PETRIFYING SPRING SURVEY AND ASSESSMENT
DODDER VALLEY PARK, SOUTH DUBLIN

October 2020

Report produced by Denyer Ecology for:
South Dublin County Council

CONTENTS

EXECUTIVE SUMMARY

- Denyer Ecology was commissioned by South Dublin County Council to undertake surveys and assessments of petrifying spring/ seepages at Dodder Valley Park, South Dublin as part of the Dublin Urban Rivers Life (DURL) project. The DURL Project aims to address the issue of pollution in urban rivers using techniques with proven results relating to domestic misconnection sources and Integrated Constructed Wetland (ICW) development.
- The aims of this project were to: i) identify the location and assess the status of any petrifying (tufa-forming) spring or seepage within the study area; and, ii) to assess any potential impacts from the proposed ICW on the spring/ seepages.
- A detailed survey of the petrifying springs and seepages within the study area was undertaken in late May/ early June 2020. Survey methodology followed standard *Monitoring Guidelines for the Assessment of Petrifying Springs in Irelan*d (Lyons & Kelly, 2016) and the spring vegetation communities were classified using Lyons and Kelly (2017). The ecological condition and conservation score of each spring/ seepage was assessed.
- A 'spring zone' was identified in an area of the riverbank in the southern part of the site. Within the spring zone, eight calcareous springs/ seepages were identified and mapped. These comprise: three Annex I priority petrifying springs; three non-Annex spring/ seepages with tufa; and, three non-Annex spring/ seepages with no tufa formation.
- Four springs were surveyed in detail. This includes the main spring (D02) and spring/ seepages D01, D04 and D06. One spring (D04) supported the vegetation community Group 2 *Palustriella commutata-Geranium robertianum* springhead and the remainder (D01, D02 and D06) supported Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes (Lyons, 2016). Average species richness of the spring/ seepages ranged from 11 to 27. All failed the condition assessment. Criteria which failed include invasive species presence, trampling damage and potential nutrient enrichment. The four surveyed spring/ seepages are of moderate to high national conservation ranking.
- Known petrifying springs in South Dublin are restricted to three river valleys (River Liffey, Glendoo Brook (River Dodder tributary) and River Dodder. The main area of petrifying springs is along the River Dodder valley within Glenasmole Valley SAC; Kiltipper Park and Dodder Valley Park. The springs at Dodder Valley Park (study area) have similar vegetation communities and tufa formation to those found at Kiltipper Park and Glenasmole Valley SAC.
- The study site (Dodder Valley Park) is considered to be of County ecological importance in relation to petrifying springs as: it supports a number of examples of this Annex I priority habitat; is part of an extensive spring system along the River Dodder valley, which includes Glenasmole Valley SAC; and, it contains the most downstream known petrifying spring along the River Dodder valley (spring D02)
- The main factors affecting the condition of petrifying springs are water quality (e.g. pH, mineral composition and nutrient levels) and quantity (e.g. flow rate). In addition, factors such as artificial disturbance; trampling; river engineering works; and, illegal dumping are potential negative pressures.
- A detailed hydrogeological assessment of the proposed ICW of the recorded springs was undertaken in 2020 (CDM, 2020). Potential construction impacts to the spring/ seepages include direct disturbance; disruption to bedrock aquifer from which springs discharge; indirect impact from sediment release during excavations; spills of fuel or other chemicals; hydrogeological changes resulting from alteration of gravel layers and replacement with clay liner materials.
- Proposed construction mitigation measures include: ensuring that no construction activities are undertaken in the 'spring zone'; standard best practice measures to prevent release of sediment into the spring zone; standard best practice measures in relation to the storage of fuel and other chemicals and re-fuelling; ensuring that construction is implemented as

intended, especially that the designed thickness, composition and permeability of liner materials are achieved; and, that precise elevations of key design features (notably the base of liners) should be achieved and maintained.

