Appendix A.8.21

Lackagh Quarry Petrifying Spring Survey Results

Part 1 - 2018 EIAR
Part 2 - 2023 Results

A.8.21 Lackagh Quarry Petrifying Spring Survey Results

Part 1

Appendix A.8.21 Part 1

Lackagh Quarry Petrifying Spring Survey Results (2018)

Lackagh Quarry Petrifying Spring Survey

The results of the Petrifying spring survey at Lackagh Quarry are presented below in **Table 1** and are followed by a brief discussion. The locations of the seepage lines are shown on **Plate 1** below and on **Figures 8.14.1** to **8.14.14** (Fossitt (2000) classification) and **Figures 8.15.1** to **8.15.14** (Annex I habitats).

Plate 1: Seepage lines recorded in Lackagh Quarry (including reference codes used in Table 1)

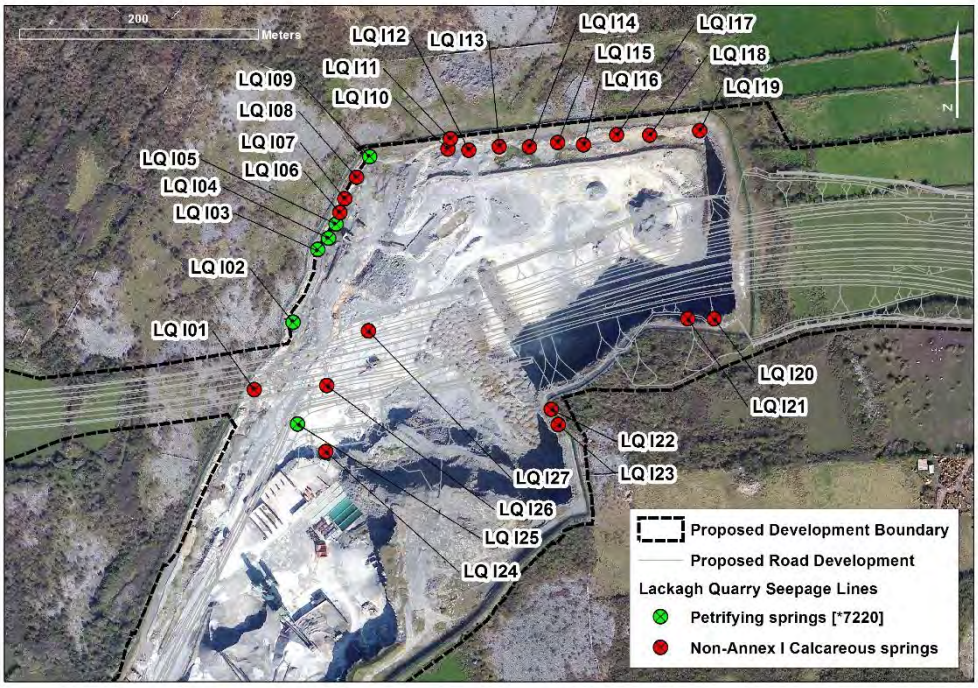

Table 1: Results of the Petrifying spring [*7220] survey at Lackagh Quarry[1]

Ref. No.	Species[2]	Comment
LQ I01	*Bryum dichotomum, Carex flacca, Centaurea nigra, Dactylis glomerata, Dicranella varia,* ***Festuca rubra, Fissidens adianthoides****, Geranium robertianum, Hieracium sp., Leontodon hispidus, Leucanthemum vulgare, Linum catharticum, Polygala vulgaris, Prunella vulgaris, Rubus fruticosus agg., Scrophularia nodosa, Sesleria caerulea, Sonchus oleraceus, Teucrium scorodonia, Tortella tortuosa, Trichostomum brachydontium, Tussilago farfara, Weissia controversa*	Although this seepage is relatively species rich, there are few species present that act as indicators of petrifying tufa springs. There is also no tufa present, with the calcareous material that has been deposited taking the form of calcareous mud, rather than tufa. Therefore, this seepage does not correspond to the EU Annex I habitat 7220 petrifying tufa spring.
LQ I02	*Bryum sp.,* ***Campylium stellatum****, Dactylis glomerata,* ***Didymodon tophaceus,*** *Encalypta streptocarpa, Epilobium parviflorum,* ***Fissidens adianthoides****, Geranium robertianum, Hieracium sp., Leucanthemum vulgare,* ***Pellia endiviifolia,*** *Sesleria caerulea, Sonchus oleraceus, Tortella tortuosa, Tussilago farfara, Weissia controversa.*	Four species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Campylium stellatum, Fissidens adianthoides, Didymodon tophaceus* and *Pellia endiviifolia*, are present in this seepage, and tufa is forming, primarily amongst and between cushions of *D. tophaceus*, over a limited area. However, there are no other indicative species of tufa springs present, and tufa is only present over a small area. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. A small area of this seepage could be classified as corresponding to the Annex habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.

[1] Seepage lines which correspond with the [*7220] Annex I habitat type are highlighted in green
[2] Indicator species (after NPWS, 2013) for the Annex I habitat **Petrifying springs with tufa formation (Cratoneurion)* [7220] are highlighted in **bold** font.

LQ I03	*Brachypodium sylvaticum, Carex flacca, Carlina vulgaris, Cymbalaria muralis, Dactylis glomerata,* ***Didymodon tophaceus, Festuca rubra, Fissidens adianthoides****, Hypericum pulchrum, Juncus acutifolius, Leontodon hispidus, Leucanthemum vulgaris, Linum catharticum,* ***Pellia endiviifolia,*** *Plantago lanceolata, Polygala vulgaris, Sesleria caerulea, Solidago virgaurea, Weissia controversa.*	Four species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Didymodon tophaceus*, *Pellia endiviifolia*, *Fissidens adianthoides* and *Festuca rubra*, are present in this seepage, and tufa is forming, primarily amongst and between cushions of *D. tophaceus*, over a limited area. However, the layer of tufa generally has little vegetation growing upon it, and a vegetation community is not well developed on the tufa. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. Part of this seepage could be classified as corresponding to the Annex habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.
LQ I04	*Blackstonia perfoliata, Carex flacca, Dicranella varia,* ***Didymodon tophaceus,*** *Epilobium parviflorum,* ***Festuca rubra, Fissidens adianthoides****, Hieracium sp., Leontodon hispidus,* ***Pellia endiviifolia,*** *Sesleria caerulea, Sonchus oleraceus, Tussilago farfara*	Four species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Didymodon tophaceus*, *Fissidens adianthoides*, *Pellia endiviifolia* and *Festuca rubra*, are present in this seepage, and tufa is forming, both amongst and between cushions of *D. tophaceus*, and as a thin layer covering the wet rock face down which water seeps. However, the layer of tufa generally has little vegetation growing upon it, and a vegetation community is not well developed on the tufa. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. Part of this seepage could be classified as corresponding to the Annex habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.

