial limit would be arbitrary and lacking rationale. Burying head tanks underground may give rise to excavations near to watercourses, which may be damaging in themselves if there is sediment run-off. However, unabated siting of overground header tanks may be unacceptable. Possibly therefore the text in b) could be augmented with *"… or where they cannot be buried due to site conditions must be housed in / screened by materials of the local vernacular."*
c) overground pipelines are black only and located in sheltered locations, such as unprotected woodland, and will be no from ground level of 300mm	Limit visual impact of pipelines but allowing over-ground option, which is often less costly. Have not included a maximum height above ground level as sometimes supports are required. May be useful to have a restriction on the type of pipe support - metal or timber.

d) pipelines are not open watercourse channels, such as leats	To avoid ecologically and visually damaging features; should a leat be preferred that then the landowner / developer can seek planning permission through the standard route.
e) pipelines do not exceed a diameter of more than [280] / [355] / [400]mm	Pipes are supplied in rolls at sizes up to 280mm, which avoid the need for welding of pipe sections and reduces the damage of conducting the pipes up the slope to the intake. Above 280mm, pipes come in sections, and for HDPE pipes are supplied at up to 355m, which is a fairly common size. 400mm would allow some flexibility for higher flow rates, if required.
f) pipelines do not exceed a length of 1500 metres	Deriving a figure for an appropriate length of pipeline, which is a fairly arbitrary exercise, has been challenging. Several consultees contested applying such a limitation. The authors have proposed a limit of 1500m as this should enable, at this scale, the vast majority of potentially qualifying sites to benefit from PDR without introducing too high a level of environmental risk. Where schemes require a pipeline of >1500m planning permission can still be secured through a standard TCPA route but with the necessity to demonstrate that environmental effects will be controlled.
g) the external footprint of the powerhouse does not exceed 30m^2 and does not exceed 4.2m in height from the floor level to the apex (not including any floor slab)	These are standard dimensions for schemes of this size; however it may be useful to correlate to any other PDR (e.g. agriculture, forestry) pertaining to single storey buildings in a non-urban setting. It is noted that heights of buildings under parts 6&7 of the GPDO are controlled by the prior approval process. The max height is 12m, unless within 3km of the perimeter of an aerodrome when it is reduced to 3m. However, 12m is unnecessary and felt to be too unrestrictive. The rationale for these dimensions is based on typical powerhouse sizes for schemes circa 100kW which do require this footprint for housing turbines / gantry / control units on medium and high head schemes.

	NRW notes "… *that there are many dwelling houses of about this size and construction of new dwellings is not permitted development anywhere, let alone in rural areas that may be particularly sensitive to the visual/amenity impact of new buildings. For example, without any restriction concerning potential impact on areas of high landscape or amenity value, this would allow potentially very visually intrusive buildings to be erected in National Parks or AONBs*."
h) the external finishes of the powerhouse and ancillary structures are in keeping with [*local landscape character*] [*natural materials*]	For the purpose of controlling visual effects.
i) the powerhouse is located outside of Flood Risk Zone 3 unless provision is made to ensure complete protection against floods i.e. raising the foundations to bring the floor level above the 100-year flood return level	To avoid exacerbation of flood risk. This could be extended to Flood Risk Zone 2 for a 1000 year event but this may be too restrictive.
j) the outfall structure should have a screen area no greater than $1m^2$ and avoids concrete works in or adjacent to the watercourse and is in keeping with local landscape character	The proposed area will be more than sufficient to cover the scales of schemes addressed in this research. The additional factors are to protect the watercourse from pollution and ensure it is visually finished appropriately.
k) any requirement for felling does not include trees in Ancient Semi Natural Woodland or those protected by Tree Preservation Orders and is supported by tree surveys to confirm the absence of protected species prior to commencement of the scheme construction	The design of hydro schemes can often avoid tree removal (i.e. pipeline re-routing), which is always to be preferred. If trees are to be felled, some protection for protected residents should be ensured.
l) watercourse crossing(s) for either pipework or temporary access tracks or cables have been granted a flood risk activity permit	To ensure elements of the development do not cause flood risk elsewhere.
m) construction practices are compliant with current NRW regulatory guidance notes (RGNs)	NRW source: http://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

Hydropower schemes that are no longer needed or are incapable of generation must be removed by following a method statement agreed with the appropriate regulators prior to decommissioning. *** fish pass criteria are not included as these are adequately controlled by NRW licence provisions.	NRW notes that this item is not one of the limitations that would define the scope of the PDRs and a question arises as to how this could be written into the legislation.

5.6 Other Planning Considerations

EIA Regulations

5.6.1 Special rules apply to permitted development rights where they relate to development specified in Schedules 1 and 2 of the *Town and Country Planning (Environmental Impact Assessment) (Wales) Regulations 2016*. Permitted development would only arise where the local planning authority or other statutory regulator has issued a screening opinion determining that the proposed development is not EIA development.

Avoiding Duplication of Regulatory Requirements

5.6.2 Welsh Government may look to consider whether, in the event that PDR are not applied to small scale hydro, the planning requirements for such developments can be simplified to avoid duplication with the requirements of the abstraction licencing process.

5.6.3 Planning requirements might be simplified to include matters outwith the control of licencing, including the wider, non riparian ecology; landscape and visual matters; archaeology; and residential amenity.

5.6.4 The PDR criteria in Table 5.5 above are based upon relevant planning issues only and do not seek to replicate the matters covered by NRW licencing.

Prior Approval

5.6.5 One consideration may be to utilise the Prior Notification process to screen potential schemes and ensure they accord with set requirements prior to agreement that PDR would apply.

5.6.6 However, prior approval determines that only specified elements of the proposed development are acceptable before work can proceed and does not, therefore, necessarily pertain to all elements of the proposed development, which themselves may be risky or harmful.

5.6.7 Further, responses to requests for prior approval are required within 21 days of the request; where, for whatever reason, a local planning authority is unable to respond to request for prior approval within this period the applicant is entitled to proceed with the development. Prior approval is not therefore an entirely suitable means of controlling development that may well be harmful to the environment.

5.6.8 Prior approval also requires an application process which may not be deemed as simplifying the planning process and does not therefore substantially reduce the burden on the applicant.