- During the ICW operation phase there is a potential impact from leakage of water from the ICW through the clay liner. Leakage water will migrate in the shallow groundwater environment under the prevailing hydraulic gradients towards the river (and spring D02). There are currently no observations of escarpment seeps from shallow groundwater pathways following storm events. However, even if it is assumed that all of the ICW leakage water would discharge at the petrifying springs, the influence would be minor as the estimated leakage represents only c. 1.7% of the total spring discharge. Under normal, operations, the water would be relatively free of any pollutants, and any pollutants that may be present will undergo some attenuation in the shallow groundwater environment.
- With these mitigation measures in place, the results of the hydrogeological assessment (CDM, 2020) show that there are no proposed residual impacts to the springs/ seepages recorded at this site as a result of the ICW construction and operation.
- Management recommendations for the spring/ seepages include removal of invasive species, removal of litter and protection from trampling and disturbance.
- Monitoring recommendations for the spring/ seepages include ecological monitoring (following the methodology used in the 2020 survey) every 2-3 years. The hydrogeological assessment report details recommended hydrogeological monitoring criteria (CDM, 2020).

1 INTRODUCTION

The following report reflects only the author's view and the Executive Agency for Small and Medium-sized Enterprises is not responsible for any use that may be made of the information it contains.

1.1 Project details

Denyer Ecology was commissioned by South Dublin County Council to undertake surveys and assessments of petrifying spring/ seepages at Dodder Valley Park, South Dublin. This Dublin Urban Rivers Life (DURL) project (Agreement number: LIFE17 ENV/IE/000281) is a collaboration between South Dublin County Council and Dún Laoghaire-Rathdown County Council. The DURL Project aims to address the issue of pollution in urban rivers using techniques with proven results relating to domestic misconnection sources and Integrated Constructed Wetland (ICW) development. The River Griffeen in South Dublin County and the Carrickmines Stream in Dún Laoghaire-Rathdown County have been identified for water quality improvement and five ICWs will be developed in South Dublin County. South Dublin County Council is the lead authority on the project.

The DURL Project (Agreement number: LIFE17 ENV/IE/000281) has received funding from the Union.

The DURL Project intends to consider applying for Part 8 approval for the construction of two Integrated Constructed Wetlands (ICWs) at Dodder Valley Park, South Dublin. These proposed sites are selected to improve water quality through the development of ICWs through the treatment of stormwater contaminated with misconnections from domestic dwellings which currently discharge directly into the Dodder River. The estimated effective size of each ICW is 2000m^2 with an estimated additional boundary of 1000m^2. The works include installation of ICWs, landscaping works, new pedestrian access routes in the park and all necessary associated ancillary works on the site and adjacent areas.

1.2 Project aims

The objectives of this project are to identify the location and assess the status of any petrifying (tufa-forming) spring or seepage found within the study area (Figure 1.0) and to provide an output report for consideration at a possible Part 8 approval for ICW development.

'Petrifying springs with tufa formation (*Cratoneurion*)' [7220] are an EU Habitats Directive Annex I priority habitat. Petrifying springs are a 'Feature of Interest' for the Glenasmole Valley Special Area of Conservation (SAC), which is located within the Dodder Valley (upstream of the study site). Petrifying springs have also been recorded downstream of the SAC along the Dodder Valley (including the study site).

1.3 Site

The survey area (Figure 1.0) comprises a section of *c.* 15 hectares of the Dodder Valley Park. The River Dodder forms the southern boundary of the survey area. The survey area includes the northern bank of the river, which is largely steep and wooded, and playing fields/ amenity grassland on the flat area above the river valley. There are various paths through the site (including the wooded valley) and recreational users are frequent.

Figure 1.0. Location of study area, Dodder Valley Park, South Dublin

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1.4 Relevant Expertise

Dr Joanne Denyer is a highly experienced botanist and bryologist with over 18 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. She received the National Biodiversity Data Centre 'Distinguished Recorder Award' in 2014 in recognition of outstanding contribution to bryological recording in Ireland. She regularly provides botanical and bryological training courses for amateurs and professionals and leads training meetings for the British Bryological Society (Irish group), Dublin Naturalist Field Club and the Botanical Society of the British Isles. Training courses provided include grass, sedge and rush identification, bryophyte and *Sphagnum* identification and using bryophytes as habitat indicators. She also lectures on bryophyte ecology and identification to undergraduates at University College Dublin and Trinity College Dublin.