LQ I05	*Briza media, Carex flacca,* ***Carex panicea,*** *Dicranella varia,* ***Didymodon tophaceus, Festuca rubra, Fissidens adianthoides****, Leontodon hispidus, Lotus uliginosus,* ***Pellia endiviifolia,*** *Polygala vulgaris, Sesleria caerulea, Sonchus oleraceus, Tussilago farfara.*	Five species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Didymodon tophaceus*, *Fissidens adianthoides*, *Pellia endiviifolia*, *Carex panicea* and *Festuca rubra*, are present in this seepage, and tufa is forming, both amongst and between cushions of *D. tophaceus*, and as a thin layer covering an extensive area of the wet rock face down which water seeps. However, the layer of tufa generally has little vegetation growing upon it, and a vegetation community is not well developed on the tufa. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. Part of this seepage could be classified as corresponding to the Annex habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.
LQ I06	*Carex flacca, Dicranella varia, Equisetum pratense,* ***Festuca rubra,*** *Holcus lanatus, Lotus uliginosus,* ***Pellia endiviifolia,*** *Polygala vulgaris, Rubus fruticosus agg., Senecio jacobaea, Taraxacum officinalis, Tussilago farfara.*	Two characteristic species of Petrifying springs in Ireland, *Festuca rubra* and *Pellia endiviifolia*, were recorded from this seepage, but were not growing in association with tufa. Calcareous deposits were present on the rock face, but no species were growing in association with this. Therefore, this seepage does not currently support Annex I Petrifying spring habitat.
LQ I07	*Blackstonia perfoliata, Brachypodium sylvaticum, Carex flacca, Dicranella varia,* ***Didymodon tophaceus****, Epilobium parviflorum, Equisetum pratense,* ***Festuca rubra****, Geranium robertianum, Hypericum pulchrum, Leontodon hispidus,* ***Pellia endiviifolia****, Senecio jacobaea, Taraxacum officinalis, Tussilago farfara.*	Three indicator species of Petrifying springs in Ireland are present in this seepage, but were not growing in association with tufa. A film of calcareous material has formed on the rock surface in places, with some tufaceous material present, but no plant species grow upon this. Therefore, this seepage does not correspond to the Annex I Petrifying spring habitat.

LQ I08	*Carex flacca, Dactylis glomerata, Dicranella varia,* ***Didymodon tophaceus****, Epilobium parviflorum,* ***Fissidens adianthoides****, Hypericum pulchrum, Juncus acutiflorus, Leontodon hispidus,* ***Pellia endiviifolia****, Pohlia melanodon, Tussilago farfara.*	Deposits of calcareous material are present on the rock face in this seepage, and three indicative species of Petrifying springs are present. However, these indicative species are not associated with the calcareous depositions, and no vegetation is present upon the calcareous depositions. Therefore, this seepage cannot be classified as Annex I Petrifying spring habitat.
LQ I09	*Ctenidium molluscum, Dicranella varia,* ***Didymodon tophaceus****, Epilobium parviflorum,* ***Fissidens adianthoides****, Hypericum pulchrum,* ***Pellia endiviifolia****, Ranunculus acris, Ranunculus repens, Rubus fruticosus agg., Salix aurita, Salix cinerea, Tussilago farfara.*	Three species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Didymodon tophaceus*, *Fissidens adianthoides* and *Pellia endiviifolia*, are present in this seepage, and tufa is forming, primarily amongst and between cushions of *D. tophaceus*, over a limited area. However, there are no other indicative species of tufa springs present, and tufa is only present over a small area. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. A small area of this seepage could be classified as corresponding to the Annex I habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.
LQ I10	Seepage inaccessible	This seepage was not accessible, as located on an inaccessible cliff face, but little vegetation cover was observed, with small amounts of tufa depositions likely to be present. This seepage may or may not contain potential Annex I Petrifying spring habitat, but it is not likely to be different in composition to that observed in association with other seepages.
LQ I11	*Blackstonia perfoliata, Brachypodium sylvaticum, Carex flacca, Dicranella varia,* ***Didymodon tophaceus****,* ***Fissidens adianthoides****, Holcus lanatus, Leontodon hispidus, Sonchus oleraceus, Tussilago farfara.*	Two indicator species, *Didymodon tophaceus* and *Fissidens adianthoides*, and small amounts of tufaceous deposits are present in this seepage, but are not growing in association with each other, so this seepage does not qualify as Annex I Petrifying spring habitat.

LQ I12	*Agrostis stolonifera, Dicranella varia,* ***Didymodon tophaceus****, Epilobium parviflorum,* ***Fissidens adianthoides****, Sonchus oleraceus, Tussilago farfara.*	Two indicator species of Annex I Petrifying spring habitat, *Didymodon tophaceus* and *Fissidens adianthoides*, and small amounts of tufaceous deposits are present in this seepage, but are not growing in association with each other, so this seepage does not qualify as Annex I Petrifying spring habitat.
LQ I13	*Buddleia davidii, Dicranella varia, Holcus lanatus, Leontodon hispidus, Salix caprea, Sonchus oleraceus, Tussilago farfara.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I14	*Blackstonia perfoliata, Carex pendula, Dicranella varia, Epilobium parviflorum, Geranium robertianum, Holcus lanatus, Leontodon hispidus, Leucanthemum vulgare, Scrophularia nodosa, Tussilago farfara.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I15	***Bryum pseudotriquetrum****, Carex flacca, Carex pendula, Centaurea nigra,* ***Didymodon tophaceus****, Epilobium parviflorum, Equisetum pratense,* ***Festuca rubra****,* ***Fissidens adianthoides****, Holcus lanatus, Leontodon hispidus, Lotus uliginosus, Preissia quadrata, Scrophularia nodosa, Sonchus oleraceus, Tussilago farfara.*	Although four species indicative of Annex I Petrifying spring vegetation in Ireland are present, there is no tufa present, and these species are not growing directly in association with each other, so Annex I Petrifying spring habitat is not present in this seepage.
LQ I16	None present	No plant species, and no deposits of tufa, were found in association with this seepage, so this seepage contains no Annex I tufa spring habitat.
LQ I17	*Dicranella varia,* ***Festuca rubra****, Hieracium sp., Leontodon hispidus, Lotus uliginosus, Scrophularia nodosa, Sesleria caerulea, Sonchus oleraceus, Tussilago farfara.*	Only one indicator species of tufa-forming springs, *Festuca rubra*, is present but does not occur in association with tufa, which is not present in this seepage. Therefore, Annex I Petrifying spring habitat is not present
LQ I18	*Blackstonia perfoliata, Carex flacca, Centaurea nigra, Dactylis glomerata, Dicranella varia, Hieracium sp., Holcus lanatus, Leontodon hispidus, Linum catharticum, Preissia quadrata, Sonchus oleraceus, Trichostomum crispulum, Tussilago farfara.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I19	Seepage inaccessible	This seepage was located at ca. 10m up a vertical cliff face, so was not accessible, and there was no evidence for the presence of tufa.

LQ I20	*Centaurea nigra, Dactylis glomerata, Dicranella varia,* ***Fissidens adianthoides****, Linum catharticum, Lotus uliginosus, Pohlia sp., Taraxacum officinalis, Teucrium scorodonia, Tussilago farfara.*	Only one indicator species of tufa-forming springs, *Fissidens adianthoides*, is present but there was no tufa present, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I21	*Agrostis stolonifera, Dicranella varia, Epilobium parviflorum.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I22	*Epilobium parviflorum, Equisetum pratense, Taraxacum officinalis, Tussilago farfara.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I23	***Aneura pinguis****, Dicranella varia, Leiocolea badensis, Tussilago farfara.*	Only one indicator species of tufa-forming springs, *Aneura pinguis*, is present but there was no tufa present, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I24	*Bryum bicolor, Dicranella varia, Tussilago farfara.*	No tufa, or species indicative of Petrifying spring habitat, are present in this seepage, so it does not contain any potential Annex I Petrifying spring habitat.
LQ I25	*Blackstonia perfoliata, Buddleia davidii, Dicranella varia,* ***Didymodon tophaceus****,* ***Festuca rubra****, Leiocolea badensis, Salix cinerea, Senecio vulgaris, Sonchus oleraceus, Tussilago farfara.*	Two species listed as indicative of [7220] habitat by NPWS (2013) and Lyons & Kelly (2016), but not according to CEC (2013), *Didymodon tophaceus* and *Festuca rubra*, are present in this seepage, and tufa is forming, primarily amongst and between cushions of *D. tophaceus*, over a limited area. However, there are no other indicative species of tufa springs present, and tufa is only present over a small area. It is likely that, over time, this tufa would continue to accumulate, and become more extensive, and other species indicative of tufa, such as *Palustriella spp.* and *Eucladium verticillatum* may colonise this spring. A small area of this seepage could be classified as corresponding to the Annex habitat 7220, although at present it is a marginal example of the habitat, representing a recent colonisation of an artificially created quarry face.

LQ I26	*Agrostis stolonifera, Dicranella varia,* ***Didymodon tophaceus****, Senecio vulgaris, Tussilago farfara.*	Only one indicator species of tufa-forming springs, *Didymodon tophaceus*, is present but not occurring in association with tufa, which is not present in this seepage. Therefore, Annex I Petrifying spring habitat is not present.
LQ I27	None present	No plant species, and no deposits of tufa, were present in association with this seepage, so it does not contain any potential Annex I Petrifying spring habitat.

Status of 7220 *Petrifying springs with tufa formations *(Cratoneurion)* in Lackagh Quarry

Of the twenty seven seepages surveyed for the presence of Annex I tufa-forming petrifying springs, six were found to contain potential Annex I Petrifying spring habitat; all located on the west face of the quarry. The other walls of the quarry were different in character, with less calcareous material deposited on the rock face, and generally less vegetation present, and are not likely to be suitable for the formation of Petrifying spring habitat. The tufa springs that have formed in the seepages on the west face of the quarry are generally species poor, with only *Didymodon tophaceus*, and occasionally *Dicranella varia* and *Pellia endiviifolia* actually growing in association with the tufa deposits. Therefore, there is not a vegetation community, per se, growing in association with the tufa; in most cases the vegetation consisting of just *Didymodon tophaceus*.

These seepages can be classified as 7220 *Petrifying springs, although they are marginal examples, lacking many of the key indicative species and are generally limited in extent; in some cases occurring only in the immediate vicinity of cushions of *Didymodon tophaceus*. They are also only present due to human activity, with the quarrying of limestone resulting in the creation of suitable habitat for their formation, and are arguably of limited conservation value. However, as these springs are relatively recently created, they are likely to continue to increase in extent if left undisturbed, and characteristic species of petrifying tufa springs, such as *Palustriella commutata* may become established in the future, increasing their conservation value.

References

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A.8.21 Lackagh Quarry Petrifying Spring Survey Results

Part 2

LACKAGH QUARRY PETRIFYING SPRINGS SURVEY 2023

August 2023

Seepage from springs, Lackagh Quarry, view to East from upper shelf

DENYER ECOLOGY

Report produced by Denyer Ecology for Scott Cawley

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1 INTRODUCTION

1.1 Background

Dr Joanne Denyer was commissioned by Scott Cawley to undertake a survey and assessment of calcareous seepages at Lackagh Quarry, Co. Galway. A previous survey was undertaken by Dr Rory Hodd in 2018. The aim of the 2023 survey was to map all calcareous seepages within the quarry, assess if they correspond to the Annex I priority habitat 'Petrifying spring with tufa formation' *7220 and note any changes from the 2018 survey.

1.2 Relevant expertise

Dr Joanne Denyer is a highly experienced botanist and bryologist with over 20 years' experience of ecological survey and research. She is experienced in the identification of all plant groups, including difficult groups such as aquatic macrophytes, charophytes and bryophytes. Dr Denyer specialises in fen and wetland habitats including lowland and upland fens, springs and flushes, turloughs, raised and blanket bogs and transition mire; wet woodlands, machair and aquatic macrophytes of rivers, lakes and ditches. Dr Denyer is a national expert on the Annex I priority habitat petrifying springs and has worked on a wide range of projects and sites in relation to this habitat. This includes detailed site survey, assessment and monitoring, habitat management, Ecological Impact Assessment, pre and post construction monitoring, acting as an expert witness on calcareous springs at an Oral Hearing and providing advice to county councils and NPWS. In 2018 and 2023-2024 she assisted National Parks and Wildlife Service (NPWS) in the Article 17 reporting on Petrifying springs to the European Commission. She has recently undertaken a literature review and survey work on the impacts of ammonia deposition on bryophytes in petrifying springs and a review of herbicide use (to control invasive species) on and adjacent to petrifying springs. She is the lead author of new guidance on petrifying spring assessment and monitoring (Denyer et al., 2023).

2 METHODOLOGY

2.1 Habitat survey

The site was walked over in early July 2023 by Dr Joanne Denyer. Each calcareous seepage area recorded in the 2023 survey was relocated and assessed. Additional seepages were also recorded. For each seepage the presence of tufa, positive indicator species for petrifying springs (Denyer et al., 2023; Lyons & Kelly, 2016) and water flow were recorded. Where a seepage corresponded to the Annex I priority habitat 'Petrifying spring with tufa formation' *7220, a detailed monitoring plot was undertaken following the methodology of Denyer et al. (2023) and Lyons & Kelly (2016). Note that not all seepages were accessible in full due to the steep quarry face and loose rock present.

2.2 Plant species nomenclature

Vascular plant nomenclature follows that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). The bryophyte nomenclature adopted by Blockeel et al. (2021) is used.

3 RESULTS

Twenty-nine calcareous seepages were recorded LQ101-LQ129. These are summarised in Table 3.1, with photographs of each seepage included in Table 3.2. These are mapped on Figure 3.1. Some of these were dry at the time of the 2023 survey but had been recorded as having water seepage/ tufa presence in the 2018 survey. LQ108, LQ113 and LQ125 are seepage complexes with multiple seepage zones on the rockface in these locations (Table 3.1; Figure 3.1).

Of the 29 mapped seepages/ seepage complexes, 6 are examples of the Annex I priority habitat petrifying springs *7220 (LQ102, LQ107, LQ108d, LQ113a, LQ113b and LQ123; Table 3.1). These are seepages were there are at least 3 positive indicator species for *7220 recorded, in association with tufa formation. Four detailed monitoring plots were undertaken in *7220 seepages (listed in Table 3.1, full details in Appendix A).

Figure 3.1. Calcareous seepages and *7220 habitat within survey area

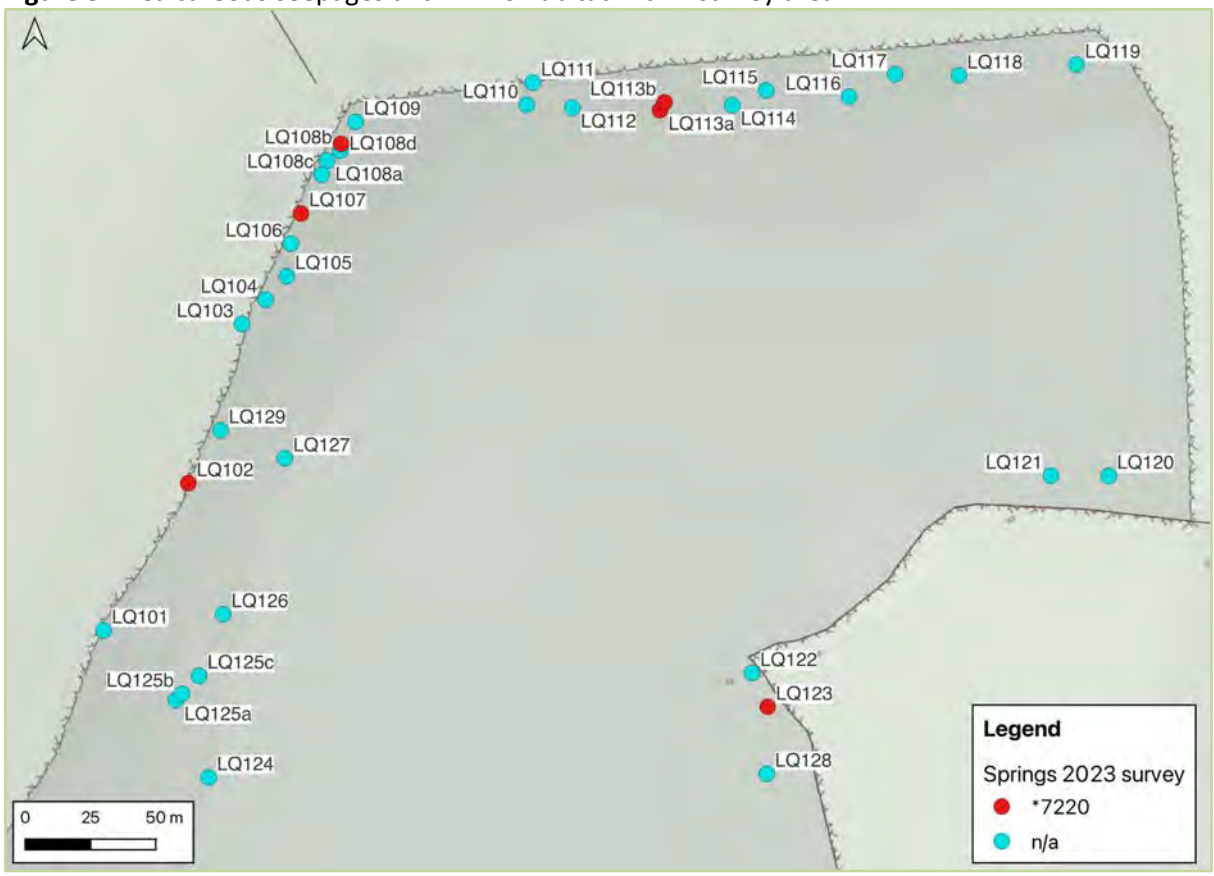


Table 3.1. Summary details for each mapped calcareous seepage/ former seepage

Spring ID	Description	Tufa formation	Positive indicator species	Annex I habitat	Detailed plot survey	Change from 2018 survey
LQ101	Calcareous mud on level ground. Rockface with some calcareous deposit, but low number of indicator species and relatively low species richness overall.	Slight calcareous deposit on mud and rock	*Didymodon tophaceus*	No	No	Noted as being relatively species rich in 2018 survey. 2 indicator species recorded (*Fissidens adianthoides* & *Festuca rubra*), which were not recorded in 2023.
LQ102	Tufa cascade on rockface with area of wetland/ swamp on ground below	Hard cascade tufa	*Didymodon tophaceus* *Festuca rubra* *Fissidens adianthoides* *Pellia endiviifolia*	**Yes**	Yes	Four positive indicator species recorded in both years but slightly different species present
LQ103	Slight tufa on rockface with patchy vegetation. Positive indicator species of low cover and only 2 species recorded.	Slight cascade tufa	*Didymodon tophaceus* *Fissidens adianthoides*	No	No	4 positive indicator species recorded in 2018 survey and considered partly corresponding to *7220. *Festuca rubra* and *Pellia endiviifolia* not recorded in 2023 and not considered Annex I habitat.
LQ104	Soft marl on quarry floor but no seepage and no positive indicator species	Not present	None	No	No	Seepage not relocated. Near to the western edge of LQ105 and could have been part of that spring complex.
LQ105	Seepage on rockface has some affinity to *7220 but limited positive indicator species present on rockface. Wetland area below has affinity to Cladium fen *7210 with *Cladium mariscus*	Patchy cascade tufa	Patchy *Festuca rubra* & *Pellia endiviifolia* on rock face. *Bryum pseudotriquetrum* in fen below rockface but not in seepage area on rock.	No	No	5 positive indicator species recorded in 2018 survey and considered partly corresponding to *7220. *Carex panicea, Didymodon tophaceus* and *Fissidens adianthoides* and not considered Annex I habitat.
LQ106	Seepage on rockface with little vegetation. Also a pool with some marl deposits on the quarry floor but without indicator species.	Slight tufa on rockface	*Fissidens adianthoides*	No	No	Little change. *Festuca rubra* recorded in the 2023 survey but only 2 positive indicator species recorded in total and not considered *7220.
LQ107	Seepage on rockface. Associated with small area of alkaline fen 7230 below the rockface with *Chara vulgaris, Bryum pseudotriquetrum* and *Potamogeton coloratus*	Soft tufa deposits on rockface	*Didymodon tophaceus* *Eucladium verticillatum* *Festuca rubra* *Fissidens adianthoides* *Pellia endiviifolia*	**Yes**	Yes	Increase in number of positive indicator species from 2018 survey and species growing in association with tufa. Not considered *7220 in 2018 survey but mapped as *7220 in 2023.

Spring ID	Description	Tufa formation	Positive indicator species	Annex I habitat	Detailed plot survey	Change from 2018 survey
LQ108a	Seepage on rockface with some cascade tufa but no *7220 positive indicator species. Associated with alkaline fen 7230 below.	Cascade tufa	None	No	No	LQ108 recorded as one point in 2018 survey. 3 positive indicator species were recorded: *Didymodon tophaceus, Fissidens adianthoides* and *Pellia endiviifolia.* However no positive indicator species were associated with tufa formation, and it was not considered *7220 habitat.
LQ108b	Seepage on rockface with some cascade tufa but no *7220 positive indicator species. Associated with alkaline fen 7230 below.	Cascade tufa	None	No	No	LQ108 recorded as one point in 2018 survey. 3 positive indicator species were recorded: *Didymodon tophaceus, Fissidens adianthoides* and *Pellia endiviifolia.* However no positive indicator species were associated with tufa formation, and it was not considered *7220 habitat.
LQ108c	Seepage on rockface with some cascade tufa but no *7220 positive indicator species. Associated with alkaline fen 7230 below.	Cascade tufa	None	No	No	LQ108 recorded as one point in 2018 survey. 3 positive indicator species were recorded: *Didymodon tophaceus, Fissidens adianthoides* and *Pellia endiviifolia.* However no positive indicator species were associated with tufa formation, and it was not considered *7220 habitat.
LQ108d	Seepage on rockface with some cascade tufa and positive indicator species recorded. This is the eastern seepage of complex LQ108.	Cascade tufa	*Bryum pseudotriquetrum* *Festuca rubra* *Didymodon tophaceus* *Pellia endiviifolia*	**Yes**	Yes	LQ108 recorded as one point in 2018 survey. 3 positive indicator species were recorded: *Didymodon tophaceus, Fissidens adianthoides* and *Pellia endiviifolia.* However no positive indicator species were associated with tufa formation, and it was not considered *7220 habitat.
LQ109	Some cascade tufa present but no positive indicator species	Cascade tufa	None	No	No	4 positive indicator species recorded in 2018 survey: *Ctenidium molluscum*, *Didymodon tophaceus*, *Fissidens adianthoides, Pellia endiviifolia* and part of seepage considered *7220 habitat. Stated that tufa was present in only a small area. No positive indicator species refound in 2023.
LQ110	Seepage was not accessible as located on an inaccessible cliff face. Little vegetation cover was observed, with small amounts of tufa depositions likely to be present.	Small tufa deposits	n/a as not accessible	No	No	No change
LQ111	Small amounts of tufa deposits on rockface but no positive indicator species associated with tufa. Some soft marl on quarry floor.	Small tufa deposits	None	No	No	No major change. 2 positive indicator species recorded in 2018 survey (*Didymodon tophaceus* and *Fissidens adianthoides*) but not associated with tufa and not refound in 2023.
LQ112	Small amounts of tufa deposits on rockface but no species associated with tufa	Small tufa deposits	None	No	No	No major change. 2 positive indicator species recorded in 2018 survey (*Didymodon tophaceus* and *Fissidens adianthoides*) but not associated with tufa and not refound in 2023.

Spring ID	Description	Tufa formation	Positive indicator species	Annex I habitat	Detailed plot survey	Change from 2018 survey
LQ113a	Two adjacent seepages shaded by trees on dripping rocks. Soft calcareous deposits on damp rockface.	Soft calcareous deposits	*Didymodon tophaceus* *Fissidens adianthoides* *Pellia endiviifolia*	**Yes**	Yes	2018 survey did not record tufa or positive indicator species in this location, and it was not mapped as *7220. It may have become wetter since the 2018 survey.
LQ113b	Two adjacent seepages shaded by trees on dropping rocks. Soft calcareous deposits on damp rockface.	Soft calcareous deposits	*Didymodon tophaceus* *Fissidens adianthoides* *Pellia endiviifolia*	**Yes**	No (adjacent to plot 113a)	2018 survey did not record tufa or positive indicator species in this location, and it was not mapped as *7220. It may have become wetter since the 2018 survey.
LQ114	Partly shaded seepage on rockface with little vegetation	Little tufa, slight calcareous deposit	None	No	No	No change
LQ115	Partly shaded seepage on rockface with little vegetation. Seepage area below rocks but no tufa present there.	Soft algal/ calcareous deposit	None	No	No	4 positive indicator species recorded in 2018 survey: *Bryum pseudotriquetrum, Didymodon tophaceus, Festuca rubra* and *Fissidens adianthoides,* but not associated with tufa or growing with each other. Not recorded in 2023.
LQ116	Seepage with slight algal/ calcareous deposit but no tufa present and no positive indicator species	None	None	No	No	2018 survey recorded no plants present. Some vegetation present in 2023 but no positive indicator species.
LQ117	Dry rockface with no seepage or tufa present	None	None	No	No	2018 survey recorded *festuca rubra* but not associated with tufa (none present)
LQ118	Seepage with slightly damp rockface and some patchy paludal tufa	Paludal tufa	*Didymodon tophaceus*	No	No	No tufa or positive indicator species recorded
LQ119	Seepage inaccessible as located ca. 10m up a vertical cliff face. Rocks appeared dry with little vegetation.	No tufa observed	n/a as not accessible	No	No	No tufa or positive indicator species recorded
LQ120	Slightly damp from drips from upper quarry shelf. Quarry vertical face dry.	No tufa observed	*Festuca rubra* *Pellia endiviifolia* (not associated with tufa)	No	No	1 positive indicator species recorded (*Fissidens adianthoides*) which was not re-found. Vegetation cover slightly higher in 2018 survey.
LQ121	Quarry face dry, slight calcareous deposit on rock face	Slight calcareous deposit	None	No	No	No change
LQ122	Seepage slightly damp but with no vegetation in seepage	Slight calcareous deposit	No	No	No	No change

Spring ID	Description	Tufa formation	Positive indicator species	Annex I habitat	Detailed plot survey	Change from 2018 survey
LQ123	Cascade tufa in upper parts of seepage with dropping water. Well-developed vegetation on upper shelf but not accessible for survey.	Calcareous deposits	*Festuca rubra, Equisetum* cf. *palustre* and probable *Didymodon tophaceus* and *Eucladium verticillatum* (observed with binoculars)	**Yes**	No (*7220 area not accessible)	*Aneura pinguis* the only positive indicator species recorded and not associated with tufa. Not considered *7220 habitat in 2018 survey.
LQ124	Seepage with calcareous deposits but little vegetation and no positive indicator species	Calcareous deposits	None	No	No	No change
LQ125a	Complex of three seepages in this area. Soft calcareous deposits on rock with slightly dropping water but little vegetation. No positive indicator species recorded in seepages or on quarry floor.	Soft calcareous deposits	None	No	No	3 positive indicator species recorded in 2018 survey *Didymodon tophaceus, Festuca rubra, Leiocolea (Mesoptychia) badensis* and considered to be *7220 habitat. Not refound in 2023 survey in any of the three seepages in this area. It is possible that these were present on the quarry floor in the 2018 survey (now dry) as quarry face does not appear to be suitable habitat.
LQ125b	Complex of three seepages in this area. Soft calcareous deposits on rock with slightly dropping water but little vegetation. No positive indicator species recorded in seepages or on quarry floor.	Soft calcareous deposits	None	No	No	3 positive indicator species recorded in 2018 survey *Didymodon tophaceus, Festuca rubra, Leiocolea (Mesoptychia) badensis* and considered to be *7220 habitat. Not refound in 2023 survey in any of the three seepages in this area. It is possible that these were present on the quarry floor in the 2018 survey (now dry) as quarry face does not appear to be suitable habitat.
LQ125c	Complex of three seepages in this area. Soft calcareous deposits on rock with slightly dropping water but little vegetation. No positive indicator species recorded in seepages or on quarry floor.	Soft calcareous deposits	None	No	No	3 positive indicator species recorded in 2018 survey *Didymodon tophaceus, Festuca rubra, Leiocolea (Mesoptychia) badensis* and considered to be *7220 habitat. Not refound in 2023 survey in any of the three seepages in this area. It is possible that these were present on the quarry floor in the 2018 survey (now dry) as quarry face does not appear to be suitable habitat.
LQ126	Damp seepage on rockface with slight calcareous deposits but no vegetation present	Soft calcareous deposits	None	No	No	*Didymodon tophaceus* recorded in 2018 survey but not associated with tufa deposits
LQ127	No tufa, seepage or positive indicator species on rockface or quarry floor	No	None	No	No	GPS point for 2018 survey located on quarry floor. But no tufa/ seepage present here or on rockface.

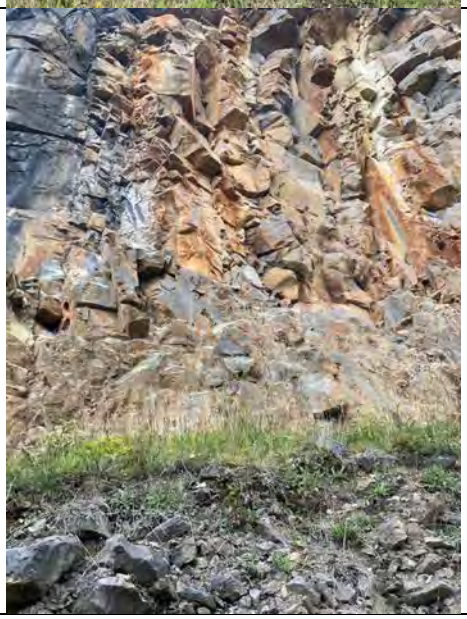
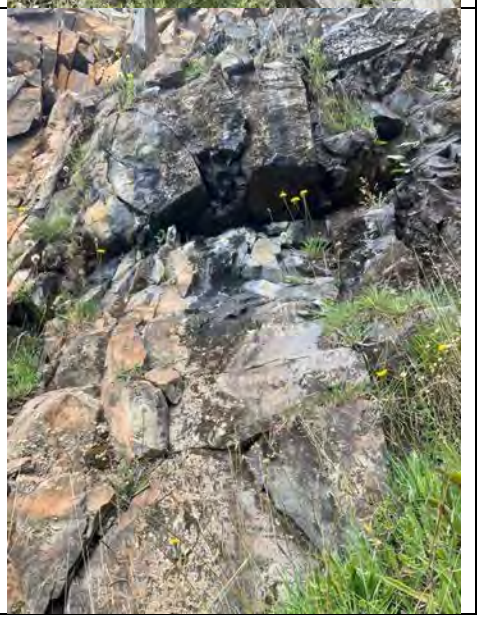
Spring ID	Description	Tufa formation	Positive indicator species	Annex I habitat	Detailed plot survey	Change from 2018 survey
LQI28	Several seepages in this area on the quarry rockface, one with tufa formation, but little vegetation present	Cascade tufa	None	No	No	Newly mapped point, no 2018 data
LQI29	Seepage with small amount of cascade tufa	Cascade tufa	None	No	No	Newly mapped point, no 2018 data

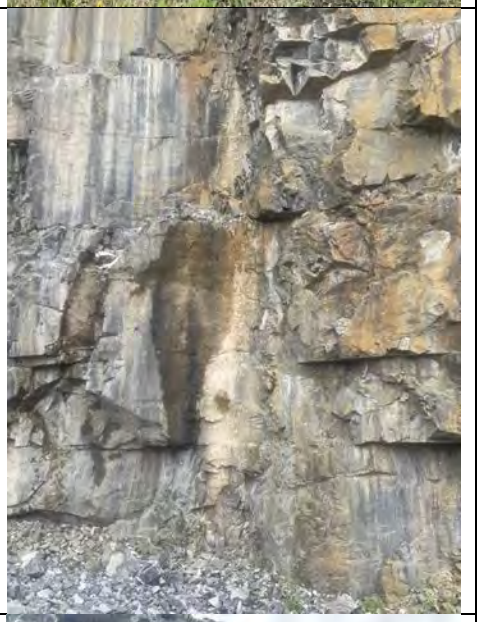
Table 3.2. Photographs for springs LQ101 to LQ129

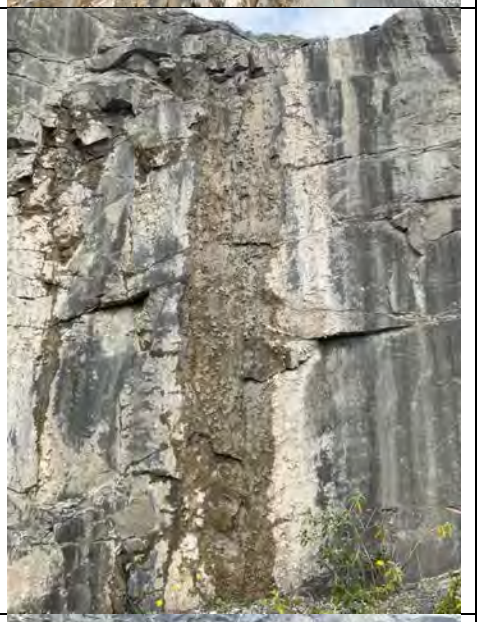
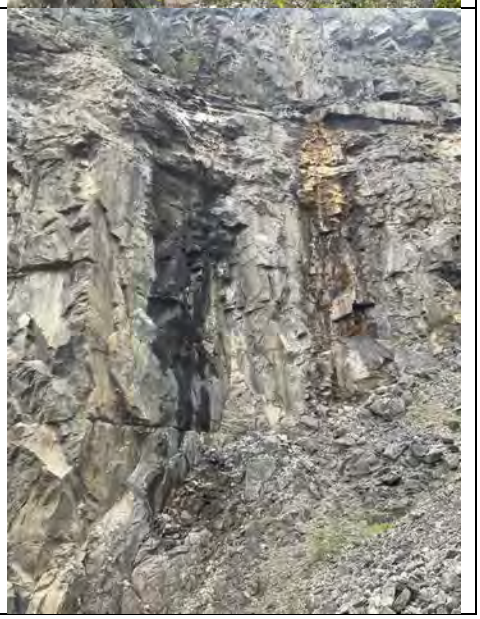
ID	Photograph	ID	Photograph
LQ101		LQ102	
LQ103		LQ104	

ID	Photograph	ID	Photograph
LQ105		LQ106	
LQ107		LQ108a	
LQ108b		LQ108c	

ID	Photograph	ID	Photograph
LQ108d		LQ109	
LQ110		LQ111	
LQ112		LQ113a	

ID	Photograph	ID	Photograph
LQ113b		LQ114	
LQ115		LQ116	
LQ117		LQ118	

ID	Photograph	ID	Photograph
LQ119		LQ120	
LQ121		LQ122	
LQ123		LQ124	

ID	Photograph	ID	Photograph
LQ125a		LQ125b	
LQ125c		LQ126a	
LQ127		LQl28	

ID	Photograph	ID	Photograph
LQI29			

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APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

PLOT DETAILS

Site name: Lackagh Quarry				
Plot ID	**LQ102**	**LQ107**	**LQ108d**	**LQ113**
Survey date	04/07/2023	04/07/2023	04/07/2023	04/07/2023
Grid reference	M3039128445	M3043328548	M3044228567	M3056728579
Spring type	Seepage	Seepage	Seepage	Seepage
Plot dimensions	2m x 2m	2m x 2m	2m x 2m	1m x 4m
Slope	c 90^{o}	c 90^{o}	c 90^{o}	c 50^{o}
Altitude (m)	c 33m	c 37m	c 42m	c 33m
Aspect	E	SE	SE	SSW
pH	7.32	7.25	7.34	Not possible to sample
EC mS	0.91	0.85	2.28	n/a
Water temp.	20.2	24.9	19.7	n/a
Vegetation community	Group 1	Group 1	Group 1	Group 1

PHYSICAL CHARACTERISTICS

Category	**LQ102**	**LQ107**	**LQ108d**	**LQ113**
Tufa formation				
Cascade	30	60	75	5
Paludal (1)	Algal 50	5	5	
Paludal (2)	10			20
Paludal (3)				
Stream crust				
Oncoids/ ooids				
Dam				
Cemented rudites				
Non-tufa	10	35	20	75
Total	100%	100%	100%	100%
Water				
Flowing/ trickling	20	15	60	15
Pool/ standing water				
Dripping	15			
Damp	50	45	35	20
Dry	15	40	5	65
Other				
Total	100%	100%	100%	100%
Surface				
Living field/ ground flora	30	15	15	40
Bare tufa (active/ recent)	20	60	70	15
Ancient/ inactive tufa	40			
Leaf litter/ standing dead			3	1
Bare soil	10		2	1
Bare stone		25	10	43

APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

Category	LQ102	LQ107	LQ108d	LQ113
Other				
Total	100%	100%	100%	100%
Canopy				
Total canopy cover (%)	0	0	0	35
Maximum height above plot (m)				15
Other				
Vegetation height (cm)	10	10	5	20
Dung	Absent	Absent	Absent	Absent
Trampling	Absent	Absent	Absent	Absent
Water flow	Damp, no flow	Dripping	Flowing/ trickling	Dripping
Other notes	No obvious impacts	No obvious impacts	No obvious impacts	No obvious impacts

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous

VEGETATION SUMMARY

Category	LQ102	LQ107	LQ108d	LQ113
Bryophyte total cover (%)	19	9	3.5	12
Vascular plant total cover (%)	10.5	6.5	9	26
Woody vegetation total cover (%)	0.5	0.5	3	2
Plot species richness	14	13	14	14

SPECIES COVER

Plot ID	Group	Species	Species type	Cover %
LQ02	Bryophyte	*Didymodon tophaceus*	Positive	10
LQ02	Bryophyte	*Fissidens adianthoides*	Positive	0.5
LQ02	Bryophyte	*Pellia endiviifolia*	Positive	0.5
LQ02	Bryophyte	*Sesleria caerulea*	Accompanying	8
LQ02	Vascular	*Briza media*	Accompanying	1
LQ02	Vascular	*Buddleja davidii*	n/a	0.5
LQ02	Vascular	*Carex flacca*	Accompanying	1
LQ02	Vascular	*Cymbalaria muralis*	n/a	0.5
LQ02	Vascular	*Equisetum palustre*	Accompanying	5
LQ02	Vascular	*Festuca rubra*	Positive	0.5
LQ02	Vascular	*Juncus subnodulosus*	Accompanying	0.3
LQ02	Vascular	*Taraxacum officinale agg.*	Accompanying	0.5
LQ02	Vascular	*Typhus latifolia*	n/a	1
LQ07	Bryophyte	*Cratoneuron filicinum*	Negative	3
LQ07	Bryophyte	*Didymodon tophaceus*	Positive	0.7
LQ07	Bryophyte	*Eucladium verticillatum*	Positive	0.5
LQ07	Bryophyte	*Fissidens adianthoides*	Positive	1
LQ07	Bryophyte	*Pellia endiviifolia*	Positive	3
LQ07	Bryophyte	*Sesleria caerulea*	Accompanying	0.7
LQ07	Vascular	*Carex flacca*	Accompanying	1
LQ07	Vascular	*Festuca rubra*	Positive	1
LQ07	Vascular	*Geranium robertianum*	Accompanying	0.1
LQ07	Vascular	*Holcus lanatus*	Accompanying	0.3
LQ07	Vascular	*Leontodon hispidus*	Accompanying	3
LQ07	Vascular	*Rubus fruticosus agg. (unwooded springs only)*	Negative woody	0.5
LQ07	Vascular	*Salix cinerea (unwooded springs only)*	Negative woody	1
LQ08d	Bryophyte	*Didymodon tophaceus*	Positive	0.5
LQ08d	Bryophyte	*Pellia endiviifolia*	Positive	3

APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

Plot ID	Group	Species	Species type	Cover %
LQ08d	Vascular	*Agrostis stolonifera*	Accompanying	0.1
LQ08d	Vascular	*Brachypodium sylvaticum*	Accompanying	0.3
LQ08d	Vascular	*Briza media*	Accompanying	0.5
LQ08d	Vascular	*Carex flacca*	Accompanying	0.5
LQ08d	Vascular	*Equisetum palustre*	Accompanying	0.5
LQ08d	Vascular	*Festuca rubra*	Positive	1
LQ08d	Vascular	*Leontodon hispidus*	Accompanying	0.5
LQ08d	Vascular	*Lotus corniculatus*	Accompanying	0.1
LQ08d	Vascular	*Molinia caerulea*	Accompanying	5
LQ08d	Vascular	*Rubus fruticosus agg. (unwooded springs only)*	Negative woody	3
LQ08d	Vascular	*Salix cinerea (unwooded springs only)*	Negative woody	0.3
LQ08d	Vascular	*Scrophularia auriculata*	Accompanying	0.3
LQ13	Bryophyte	*Cratoneuron filicinum*	Negative	3
LQ13	Bryophyte	*Didymodon tophaceus*	Positive	3
LQ13	Bryophyte	*Fissidens adianthoides*	Positive	3
LQ13	Bryophyte	*Pellia endiviifolia*	Positive	3
LQ13	Bryophyte	*Pohlia melanodon*	Accompanying	0.1
LQ13	Vascular	*Brachypodium sylvaticum*	Accompanying	10
LQ13	Vascular	*Carex flacca*	Accompanying	8
LQ13	Vascular	*Epilobium parviflorum*	Accompanying	0.5
LQ13	Vascular	*Fraxinus excelsior (unwooded springs only)*	Negative woody	0.5
LQ13	Vascular	*Hedera hibernica (unwooded springs only)*	Negative woody	0.5
LQ13	Vascular	*Leontodon hispidus*	Accompanying	8
LQ13	Vascular	*Lotus corniculatus*	Accompanying	0.5
LQ13	Vascular	*Rubus fruticosus agg. (unwooded springs only)*	Negative woody	1
LQ13	Vascular	*Solidago virgaurea*	Accompanying	0.5

PLOT PHOTOS

Plot photos

LQ102 Plot

LQ102 Close-up of plot vegetation

APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

Plot photos

LQ107 Plot

LQ107 Close-up of plot vegetation

LQ108d Plot

LQ108d Close-up of plot vegetation

LQ113 Plot

LQ113 Close-up of plot vegetation

APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

CONSERVATION SCORE

Category	LQ102	LQ107	LQ108d	LQ113
Species diversity score	Low = 1	Moderate = 2	Low = 1	Low = 1
HQ Indicator Species	0	0	0	0
Tufa-forming capacity	High = 3	High = 3	High = 3	Moderate = 2
Other positive characteristics	Spring is part of spring complex within quarry	Spring is part of spring complex within quarry	Spring is part of spring complex within quarry	Spring is part of spring complex within quarry
Conservation Score	5	6	5	4
Rank	High	High	High	Moderate

CONDITION ASSESSMENT

Criteria	LQ102	LQ107	LQ108d	LQ113
Species assessment criteria				
High quality indicator species	0	0	0	0
Positive indicator species	4 **PASS**	5 **PASS**	3 **PASS**	3 **PASS**
Invasive species	0	0	0	0
Negative herbaceous indicator species	Absent **PASS**	Absent **PASS**	Absent **PASS**	Absent **PASS**
Negative bryophyte indicator species	Absent **PASS**	*Cratoneuron filicinum* F **PASS**	Absent **PASS**	*Cratoneuron filicinum* F **PASS**
Negative woody indicator species	*Buddleja davidii* **FAIL**	*Rubus fruticosus* agg., *Salix cinerea* **FAIL**	*Rubus fruticosus* agg., *Salix cinerea* **FAIL**	*Rubus fruticosus* agg. **FAIL**
Spring water composition and flow				
Nitrate level (mg/l)	Unknown **n/a**	Unknown **n/a**	Unknown **n/a**	Unknown **n/a**
Phosphate level (Ortho-P) (µg/l)	Unknown **n/a**	Unknown **n/a**	Unknown **n/a**	Unknown **n/a**
Water flow	No obvious alteration **PASS**	No obvious alteration **PASS**	No obvious alteration **PASS**	No obvious alteration **PASS**
Impacts of grazing				
Field layer height	**PASS**	**PASS***	**PASS***	**PASS**
Trampling/dung	**PASS**	**PASS**	**PASS**	**PASS**
Overall Assessment				
Structure & Functions	Result = 1 fail **UNFAVOURABLE - INADEQUATE**	Result = 1 fail **UNFAVOURABLE - INADEQUATE**	Result = 2 fail **UNFAVOURABLE - INADEQUATE**	Result = 1 fail **UNFAVOURABLE - INADEQUATE**
Future prospects	**UNFAVOURABLE - INADEQUATE**	**UNFAVOURABLE - INADEQUATE**	**UNFAVOURABLE - INADEQUATE**	**UNFAVOURABLE - INADEQUATE**

*Bryophyte dominated so vegetation height naturally lower than 10cm

NEGATIVE ACTIVITIES

Activity	LQ102	LQ107	LQ108d	LQ113
PM07 Natural processes without direct or indirect influence from human activities or climate change (natural succession and woody species invasion)	Low negative impact, originating inside of site	Low negative impact, originating inside of site	Low negative impact, originating inside of site	Low negative impact, originating inside of site

TARGET VALUES FOR CONDITION ASSESSMENT CRITERIA

Criteria	Target value
Species assessment criteria	
High quality indicator species	n/a (included with positive indicator species)
Positive indicator species	3 species AND no loss from baseline number of species
Invasive species	Absent

APPENDIX A - DETAILED PLOT RESULTS AND ASSESSMENT

Criteria	Target value
Negative herbaceous indicator species	Total cover should not be dominant or abundant
Negative bryophyte indicator species	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 is frequent or 1 is abundant
Negative woody indicator species	Absent (except in wooded springs)
Spring water composition and flow	
Nitrate level	No increase from baseline and not above 10 mg/l
Phosphate level	No increase from baseline and not above 15 µg/l
Water flow	No alteration of natural flow
Impacts of grazing	
Field layer height	Height between 10 and 50cm*
Trampling/dung	Impact should not be abundant/dominant
Overall Structure & Functions Assessment	
All pass or one minor/borderline fail AND, if some indicators are Not Determined, the number of passes is at least five AND there is a pass for Positive Indicator Species	Green - Favourable
1 - 2 Fail	Amber - Unfavourable Inadequate
>2 Fail	Red – Unfavourable Bad

*Where vegetation is naturally bryophyte dominated, expert judgement may be used to pass a plot with lower vegetation height