5.7 Links to Emerging Changes to the Licencing Process

5.7.1 NRW attended the project inception meeting with Welsh Government and explained their approach to fulfilling the recommendations of the Hydropower Task & Finish Group (December 2016), particularly no. 3 on investigating "… *ways of reducing the complexity of licencing for low risk hydropower schemes*". A presentation paper *Low risk hydropower* set out an expectation of what 'low risk' hydro is likely to be defined as, whereby they would be outside of designated sites for nature conservation, maintain appropriate environmental and amenity flows within the depleted reach, cause minimal change to the natural geomorphological (including processes and sediment transport) and the flow characteristics of river / stream systems, and maintain the movement of fish and riverine ecosystem connectivity without spatial impact. Design is identified as pivotal to devising a solution in de-risking hydropower schemes.

5.7.2 However, at the time of writing no details of proposed changes to the licencing process were made available to the research consultancy and accordingly potential links between the simplification of planning requirements and the licencing process have not been possible.

5.8 Good Practice Guidance

5.8.1 As referenced previously there has been a strong emphasis on the publication of good practice guidance from all stakeholders in order to guide low risk hydro development. Such guidance should not necessarily duplicate guidance already available through NRW and SEPA[3] but perhaps may augment that already published. Links to, or formulation of, a Good Practice Guide for small scale hydro development would be a beneficial exercise to augment any potential simplified planning process for such developments.

[3] See https://www.sepa.org.uk/regulations/water/hydropower/

APPENDIX 1: FIELD RESEARCH NOTES AND PHOTOGRAPHIC EVIDENCE

1 WG PDR Small Scale Hydro Field Research, Summer 2017

1.1 Introduction & Overview

This technical report summarises site visits to small scale hydro schemes carried out by Matt Palmer (Senior Hydro Engineer, Dulas Ltd.) during July and August 2017 as part of the field research into existing hydro schemes in Wales. The site visits covered fourteen medium and high head schemes ranging from less than 1kW up to 100kW (generally referred to as pico- and micro-hydro[1]), ranging from domestic 'DIY' schemes through farm-scale up to small commercial schemes. Most were operational, but three were under construction. Low head schemes, such as Archimedes Screw installations or water mill refurbishments, are not covered by this work package. Additional reference photos from sites previously visited have been included where further illustration is required. All photos are copyright Dulas Ltd. unless noted otherwise.

Some of the sites have been visited and photographed with the consent of the landowner on the condition that they remain anonymous. In the interests of impartiality, no sites are referred to by name or owner, but rather are described by their parameters – specifically power output (kW), design flow rate (l/s), gross head (m), and regional location.

Hydro is different from other renewable technologies in that every site is different, depending not only on the available resource (head, flow, grid capacity, etc.) or nominal power output, but also on the topography, ecology, existing structures, access, etc. A given site can present many different potential layout options (intake location(s), pipe length / route, powerhouse location, etc.) and the final layout chosen will depend on a combination of technical, financial and consenting factors. The *scale* and *risk* of each development therefore needs to be understood in the context of the various scheme components, rather than simply as a 'hydro scheme'.

The research, and indeed prior knowledge of such schemes, demonstrates that the main issue with trying to identify a 'low risk' hydro scheme in terms of PDR is that power output has little relevance to the *scale* of the development; for example a 1kW low head scheme that depends on a relatively high flow rate may have a significantly bigger intake structure than a 100kW scheme running off a 200m head. This factor has played an integral part in shaping the research and in recommending the potential options for 'softening' the planning requirements for new hydro developments.

It should also be noted that the somewhat artificial Feed-in Tariff (FiT) power bands have resulted in some schemes being built to match the resource, but then registered and operated at a lower power output to attract higher rates, with the intention that, when the 20 year FiT expires and income is solely from export, they will have the generator replaced with a larger one and the remaining infrastructure will already be in place to increase generation. (This generally applies to schemes registered as "15kW" and "100kW".)

In order to allow better comparison of the design options and issues for each scheme element, the technical site assessment has been split into the following sections:

- Access Tracks
- Intakes & Header Tanks
- Pipelines & Leats (open channels)
- Powerhouses
- Outfalls
- Grid connections

Each section consists of a brief overview, relevant photographs from sites visited (with additional photographs from other schemes if required) and a summary of the main issues relating to PDR. This is then followed by a final section covering implementation, particularly the potential issues with construction practices, as well as some notes on operational issues and decommissioning. No overall summary completes this sub-report, which is instead covered by the principal research study report.

[1] There is no formal classification of hydro scheme size; schemes with a power output of a few kW or less are generally referred to as 'pico-hydro' whilst those from a few kW up to a few hundred kW are 'micro-hydro'. 'Mini', 'small', 'medium' and 'large' then often refer to <1MW, <10MW, <100MW and >100MW respectively.

1.2 Summary of Sites Visited

The following table lists the main scheme parameters (where known) of the thirteen schemes visited specifically during the field work. Photographs and information from previous Dulas site visits to other schemes have been included in order to further illustrate various points where this is deemed to be useful. Some of these additional sites are in England and Scotland, however themes with design and construction remain relevant to this report.

Rated Power (kW)	Design Flow (l/s)	Gross Head (m)	Pipe Diameter (mm)	Region
100	85	169	280	Snowdonia
100	127	149	355	Snowdonia *
100	~250	~60	-	Snowdonia
88	~80	~160	-	Snowdonia
35	20	250	180	Mid-Wales
15	~45	~50	-	Snowdonia
14	36	59	180	Snowdonia *
10	10	37	250	Snowdonia
6	18	45	180	Brecon Beacons
7.5	6	170	-	Brecon Beacons
3	30	18	180	Brecon Beacons
1.4	9	26	-	Mid-Wales *
0.75	8	53	-	Brecon Beacons

We express our thanks to the National Trust for agreement to use photographs of some of their hydro schemes (as denoted under the images).

* Denotes site under construction.

2 Technical Site Assessments

2.1 Access Tracks

Hydro scheme developers will usually try to make use of existing tracks, whether farm tracks, forestry harvesting tracks or other access routes where available. This not only reduces construction cost, but also reduces the potential impact of new track works, whether permanent or temporary. It should be noted that the rules governing forestry and agricultural works are far less stringent than those for hydro, and consequently existing tracks are used whenever possible. For smaller schemes, only pedestrian access may be required, and, for others, vehicle access may only need to be temporary (i.e. for construction) or the track width may be reduced post-construction.

The three pairs of photographs below show ‘before’ and ‘after’ views of the sensitive upgrade of an existing but disused access track. This created permanent 4x4 vehicle access to the powerhouse which is an operational preference for most schemes.

Before… After….






[100kW, 160l/s, 93m, Pembrokeshire]

The photo below shows an existing forestry track where the pipeline has been laid under the lower track and the upper track has been used for plant access.


[35kW, 20l/s, 250m, mid-Wales]

The photo below shows a permanent powerhouse access track created through an area of commercial forestry clearfell. The 2m high white posts on the left are pipeline marker posts as required by NRW for buried services on their forestry estate.


[35kW, 20l/s, 250m, mid-Wales]

2.1.1 *Summary – Access*

Issues relevant to PDR include:

- Use of existing tracks will reduce the impact of the development in almost every case;
- The impact of a new track depends primarily on location – commercial forestry (particularly clearfell) is unlikely to create significant issues, whereas a new track across upland pasture / moorland / broadleaf woodland could potentially have both ecological and visual impacts;
- Where new tracks are required, detailed consideration of siting and working with the topography to avoid excessive scarring and cut/fill is suggested;
- Track drainage needs to be well designed to prevent wash-out and sediment runoff, particularly if close to a watercourse;
- Bridges or culverts may be required, and these need to be of suitable design / quality;
- Visual impact needs to be considered in both a local and overall landscape context.

2.2 Intakes

Intakes generally fall into the following categories:

- Coanda screen;
- Perforated sheet screen;
- Drop-bar screen;
- Side intake (submerged screen), sometimes with an automatic screen cleaner;
- Submerged ‘strainer’ on the end of a pipe.

With the exception of some strainer intakes, concrete is generally required for installation. This may be limited to a base slab and main weir wall (although sometimes this can be pre-fabricated) however there may be a requirement for a concrete screen sump, intake chamber and /or wing walls, and also boulders set in concrete to provide downstream scour protection. Sometimes the screen is fixed to a prefabricated steel sump. In some cases a formal or semi-formal fish pass may be required, which can increase the scale of the structure significantly.

Depending on the location, the exposed concrete may need to be covered with stone facing or timber (oak) cladding to improve the visual integration into the environment.

It is important to note that the scale of an intake is determined by the flow rate and type of construction, rather than the scheme power output.

Note – issues relating to intake functionality (compensation flow provision, fish protection, screen capacity, etc.) are not covered by this report, as their regulation is covered by NRW's licencing rather than planning permission.

2.2.1 *Coanda Screen Intakes*

Coanda screens are used for the majority of commercial small hydro schemes in the UK. Most installations in Wales (including the two larger installations shown below) use 700mm high screens with 1mm spacing and a capacity of 70l/s per metre width, or 400mm high screens with half the capacity. Using a 2mm screen spacing will generally double the capacity.

The photos below show two large commercial hydro scheme intakes in Snowdonia – the first incorporates a 6m wide screen, the second is 12m wide.


[600kW, 450l/s, 190m, Snowdonia]


[500kW, 800l/s, 100m, Snowdonia]

The 100kW medium head scheme below incorporates a 400mm high Coanda screen. Note that a significant part of the concrete works consists of a 'pool & traverse' fish pass.


[100kW, 250l/s, 55m, mid-Wales]

The intake below uses a 4m wide, 400mm high, 2mm spaced Coanda screen to abstract 250l/s. The screens are installed at the top of a natural waterfall that had historically been modified to provide water for mine workings.

[100kW, ~250l/s, ~60m, Snowdonia]

The intake shown below is a recent (2016) installation with a Coanda screen fitted to a concrete chamber. Timber handrails have been installed for public safety around the top of the chamber, however timber decays over time and can become unsafe – steel 'Kee-clamp' type railings are therefore safer and more practical but appear less 'natural'. The second photo shows a build-up of sediment in the pool formed by the weir above. In many cases, after a few spate flows the weir pool fills with material and then subsequent bed load passes over the weir unhindered, thus having minimal impact on the geomorphology.

[88kW, ~80l/s, ~160m, Snowdonia]

The following scheme was one of the first Coanda intakes in the UK, installed in the mid-1990s.

[4kW, 36l/s, 23m, mid-Wales]

The intake below has been reinstated with good quality stone facing, but there is only limited provision for safe access; as can be seen from the photo showing the screens being brushed down, the operator is required to stand on a wet stone slab with a drop to rocks below.




[100kW, 85l/s, 169m, Snowdonia]

The 100kW scheme shown below used a prefabricated concrete weir wall, which reduced the need for major in-river concrete works. There was still a requirement for grout around the prefabricated weir sections and for the stone facing to be mortared in place – it can also be seen that the weir did not quite seal completely when first inundated. The screen is mounted on a prefabricated sump, and the additional chambers are also prefabricated (the purpose of the third chamber is not known). Note that there is no provision for safe access for maintenance.



[Continued below]


[100kW, 92l/s, 145m, Cumbria, photos courtesy of the National Trust]

The photos below are of a relatively small intake (20l/s) showing the weir before and after the screen (with prefabricated steel sump) was installed. The PE pipe has been protected using twin-wall pipe where it runs in the stream bed.




[35kW, 20l/s, 250m, mid-Wales]

The photos below show a Coanda intake in a location with full public access. The intake presents a significant hazard for children (or adults) who may try to cross the weir, slip on the curved steel screen plate, and fall around 1.5m onto the rocks below. The warning sign shows that a hazard has been identified, but signage alone is not generally considered adequate by the HSE. As with some of the other intakes shown, there is also no provision for operator safety for inspection or maintenance.


[25kW, 79l/s, 45m, Brecon Beacons

The photos below show a domestic scheme intake, installed in 2001. The Coanda screen fits onto a prefabricated stainless steel sump unit (as shown in the photo on the left), and this is fixed to a natural bedrock waterfall before rocks are mortared around it to prevent scour. The middle photo shows the diversion pipe and additional length of guttering used to keep the working area dry.



[0.8kW, 7l/s, 28m, mid-Wales]

Below is a similar capacity domestic hydro scheme intake consisting of a concrete weir structure rather than a prefabricated sump. The quality of the concrete work is poor and the scale of the structure significant compared to the size of scheme.


[0.6kW, 7l/s, 22m, mid-Wales]

The photo below shows the construction of a similar capacity intake for an off-grid hydro scheme. Again the quality of the work is poor, although reinstatement may have since tidied things up.

[6kW, 12l/s, 84m, Cumbria]

2.2.2 *Perforated Sheet Intakes*

Perforated sheet is a low cost alternative to Coanda screen, as it can be bought off-the-shelf with various hole sizes (typically 2~10mm) and fitted to a prefabricated stainless steel sump. A larger screen area is generally required than for a Coanda screen, but there is more flexibility with screen angle.

The photos below show a perforated sheet intake for a 75kW hydro scheme, which is a relatively large structure.

[75kW, flow and head not known, Snowdonia]

A prefabricated screen intake for a domestic scheme is shown below. The concrete sump chamber shown during construction has then been sensitively hidden with stonework and boulders, and over a couple of years the moss has covered it to the extent that it now blends into the local environment.

[3kW, 30l/s, 18m, Brecon Beacons, historical photo courtesy of the site owner]

The following photos show a similar perforated sheet intake for a small scheme, again fixed to a concrete sump but without any stone facing.

[15kW, ~45l/s, ~50m, Snowdonia]

A more common perforated sheet intake arrangement is shown below, using a simple concrete weir with a prefabricated steel sump unit incorporating the screen and pipe outlet. Often the pipe is run along the bed of the stream for a short distance until it can exit onto the bank. The pipe coming in to the top of the sump is bringing water from a secondary intake. The aesthetics are not particularly sensitive to the location within Snowdonia National Park.



[10kW, 39l/s, 37m, Snowdonia]

The photos below show a domestic scheme intake, with similar perforated screen / sump on a concrete weir. The weir itself is a relatively large structure, and the pool formed upstream has filled with sediment.


[6kW, 18l/s, ~50m, Brecon Beacons]

2.2.3 *Drop-bar Screen*

Traditional ‘Tyrolean’ or ‘drop-bar’ intakes use simple bar screens often set at about 10°. They are still sometimes used for medium-low head sites where a high abstraction is required, but generally require regular manual cleaning, particularly in autumn.

[60kW, 650l/s, 33m, Snowdonia]

[50l/s auxiliary intake, Scotland]

2.2.4 *Side Intake*

This scheme was a refurbishment of an old medium-low head scheme, with a full width weir directing water into a side intake collection chamber. The screens need manual cleaning, which can be several times a day in the autumn.

[30kW, ~150l/s, ~30m, Scottish Borders]

2.2.5 *Submerged Strainer*

These photos show a coffin-shaped ‘strainer’ made from perforated sheet steel, fixed to the bedrock in an existing pool with four threaded bars, but set above the bed of the stream to allow sediment to pass underneath. No concrete was required. The pipeline is an historical water supply pipe, so the strainer was fitted to the end and no new pipeline works were required. The final photo shows the strainer fully submerged during medium-high flows. This is an almost zero-impact solution, but unfortunately is not possible or practical in a lot of cases.


[1.4kW, 9l/s, 26m, mid-Wales]

2.2.6 *Miscellaneous*

This is an intake for a spring-fed domestic hydro scheme, using a simple mesh screen and a cattle-trough.

[0.75kW, 8l/s, 53m, Brecon Beacons]

2.2.7 *Intake Ancillaries*

In addition to the intake structure itself, there may also be pipeline vent pipes and signal cable junction boxes as shown below.


2.2.8 *Reinstatement & scour protection*

Stone facing can be used to reduce visual impact, however, it is costly and requires additional concrete foundations to provide a shelf to build up from. This can be complex if wing walls, sump, fish pass and other areas are to be covered rather than just simple flat surfaces, as can be seen from the photo below.

[100kW, 160l/s, 93m, Pembrokeshire]

In addition, the force of water within the river can erode stone facing as can be seen in the photo below. In some cases a combination of stone-faced wing walls and plain concrete in-river structures is used to mitigate this.

[100kW, flow & head not known, Snowdonia]

For watercourses where the bed and banks consist of bedrock, there is little risk of scouring as water flows over the intake structure. Concrete can be cast directly onto the rock, and keyed or dowelled to ensure stability. If there is no (or little) bedrock present, the wingwalls and / or downstream toe of the intake need to be protected from the scouring effect of high flows so that the bed / banks are not eroded and the structure does not become undercut. This is usually achieved with boulders set in concrete, ideally with the amount of visible concrete minimised – if done well, this can significantly reduce the visual impact of the concrete works. It should be noted that if the ground is made up of gravel or shale, significant scour protection may be required.

[500kW, 100l/s, 230m, Scotland (multiple intakes)]

Upstream of a weir, large placed boulders (without concrete) can be used for bank protection as the energy in the water is generally lower. The photo below shows bank reinforcement upstream of an intake, to prevent flood water bypassing the structure. Gabion baskets are sometimes used, although these can potentially trap fish so are generally not acceptable within the wetted areas of the watercourse.


[100kW, 250l/s, 55m, mid-Wales]

2.2.9 *Header Tanks*

Where an intake chamber is impractical (or too expensive) to build in-river, a header tank situated downstream of the intake creates a collection chamber where air can escape and provides a 'control volume' for turbine operation. In addition it may enable pig launching (insertion of a foam swab for pipe cleaning). Header tanks allow for reduced in-river works and therefore should be seen as a method of reducing construction risk, although they are not always required. Usually they are buried.

The following photos show a prefabricated steel header tank before and after burial.


Fully buried header tank (construction unknown) for a 100kW scheme:


Overground prefabricated tanks for domestic schemes – GRP and galvanised steel:

[15kW, ~45l/s, ~50m, Snowdonia]

[0.75kW, 8l/s, 53m, Brecon Beacons]

A concrete header tank during construction (prior to burial and reinstatement):

[250kW, 188l/s, 186m, Cumbria. Photo courtesy of the National Trust]

Another concrete header tank, this time stone faced and also acting as a spill-chamber during high flows:

[100kW, ~750l/s, ~20m, Snowdonia. Photos courtesy of Will Handford]

2.2.10 *Summary – Intakes & Header Tanks*

Issues relevant to PDR include:

- There are numerous types of 'standard' intake; however each 'standard' intake needs to be individually designed to meet site-specific requirements;
- Functional design must meet NRW requirements;
- The *scale* of an intake is determined by the flow rate and type of construction, rather than the scheme power output;
- With the exception of certain strainer-type arrangements, all intakes rely on concrete to a greater or lesser extent, which creates a pollution risk during construction;
- Prefabricated concrete weirs and / or prefabricated steel sumps can be used in some cases to reduce the extent of in-river works and minimise the amount of concrete mixed and poured on site;
- Intakes built in areas with bedrock require significantly smaller structures, as only limited scour protection is required;
- Visual impact, such as large areas of exposed concrete, can be mitigated with stone facing, but this adds complexity and cost, and may not be suitable for watercourses subject to high flood flows;
- Health and safety is often neglected from intake design, whether public protection or the provision of safe access for maintenance – this is particularly true for domestic schemes, where budgets are tight and the risk is borne by the developer themselves; however it is also often true for commercial schemes;
- In some cases, safety can be compromised by planning requirements for minimising visual impact (wooden handrails, no permanent access, etc.);
- Intake ancillaries need to be considered in addition to the structure itself;
- Use of header tanks can reduce in-river works and therefore reduce construction risk (assuming they are installed sufficiently far away from the watercourse);
- A buried header tank will result in minimal visual impact.

2.3 Pipelines

By far the most common pipeline material is polyethylene (PE) which can be welded together to form a continuous string. At higher pressures (generally above 16bar) ductile iron pipes are used, but these require concrete thrust blocks to restrain any bends.

In general, pipelines can be fully buried, part buried, or surface laid – or a combination of these depending on the terrain. Full burial is usually in a trench of the order of a metre deep, and protects the pipe from freezing and mechanical damage (although PE can generally cope with freezing). Surface laying has the least environmental impact, but can be visually intrusive; in Snowdonia it has been allowed (to date) through forestry and quarry sites, but not across open countryside. Part-buried pipes are usually laid in a shallow trench, or with the trench depth varying depending on the terrain. The excavation may be done by hand through areas inaccessible to plant, or in woodland where damage to tree roots can be avoided. Excavated material can then be used to partly cover the pipe, and in some cases hessian is wrapped around it – in both cases vegetation often quickly obscures the pipeline.
The diameter of the pipe is determined by the flow rate and overall length, and is chosen to balance the material cost with the head lost as friction (essentially capital cost vs. generation revenue). As with intake size, pipe diameter is not directly related to the power output. Smaller diameter PE pipe sections can be carried by one or two people, and by using electro-fusion couplers some pipelines can be installed completely by hand without any need for plant.

2.3.1 *Buried Pipelines*

The following photos show pipelines buried in the verge of a track, under an existing track through broadleaf woodland, down a steep slope through scrub, and across and area of clearfell. The marker posts are 2m high and are an NRW requirement for pipelines installed on their estate.

Pipe across open hillside – before… … and after reinstatement:

[35kW, 20l/s, 250m, mid-Wales]

Buried pipeline crossing a road and cutting through a wall (prior to reinstatement):


Pipeline buried under a track, both during construction and after reinstatement:


Pipelines buried across agricultural land – for low gradient pasture a buried pipe usually becomes invisible after one growing season, as shown in the third photo.


For steeper improved pasture with shallow soils, good quality reinstatement is required with separation of top soil during excavation – if done well then the pipe route will quickly merge into the surroundings, as can be seen in the photo below.

2.3.2 *Part-Buried Pipelines*

The pipeline below is being installed in a hand-dug shallow trench to avoid tree roots, with reinstatement made to look like an old wall:

A Ø180mm PE pipe for a domestic scheme, surface laid but then part-covered:

2.3.3 Overground Pipelines

Overground Ø280mm PE pipe installed through steep commercial forestry, requiring brackets fixed to bedrock and scaffolding bar supports over gullies, etc.






[100kW, 85l/s, 169m, Snowdonia]

Another overground pipe, this time Ø355mm laid without restraints through ancient broadleaf woodland:



[100kW, 127l/s 149m, Snowdonia]

The following Ø180mm pipe contours along the stream valley supported with wooded posts. In some places it is completely hidden with vegetation.




[6kW, 18l/s, ~50m, Brecon Beacons]

Another Ø180mm pipe with the upper section exposed, and the lower section covered with brash, which hides it completely:


[3kW, 30l/s, 18m, Brecon Beacons]

A Ø160mm overground pipeline hidden by natural regrowth after one season.


[18kW, 22l/s, 115m, Snowdonia]

Domestic Ø100mm overground pipeline, installed by hand.



[0.8kW, 7l/s, 28m, mid-Wales]

The SNPA's own scheme at Tan y Bwlch utilises a (somewhat controversial) overground pipe through broadleaf woodland supported on steel brackets. [No photographs available.]

2.3.4 *In-river Pipelines*

In some cases a short section of pipe is used to exit from the river to the bank without introducing high points.


2.3.5 *Pipe Bridges*

These can range from a formal pipe bridge using ductile iron and stone-faced concrete abutments at each end, to a simple overground pipe spanning a small stream (this pipe will later be supported using steel beams).

In some cases, the pipe will be buried under the bed of a watercourse. This requires careful construction management and must incorporate mitigation to prevent water running down the pipe trench.

2.3.6 *Pipeline Ancillaries*

Pipelines may include breather valves at high points, scour valves at low points, and sometimes isolation valves such as the one shown below. Usually these are buried in a chamber and only an access hatch is visible.

[10kW, 39l/s, 37m, Snowdonia]

For buried or part-buried pipes, the pipe trench can also act as a drain for the surrounding ground, and over time water can run through the backfilled material and scour it out. This can be mitigated by the installation of ‘water stops’ which consist of an impermeable bung around the pipe that blocks the trench, combined with a land drain that directs water to a suitable discharge point. These are standard on larger commercial schemes often not for smaller schemes.

2.3.7 Leats

Leats (open channels) are most often used at old mill sites (i.e. low head schemes), but they were also historically used to transfer water around a hillside to the start of a pressure pipeline. Sometimes sections are piped or run through slate lined channels. Modern schemes sometimes lay pipes within disused leats, as they essentially form a pre-prepared trench with a constant gradient.

The photographs below are from a historical scheme in North Wales that is currently being refurbished under the Feed-in Tariff. Due to its age and established nature, it is understood that this leat was classed as a 'watercourse' by NRW rather than as hydro infrastructure.




In general, leats are not commonly used in new hydro schemes, although in some cases they may be used to divert water from smaller neighbouring watercourses. Planning issues will be similar to those for upland drainage ditches, for example dewatering of wet flushes, drying out of boggy habitats, accelerated run-off, etc.

2.3.8 Summary – Pipelines & Leats

Issues relevant to PDR include:

- In general, overground pipelines are ecologically better (less disruption and reduced risk of root damage) and have lower construction risk, but have higher visual impact;
- Buried pipelines can become essentially invisible if reinstated well;
- Part-buried pipes can be a good compromise;
- A single pipeline can consist of overground, underground and part-buried sections;
- Pipeline ancillaries need to be considered in addition to the pipeline itself;
- Leats are generally not used for new schemes, but if used they introduce issues similar to those for upland drainage ditches.

2.4 Powerhouses

The powerhouse needs to protect the turbine, generator and control system (if relevant) from the elements. The size of structure required depends on the dimensions of this 'electro-mechanical' equipment, also taking into account ancillary items such as isolation valves, metering, ventilation, etc. As with the other scheme elements, the powerhouse size is only nominally related to the power output. Even flow rate, which often determines the physical size of the turbine and associated pipework cannot be relied upon as different *types* of turbine can have very different footprints, as can similar turbines that have different numbers of jets.

2.4.1 Existing Buildings

The photo below shows a typical 1940~50s powerhouse, recently refurbished with a new turbine.

[30kW, ~150l/s, ~30m, Scottish Borders]

The domestic off-grid turbine installation shown below is set in the floor of an existing barn.

[2x 0.8kW, 20l/s, 18m, Snowdonia]

2.4.2 Stone Faced

Traditional stone and slate construction is sometimes specified within National Park areas in order to conform to the standard building vernacular in the area, as can be seen below.

[75kW, flow and head not known, Snowdonia]

Shown below is a less traditional stone-faced powerhouse, part-buried with a turf roof.


[100kW, 110l/s, 150m, Snowdonia]

2.4.3 *Timber Clad*

Timber cladding is by far the most common external material for hydro powerhouses. Larger buildings are blockwork (similar in scale to a garage), whereas smaller ones may have a simple timber frame. The roof will be slate (generally only if specified by planning), profile sheet, or turf (green roof).

A relatively large timber clad, slate roofed powerhouse for a low head scheme is shown below:


[100kW, ~750l/s, ~20m, Snowdonia. Photos courtesy of Will Handford]

The preferred timber is larch, as it can remain untreated and then weathers over a few years from orange to silver grey. This can be seen in the photographs below, which were taken a year or so apart. The roof in this case is profile sheet, as used in standard agricultural buildings, and a vertical lap has been used for the cladding.


[100kW, 85l/s, 169m, Snowdonia]

Another example of a standard profile sheet, timber clad powerhouse:


[100kW, 110l/s, 134m, Snowdonia]

The powerhouse below is shown pre-construction, nearing completion, and as-commissioned. The extra height to the building was necessary to raise the floor level in order to mitigate flood risk. A horizontal lap has been used in this case, with a single pitch green roof.




[100kW, 160l/s, 93m, Pembrokeshire]

A smaller powerhouse built with the same construction method is shown below. Note the ancillary details such as the broadband satellite dish and external concrete anchor block. The black pipe is understood to be a temporary jet installed to demonstrate the water pressure for an open day.




[35kW, 20l/s, 250m, mid-Wales]

The powerhouse shown below has an external 'pigging' chamber to allow for pipe cleaning.


[100kW, 250l/s, 55m, mid-Wales]

Another example of a green roof, this time ridged rather than single-pitched to keep the wall plate heights low.



[88kW, ~80l/s, ~160m, Snowdonia]

The following is at the smaller end of blockwork powerhouses, with single-pitch profile sheet roof and approximately 3x4m footprint.


[14kW, 36l/s, 59m, Snowdonia]

The following powerhouses are all sub-10kW, and can essentially be considered as ‘sheds’.




This very basic domestic scheme powerhouse is around 20 years old and is circa 2.5m square:


[4kW, 36l/s, 23m, mid-Wales]

2.4.4 *Buried Powerhouse*

Some schemes use a buried powerhouse. The one shown below is under construction and will be stone faced at the front with the sides and roof back-filled to match the slope.


[100kW, 127l/s 149m, Snowdonia]

A larger part-buried stone-faced commercial scheme powerhouse is shown below.


[275kW, 600l/s, 72m, mid-Wales]

2.4.5 *Pico-Hydro*

For the smaller pico-hydro schemes a powerhouse may in fact not be required, as shown below.



2.4.6 Summary – Powerhouses

Issues relevant to PDR include:

- Power output is not an absolute indicator of powerhouse size;
- Pico-hydro turbines may not need a 'powerhouse' at all, or can be contained within existing buildings;
- Typical powerhouses consist of a concrete base slab that acts as a foundation for both the electro-mechanical equipment and the superstructure. This only introduces significant construction risk if in close proximity to the watercourse;
- The superstructure is usually either blockwork (a 'garage') or timber (a 'shed'), with timber generally only used for the smaller schemes;
- Blockwork can be stone or timber clad, but timber is cheaper and more common;
- Roofs are usually profile sheet or turf, with slate only used if specified by the LPA;
- Consideration needs to be given to ancillary items such as pigging chambers, parking / turning areas, local site drainage, satellite communication dishes, etc.

2.5 Outfalls

After passing through the turbine and into a sump below the powerhouse, water is usually returned to the watercourse via a buried ‘tailrace’ pipe, which discharges via an ‘outfall’. As with intakes, NRW have specific functional requirements relating to outfalls, such as screen spacing, energy dissipation, minimal attraction to migrating fish, etc.

One issue with outfalls that is often overlooked is that significant turbine noise can be transmitted down the tailrace pipe, and this can cause problems if the outfall points towards dwellings or amenity users. The simplest solution is to submerge the outlet (as can be seen in some of the examples below).

The photographs below show an outfall with a concrete headwall, aligned to discharge at 45° to the river flow. The screen is hinged to release pressure if it blocks from inside for any reason, and stoplogs can be inserted to submerge the pipe exit if noise becomes an issue. However, it is a relatively large concrete structure.


[100kW, 160l/s, 93m, Pembrokeshire]

Similar design principles but at a smaller scale are shown in the photo below.


[88kW, ~80l/s, ~160m, Snowdonia]

More usually, the tailrace pipe will discharge directly back to the watercourse, with or without a formal headwall. The photos below show a typical twin-wall outfall with a stainless steel screen fitted internally, discharging onto loose rocks to provide energy dissipation.


[100kW, 85l/s, 169m, Snowdonia]

A similar but slightly smaller outfall is shown below, with site drainage discharging alongside.


[14kW, 36l/s, 59m, Snowdonia]

Another similar outfall (this time with a simple mesh screen) is shown below, discharging onto a channel made from large stones.


[10kW, 39l/s, 37m, Snowdonia]

Other examples of simple outfalls are shown below.

The following unscreened outfall is discharging a jet of water that will potentially scour the stream bed and banks.

The small outfall shown below left discharges via an existing track drainage culvert, whist the one below right is completely submerged, with no visible structure.

[0.75kW, 8l/s, 53m, Brecon Beacons]

[35kW, 20l/s, 250m, mid-Wales]

The following photo shows a high level discharge from a 100kW scheme into a rocky gorge.

[100kW, ~250l/s, ~60m, Snowdonia]

A relatively unusual energy dissipating outfall (prior to reinstatement) is shown below.


[100kW, 127l/s 149m, Snowdonia]

2.5.1 *Summary – Outfalls*

Issues relevant to PDR include:

- The scale of an outfall is dependent on the flow rate rather than power output;
- Functional design must meet NRW requirements;
- The outfall is usually connected to the turbine sump by a buried tailrace pipe;
- Turbine noise can be transmitted via the tailrace and outfall, but this can usually be mitigated by submerging the outlet;
- Installation will require work to be carried out in the river bank, and sometimes the river bed;
- The energy in the discharged water should (in general) be dissipated to prevent scouring of the bed and opposite bank;
- As with intakes, safety of both the public and of scheme operators is often neglected.

2.6 Grid Connection

The infrastructure associated with the grid connection is directly related to the power output, unless the energy is wholly or partly used on site. Assuming all generation is exported:

- Pico-hydro schemes can usually be connected to an existing domestic supply with no additional equipment;
- Schemes around 25kW may require the transformer to be upgraded, but it is likely to remain on a single pole;
- For 100~200kW, the transformer would be mounted on an H-pole;
- Schemes over 200~250kW usually have an HV connection and will require a ground-mounted substation.

If the powerhouse is remote from existing connections, additional spans of HV overhead line (OHL) may be required, or a buried cable installed if this is not permitted (e.g. within a National Park). In addition, a single-phase (two-wire) OHL may need to be upgraded to three-phase (three-wire) to increase the capacity. This will end at the transformer, from where the subsequent cables will be LV, the length of which will be limited due to volt-drop.

An import / export meter will be installed at the point of connection – sometimes this is within the powerhouse, but often a dedicated cabinet is installed near the transformer. This allows the connection to be installed (and sometimes energised) prior to powerhouse completion which can avoid costly delays.

Typical 100kW grid connections are shown below, consisting of a three-phase transformer on an H-pole with a ground-mounted switchgear / metering cabinet.


Examples of metering cabinets below – standard GRP and timber clad with profile sheet roof.


Below left is a single-phase connection for an 18kW scheme, with the transformer mounted on a single pole (as per a typical rural farm supply). Below right is a GRP cabinet for a ground-mount transformer, where an H-pole was not permitted under planning (with metering cabinet to rear).

2.6.1 *Summary – Grid Connection*

Issues relevant to PDR include:

- The infrastructure required will be determined by the maximum export power.
- The Distribution Network Operator (DNO) will specify the equipment needed and will usually obtain the necessary consents and wayleaves;
- New HV cables can be installed either as overhead lines or buried in a trench, with the former significantly cheaper but more visually intrusive;
- Consideration needs to be given to the location and appearance of any metering cabinets or other enclosures that may be required.

3 Implementation

3.1 Construction

In almost all cases, the construction phase constitutes the greatest environmental risk, whether from silt discharge to the watercourse, pollution from cement, fuel or hydraulic oil, or from direct damage to ecology from the operation of plant and machinery. In addition, the noise and disruption associated with construction usually far outweighs that produced during operation.

Construction requires utilisation of the full red line boundary, including construction corridors, laydown areas, site compounds, borrow pits, etc. Red line boundaries are often underestimated, particularly as planning fees are calculated on the basis of landtake requirements and there is therefore an incentive to keep this to a minimum. Following reinstatement, a large proportion of the scheme will have been back-filled, reinstated or covered in some way, and the visible elements will therefore be significantly smaller than during construction. Developers can therefore quickly become non-compliant if the original planning application did not allow for the practicalities of construction.

Construction practices vary significantly depending on the competence of the contractor(s) involved (if any) and the available budget. For example, it is very difficult to make a 50kW scheme financially viable whilst complying with and paying for full site H&S requirements (as per the CDM Regulations 2015) and comprehensive environmental management. In practice, many installations, especially at the smaller scale, involve small agricultural or groundworks contractors who may not have previously installed pipelines or carried out in-river works.

Selecting a competent contractor with relevant hydro experience is therefore fundamental to minimising the construction risk from technical, financial, and environmental perspectives. Larger commercial schemes generally can afford to employ higher quality contractors, but the smaller the scheme, the lower the revenue and the less budget available for suitable contractors, high quality environmental management and good health and safety practices. This is particularly true with smaller groundworks contractors who are more familiar with agricultural or forestry work where enforcement is much less stringent, and where paperwork (method statements & risk assessments) may not be prepared and / or followed.

Good scheme design also plays a significant role, as incomplete or impractical design can lead directly to problems on site. The hydro boom created by the FiT lead to a number of new entrants to the industry on the design and consenting side, not always with the required levels of experience or competence.

An additional risk factor has been the artificial deadlines imposed by the FiT, which allows a two year post-consent ‘pre-accreditation’ window in which to build and commission the scheme. Failure to meet the deadline by even a day, for whatever reason, resulted in a significant drop in the tariff rate received, which in many cases could lead to tens if not hundreds of thousands of pounds of lost revenue over the twenty year FiT duration. The result was that some schemes were started with the best of intentions, using good practice and competent contractors, but were then delayed during construction often for reasons outside of their control. Consequently, as the FiT deadline approached, corners were cut and compromises made with both H&S and environmental management in order to save the project from financial ruin.

Poor construction practices can be very damaging to the environment and cause public dissatisfaction with the industry. A recent high profile pollution incident in Snowdonia highlights the risks from poor management of construction activities carried out in mountainous areas.[2] This extreme example of poor construction practice is fortunately a rare occurrence, but it has led to a significant public backlash against small hydro development in Snowdonia.

It should be noted that, in our understanding, site inspections of smaller schemes are rarely carried out by regulators (NRW, LPA, HSE, etc.) and these are usually only when an incident has already occurred; in reality there is therefore little incentive for compliance with good practice to *prevent* incidents. This can be contrasted with larger schemes in sensitive areas that may have planning conditions that require an Ecological Clerk of Works (ECoW) and / or Landscape Clerk of Works (LCoW) to undertake weekly

[2] See http://snowdonia-society.org.uk/hydro-power-images-speak-for-themselves/

or monthly visits for the duration of the construction – this however is a significant financial burden even for large schemes.

3.1.1 *Field Research*

It is not possible within the scope of this report to cover every construction issue relating to small scale hydro scheme development. Only three construction sites were visited during the course of the field research, and some of the issues observed are highlighted below. However, no pipe burial was witnessed, and no powerhouse or outfall construction, so additional examples from other schemes are included for illustration. This is by no means a comprehensive survey; rather it aims to give examples of the type of issues that may be encountered during construction.

A typical construction working area for a 'low cost' small scale intake is shown below. In general the site was acceptable, with the working area for the intake construction dewatered using twin-wall pipe, and the extent of bedrock reducing the volume of concrete required and therefore reducing the pollution risk. However, our view is that there are no cut-off drains or other silt mitigation measures between the pipeline working area and watercourse, and a concrete mixer has been operated close to the watercourse to pour a base slab (assumed to be for the header tank). In addition there is little evidence of personal protective equipment (PPE) and there was no formal site management in place. This is typical of smaller installations, and, in general, accidents are rare and pollution incidents (if any) are not of the scale as those mentioned above. However, with little or no external regulation or inspection, poor practice often goes unchallenged.


The following photos show a small perforated sheet / prefabricated sump intake under construction in Snowdonia, with water diverted via a plastic-lined trench to keep the working area dry. The diversion was working well, although it may not be sufficiently sized to cope with flood flows. However there needs to be a balance between coping with every eventuality by creating an enormous diversion and what is reasonably practicable and appropriate; the intake works below can be considered as an example of the latter. It should be remembered that most mitigation measures themselves have some associated impact and risk, whether this is the digging (or reinstatement) of a diversion channel or cut-off drain, installation of silt fences, or the first re-watering of a new intake structure.



Having said that, at the same site a silt fence had been set out but not dug into the ground, therefore allowing surface water to flow unhindered and providing no silt mitigation whatsoever; the requirement for environmental management is therefore understood (and no doubt forms part of the consented method statement) and the materials have been provided, but unfortunately the implementation has not been properly managed.

The photos below show the extent of the working corridor used for a Ø600mm PE pipeline installed at a 250kW site in Scotland. This includes cut-off drains, access track, plant working area, pipe trench and piles of stored topsoil and subsoil. For smaller pipes the corridor required for burial will be narrower, but often still of the order of 4~6m depending on terrain and access requirements. This clearly illustrates the significantly reduced risk of using overground pipes, as strings can be welded in one defined area, and then pulled into place with minimal impact.


For powerhouse construction the base slab is usually limited to the extent of the building footprint, although there may be an additional pipeline anchor block and / or pigging chamber. The complexity of the slab will depend on the type of turbine used, but in most cases there will be a sump around a metre deep under the turbine (to collect the water and direct it into the tailrace pipe), potentially a plinth for the generator, plus any ducts required for electrical cables. The superstructure with usually then be built following standard building practices.

3.2 Operation & Maintenance

Once the scheme is commissioned and operating, activity on commercial schemes is usually limited to weekly powerhouse checks, monthly intake inspections and annual maintenance visits, plus response to faults. Remote access can drastically reduce the number of site visits required. For smaller commercial schemes the relative overhead of site visits can be significant, which is one of the reasons that schemes such as the ones in this report are generally owner-operated (whether domestic or farm-scale).

In terms of planning, vehicle movements during the operational phase will be minimal, and, assuming reinstatement has been carried out to an appropriate level, most hydro schemes quickly settle into their environment. Noise, in the form of generator 'whine' or turbine noise transmitted via the outfall, may only be an issue under certain conditions – for example a river at high flow often masks noise from a turbine running at full power, whereas this can become an issue once the turbine starts to river follow.

The highest operational risk is usually from pipeline 'pigging' (cleaning the inside of the pipe by flushing a foam swab or 'pig' through it). This can result in the discharge of water containing sediment or peat fibres, which needs to be managed prior to returning it to the watercourse. For schemes with non-peaty upland intakes with good screens pigging may never be required, however some schemes need pigging annually (or more) to prevent significant pipeline headloss – this can be exacerbated if the pipeline has been undersized. The traditional method is to undertake such operations during spate flows, when the watercourse is often already laden with sediment, and where the pigging discharge can be significantly diluted. There is currently no best practice guidance from NRW, EA or SEPA regarding pigging, other than that it falls under standard pollution prevention guidance (PPG).

One issue from a planning perspective can be the retrofitting of maintenance, safety or other infrastructure omitted during the consenting and construction phase, and the subsequent deviation from consented drawings. This can also apply to repairs made during the life of the scheme, for example if scouring occurs at an intake or outfall.

3.3 Decommissioning

Decommissioning is not always considered at the planning stage, and in reality most schemes are refurbished rather than decommissioned. However, consideration must be given to whether the scheme could be returned to a 'natural' state. Whereas a buried pipeline could potentially be left in place, the most obvious issue for small scale hydro would be the removal of a concrete intake structure from a watercourse. In summary, the decommissioning impact and risks will be similar to those faced during construction.

3.4 Summary – Implementation

Issues relevant to PDR include:

- Noise, disruption and visual impact will be significantly higher during construction than during operation;
- Red line boundaries can be underestimated, particularly regarding working areas;
- Contractor competence is key to a safe and environmentally benign construction site;
- Good design and preparation, quality contactors, provision of suitable materials and good intentions are not always translated into action on the ground. This is particularly true if tight deadlines are involved or budgets are tight;
- Silt management is probably the least well implemented mitigation measure, but this is often the same for larger schemes;
- Site inspections for smaller schemes are rarely carried out by regulators, and therefore in reality there is reduced incentive for compliance;
- Other than for pigging, operational impact / risk is generally low (assuming compliance with NRW licences);
- Noise may be an issue for poorly designed schemes, but can usually be mitigated;
- Retrofitting and repairs can lead to deviation from consented drawings;
- Decommissioning has similar impact / risk to construction.

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