Dr Denyer specialises in wetland habitats and is a national expert on Annex I habitat priority petrifying springs. She has worked on a wide range of projects and sites in relation to this habitat. This includes detailed survey, assessment and monitoring, Ecological Impact Assessment and acting as an expert witness on calcareous springs at an Oral Hearing. She provides expert advice on this habitat to County Councils and National Parks and Wildlife Service (NPWS). In 2018 she assisted National Parks and Wildlife Service (NPWS) in the latest Article 17 reporting on Petrifying springs to the European Commission (under Article 11 of the Habitats Directive, each member state must report every 6 years on the conservation status of Annex I habitats).

2 METHODOLOGY

2.1 Desktop data

Desktop data accessed in this assessment includes the following data sources:

- NPWS records of rare and protected bryophytes.
- Rare and Threatened bryophytes of Ireland (Lockhart et al., 2012).

- British Bryological Society Atlas dataset.
- National Biodiversity Data Centre records for bryophytes and vascular plants.
- Survey data from the Irish Semi-natural Grassland Survey (ISGS).
- Survey data from ecological surveys undertaken by Denyer Ecology in the Dodder Valley.
- Aerial photography and OSI mapping.
- Additional literature and resources as relevant.
- Consultation with relevant ecologists and organisations.

South Dublin County Council provided the following background information for this project:

- The location of three known spring/ seepage areas within the survey area (provided by the SDCC Heritage Officer).
- 2020 water quality data on one known spring at the site.
- Hydrogeology report: '*Petrifying Springs, Dodder Valley Park Hydrogeological Assessment of Proposed ICW Development'* (CDM Smith, 2020).

2.2 Field survey

2.2.1 Site walk-over

- All accessible areas of study area (Figure 1.0) were walked over by a bryologist with experience of field survey, identification and assessment of petrifying springs in late May/ early June 2020.
- The location of any base-rich seepages/ petrifying springs/ tufa formation were mapped using a GPS.
- General notes of the vegetation (vascular plants and bryophytes) of any springs and adjacent vegetation was made, including georeferenced photographs.

2.2.2 Detailed spring survey

- Detailed survey was undertaken of a representative section of any petrifying spring/ base-rich seepages to determine a) if it is an example of the Annex I priority habitat 7220; b) to evaluate its quality and condition; and, c) assign a conservation score and ranking.
- The relevé sampling methodology followed *Monitoring Guidelines for the Assessment of Petrifying Springs in Irelan*d (Lyons & Kelly, 2016). Data collected includes habitat and relevé (plot) photographs; releve location(s) (GPS); recording of percentage cover of all vascular plant and bryophyte species (including positive and negative indicator species); shading; tufa type and extent; water chemistry (pH, conductivity and temperature with a hand-held field meter); impacting activities (such as grazing, invasive species, changes to water quality and/ or quality, trampling and dumping).
- The spring vegetation community was classified using Lyons and Kelly (2017).

2.2.3 Condition assessment

- The ecological condition of the springs was assessed using the '*Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland*' (Lyons & Kelly, 2016). Criteria include positive and negative indicator species (frequency and cover), woody species cover, vegetation height and disturbance.

2.2.4 Conservation score

- The 'Conservation Score' of the petrifying springs was assessed using the '*Monitoring Guidelines for the Assessment of Petrifying Springs in Ireland*' (Lyons & Kelly, 2016). Criteria such as species diversity, High Quality indicator species, tufa-forming capacity and other positive characteristics are used to calculate the 'Conservation Score' for each spring. This score is then be used to rank the quality of the spring at a national level (Lyons & Kelly, 2016).

2.3 Ecological evaluation

The ecological importance of the survey area (in relation to petrifying springs) was assessed using the criteria listed in the *Guidelines for Assessment of Ecological Impacts of National Roads Schemes* (NRA,

2009) and the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine version 1.1.* (CIEEM, 2018). The assessment was based on the presence and quality of the springs and associated species only. Ecological evaluation scheme:

- International ecological importance
- National ecological importance
- County ecological importance
- Local (higher value) ecological importance
- Local (lower value) ecological importance

2.4 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. (2014a & b) is used; this is based on the *Checklist of British and Irish bryophytes* (Hill et al., 2008) with minor modifications to reflect recent taxonomic changes.

2.5 Potential limitations

There are a few areas of the riverbank which have dense wooded vegetation, which is difficult to access, particularly the north-eastern section. However, there were few areas which could not be accessed from either the riverbank or bank above and it is considered that it is unlikely that any significant springs will have been missed.

3 SPRING SURVEY RESULTS AND EVALUATION

3.1 Walk-over survey

An area of the riverbank in the southern part of the site was found to support a number of springs and seepages. This 'spring zone' is shown on Figure 3.1. Within the spring zone, eight calcareous springs/ seepages were identified and mapped. These are summarised in Table 3.1 and shown on Figure 3.2. They include three categories:

- Annex I petrifying spring (3 locations)
- Non-Annex spring with no tufa (2 locations)
- Non-Annex spring with tufa (3 locations)

In addition, two streams/ discharges were recorded just outside of the northern boundary of the survey area (Figure 3.3). One of these (S1) discharges from a pipe in the river bank and flows downhill into the River Dodder. The second (S2) was recorded where it met the River Dodder (Photograph 3.1) and traced back as far as possible, but dense woody vegetation prevented the source being located. There were no signs of tufa of petrifying spring indicator species. SDCC advised that both of these discharges (S1 and S2) are stormwater outfall discharges (Figure 3.4).

Figure 3.1. 'Spring zone' in Dodder Valley Park

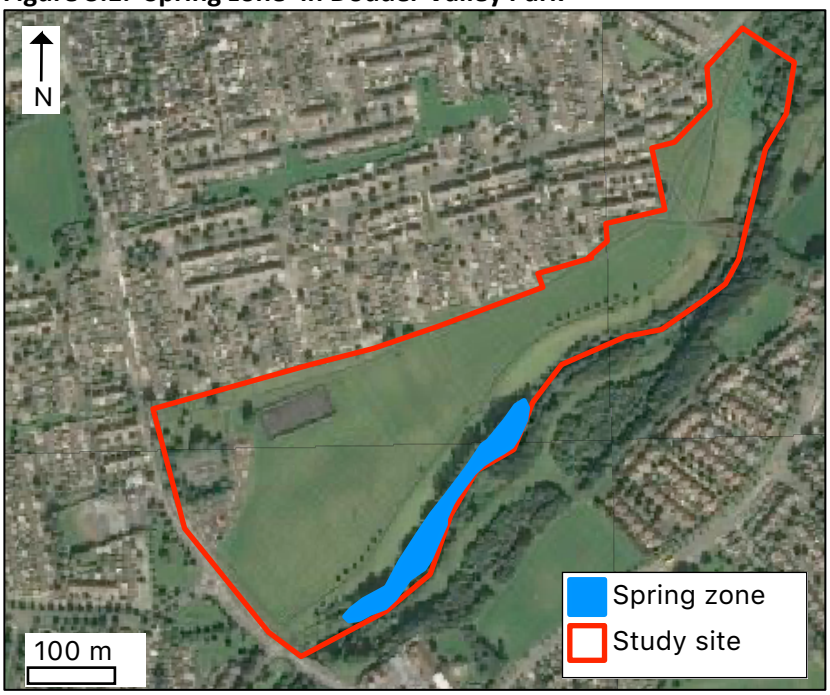


Figure 3.2. Location of recorded calcareous springs/ seepages in 'spring zone'

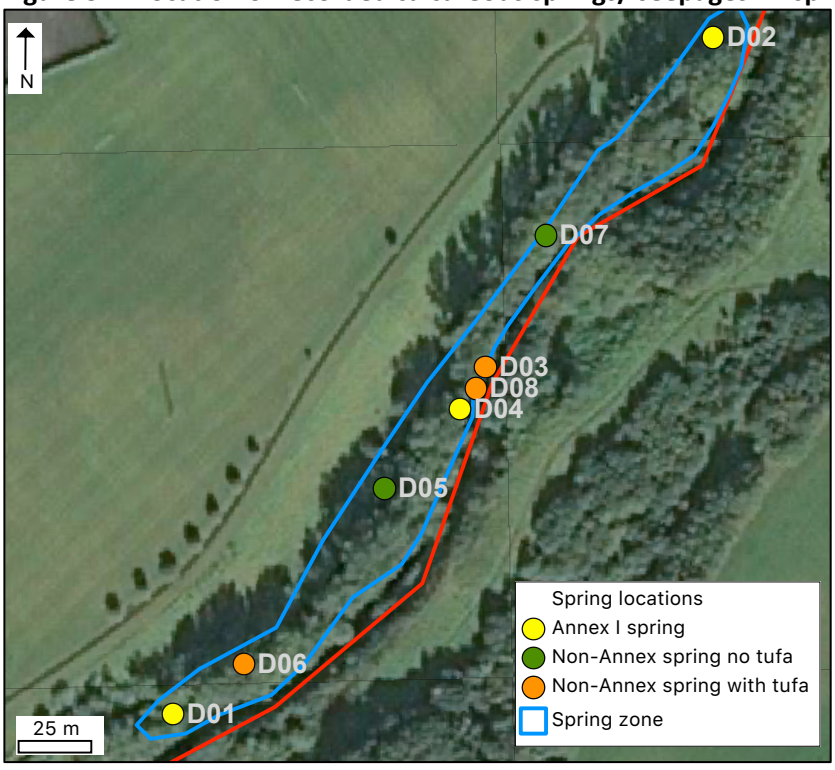


Figure 3.3. Location of two streams/ discharges to the north of the survey area

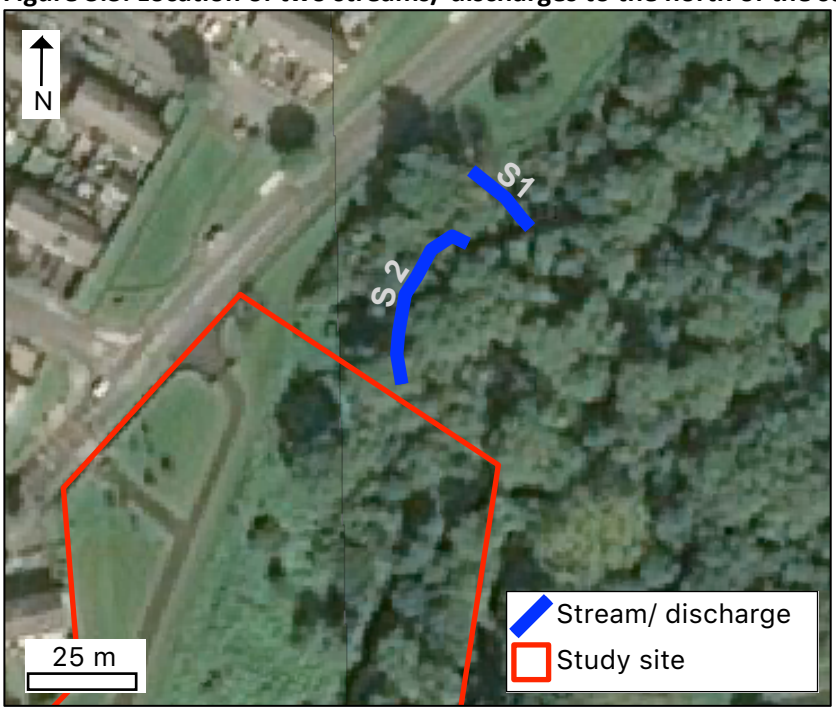
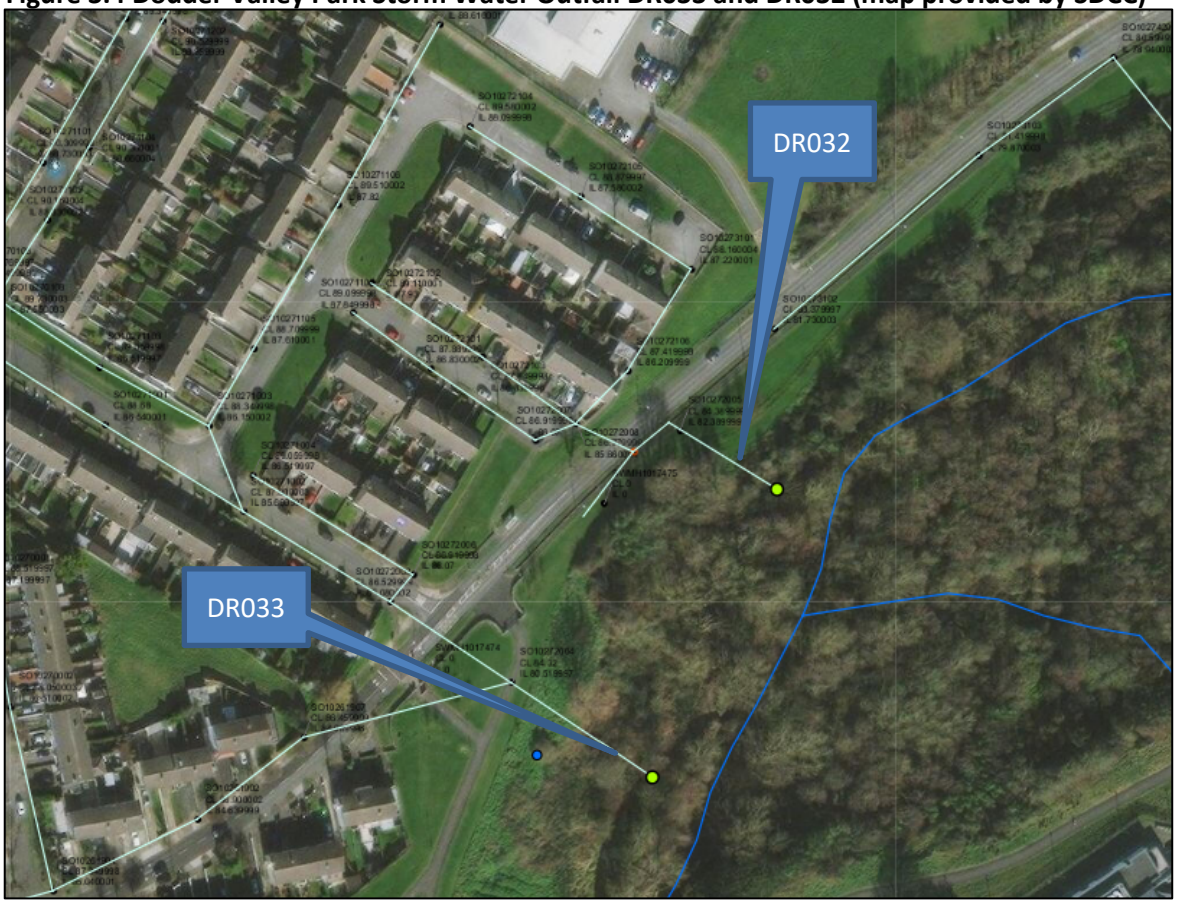


Figure 3.4 Dodder Valley Park Storm Water Outfall DR033 and DR032 (map provided by SDCC)



Photograph 3.1. Stream/ discharge S1 arising from a pipe in the wooded riverbank (view to N)

Photograph 3.2. Stream/ discharge S2 flowing into a channel of the River Dodder (view to NW)

Table 3.1. