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**Bryophyte Survey  
Nant Lletys  
Devil's Bridge  
Ceredigion**



**Client:** One Nature Homes

**Survey Dates:** 27<sup>th</sup> March 2025

**Author:** Matt Sutton

## Executive Summary

Matt Sutton was contracted to carry out survey of bryophytes (mosses, liverworts and hornworts) in the lower part of the Nant Lletys to inform proposals for a housing development in Devil's Bridge.

The proposed scheme would discharge treated sewerage into the Nant Lletys via a package treatment plant. This stream flows into the Rheidol Woods and Gorge SSSI / SAC, which includes an assemblage of 'Atlantic Woodland' bryophytes amongst its special features. Some of these bryophytes are associated with watercourses, and are considered sensitive to changes in water chemistry. As such, Natural Resources Wales specified a requirement for survey of this watercourse, and an assessment of the impact of nutrient changes on bryophyte populations in the area. Specific survey for four Atlantic woodland bryophytes closely associated with watercourses was required – *Rhynchostegium alopecurioides*, *Lejeunea patens*, *Plagiochila punctata* and *Metzgeria leptoneura*.

Survey took place over a single day in March, in ideal conditions with low water levels but damp following overnight rain. The majority of the stream could be accessed, but the high waterfall below the old watermill at the head of the valley was considered unsafe to access even with ropes.

Two of the target species – *Lejeunea patens* and *Metzgeria leptoneura* – were recorded in streamside niches within the spray zone or high-water level. Five other members of the Atlantic woodland assemblage were recorded in close association with the watercourse, including the Nationally Scarce *Heterocladium wulfsbergii*.

The stream already shows signs of poor water-quality, with patches of filamentous algae overgrowing bryophytes such as *Jubula hutchinsiae* in places. No published data on threshold levels of nutrient tolerance on Atlantic woodland species is available, but studies show that many bryophytes are negatively affected by elevated levels of nitrogen or phosphorous. A precautionary principle should be applied, with any construction and post-development discharges subject to the highest levels of pollution control, including installation of treatment plants which achieve a high level of phosphate and nitrate removal.

## 1. Introduction

Matt Sutton was contracted to carry out survey of bryophytes (mosses, liverworts and hornworts) in the lower part of the Nant Lletys to inform proposals for a housing development in Devil's Bridge.

The lower part of the Nant Lletys, to the north of Devil's Bridge, lies within the Rheidol Woods and Gorge SSSI / SAC, which includes an assemblage of 'Atlantic Woodland' bryophytes (Bosanquet, 2019) amongst its special features. Some of these bryophytes are associated with watercourses, and are considered sensitive to changes in water chemistry. The development proposal includes discharges of treated effluent into the Nant Lletys, which have the potential to alter water-chemistry by elevating levels of nutrients including nitrogen and phosphorous.

Although detailed bryophyte survey has been carried out across much of the SSSI, the Nant Lletys was considered too inaccessible for survey during NRW survey contracts carried out by Averis (1998) and Forster-Brown (2007). No records for this stream are included in the British Bryological Society Database.

The client was required by NRW to provide an assessment of bryophyte species and assemblages alongside and within Nant Lletys. Survey was required to ascertain whether the following species were present:

- *Rhynchostegium alopecurioides* (previously *Platyhypnidium lusitanicum*)
- *Plagiochila punctata*
- *Lejeunea patens*
- *Metzgeria leptoneura*

If the survey confirmed the presence of any of the species listed above, an assessment of the impact of nutrient changes on bryophyte populations in the area would be required. This would consider (1) Data on the impact of nutrient level changes (through altered water quality / regime) on the identified bryophyte species and assemblages; and (2) Threshold data - the level of nutrient loading that the bryophytes can tolerate before experiencing negative effects on their population.

## 2. Survey Details

Survey was carried out on March 27<sup>th</sup> 2025 by Matt Sutton and Ruby Bye, joint county bryophyte recorders for Ceredigion, accompanied by Phil Jennings who provided rope access assistance. Weather was mild and dry, with damp conditions following overnight rain. Water levels were low following a prolonged dry spell, making access to and along the stream generally easy. A steep waterfall at the head of the cwm could not be safely accessed from below. It was investigated from above, but the lack of safe, mature trees to rope off, combined with loose rocks apparent in the upper part, meant that access was not attempted. The survey focussed on rocks and logs within and alongside the channel in the remainder, with a particular focus on Atlantic Woodland assemblage members and other scarce or rare species. Samples were confirmed by microscopic analysis where required.



*Figure 1. Survey area at Nant Lletys, showing approximate extent of areas accessed (blue) and considered unsafe to access (red)*

### 3. Survey Results



*Approximate location of Metzgeria leptoneura (arrowed) below main waterfall at head of cwm*

The survey located eight members of the Atlantic Woodland bryophyte assemblage, including two of the four species listed by NRW as a focus for survey effort. These are tabulated below, together with their niche and approximate distribution and frequency.

Species	Niche	Distribution / Frequency
<i>Metzgeria leptoneura</i>	Rock face in spray zone below main waterfall	Scattered shoots in a single small area only, but potentially more frequent on inaccessible rock faces above.
<i>Heterocladium wulfsbergii</i>	Rocks around normal winter / high water level near cascade in upper part of site	Only one patch found, but the commoner <i>H. heteropterum</i> is abundant, making detection of <i>H. wulfsbergii</i> more difficult.
<i>Jubula hutchinsiae</i>	Rocks beside cascades	Patchily abundant around cascades in mid-section of site.
<i>Lejeunea patens</i>	Rocks and ash logs in channel	Three small patches recorded, but potentially more frequent
<i>Lejeunea lamacerina</i>	Rocks and logs in and by channel	Frequent
<i>Scapania gracilis</i>	Logs in and over channel	Rare
<i>Plagiochila spinulosa</i>	Rocks above normal winter / high water level	Four patches noted.

*Rhynchostegium riparioides* is frequent on rocks on the channel floor, together with *Chiloscyphus polyanthos*. These two species are often associated with water of relatively high nutrient status. *Scapania undulata*, *Sciuro-hypnum plumosum* and *Brachythecium rivulare* were also noted in this niche.

The regularly inundated channel sides are generally dominated by the common moss *Thamnobryum alopecurum*. *Hyocomium armoricum* and smaller mosses such as *Heterocladium heteropterum* are locally abundant in a zone above this; other species noted in this zone included *Hygroamblystegium tenax* and *Dichodontium pellucidum*. A few areas of flushed rock or bank held a more diverse range of species including *Dichodontium flavescens*, *Marsupella aquatica* and *Chionoloma cylindrotheca*.

Healthy patches of *Jubula hutchinsiae* were present around cascades in the mid-section, but other patches were being smothered by patches of filamentous algae (*Cladophora* sp.) suggestive of nutrient-enrichment in the watercourse. Small quantities of foam and a mild detergent / sewerage aroma were also noted here. Other species noted around cascades included *Heterocladium wulfsbergii* and Wilson's filmy-fern *Hymenophyllum wilsonii*.

Fallen oak and ash logs are frequent within the stream channel, and these hold a relatively diverse range of bryophytes including common species such as *Rhizomnium punctatum* and less common species such as *Riccardia palmata* and *Odontoschisma denudatum*.

There were few significant living trunks in the spray zone around cascades and below the main waterfall, and these held only common species such as *Metzgeria furcata*.



*Patches of Jubula hutchinsiae being smothered by growth of filamentous algae*



*The main waterfall at the head of the cwm was inaccessible above the lower part, but potentially diverse bryophyte-dominated communities were apparent to the sides of the main flow channels here*

## 5. Discussion

Although a potentially bryophyte-rich area adjoining the main waterfall could not be accessed, the survey effort was sufficient to reveal the presence of notable species in close association with the watercourse, most notably *Metzgeria leptoneura* and *Heterocladium wulfsbergii*. As such, an assessment of the impact of nutrient changes on such bryophytes is required.

The development proposal entails the provision of separate compact waste-water treatment plants for the new dwellings, 11 in total. The 'Diamond DMS2' has already been installed at 8 of these locations. This system specifies an average removal of 80.6% of N. The removal figures for P are not specified, but a generic figure of 52% is quoted for the Diamond Range P. This would result in a phosphorus discharge rate of 25mg/l.

The current status of water-quality in the Nant Lletys is not known. The Devil's Bridge Sewage Treatment Works discharges treated effluent into the Nant Lletys. NRW hold Water Quality Archive data from samples taken below the discharge point in 2001 and 2011, the latter listed

as reactive sampling following statutory failure, but demonstrating only a low Biological Oxygen Demand (indicating clean water).

The stream exhibited some signs of poor water-quality during survey, with patches of filamentous algae overgrowing bryophytes such as *Jubula hutchinsiae* in places. The most prominent bryophytes in the channel is *Rhynchostegium riparioides* which is tolerant of intermediate nutrient enrichment (Szoszkiewicz, 2006). It is, for example, dominant on a sewage treatment works filter bed in Pembrokeshire (Bosanquet, 2010). *Chiloscyphus polyanthos* is also prominent, and another species apparently tolerant of a degree of nutrient enrichment. However, the presence of *Scapania undulata* on rocks in the channel is suggestive of water of low nutrient status (Gecheva and Yurukova, 2013).

No published data on threshold levels of nutrient tolerance on Atlantic woodland species is available, but studies show that many bryophytes are negatively affected by elevated levels of nitrogen or phosphorous (eg. Andersen et al, 2016; Bobbink et al 1998). Of particular relevance to the current study, Vanderpoorten and Klein (1999) demonstrated the loss of sensitive species from waterfall spray zones where sewage effluent discharges were influencing stream water quality in the Vosges Mountains and Black Forest.

The BRYOATT database scores species according to various attributes including nitrogen tolerance. Two of the key liverwort species present here – *Metzgeria leptoneura* and *Lejeunea patens* - have a nitrogen index of 2, as does *Scapania undulata*, indicating a requirement for infertile sites. The liverworts *Chiloscyphus polyanthos* and *Jubula hutchinsiae* score 4 (associated with moderately enriched sites) whilst the mosses *Rhynchostegium riparioides* and *Thamnobryum alopecurum*, both abundant here, score 6 (eutrophic sites). It can be inferred therefore, that an increase in available nitrogen (and phosphorous) would favour the common mosses (and algae) over the rarer liverworts.

Without knowledge of the current water quality status, it is impossible to quantify the significance of the additional inputs which would be generated by the proposal. It is also clear that such inputs would act differently on different bryophytes, with those directly within the channel potentially subject to greater exposure to the nutrient-enriched water than those in the mist zone of waterfalls, or in other niches above the normal flow-level. However, the latter (including *Metzgeria leptoneura*) may be more likely to suffer from the indirect effects of enhanced growth of competitive species such as *Thamnobryum alopecurum*.

It would be appropriate to adopt a precautionary approach. Should the development proceed, it is recommended that the Diamond plants are upgraded to remove more P and N. There are upgrades and alternatives available using biological, chemical or filtration techniques as detailed [here](#). Alternatively, it may be possible to combine discharges from individual package treatment plants into one tertiary treatment plant for nutrient removal. In order to avoid further inputs to the Nant Lletys, with the attendant risk of impacts on bryophyte assemblages, it is recommended that such upgrades or alternatives are installed.

## References

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## Appendix 1: List of Species Recorded



Nant Lletys  
Bryophyte Records \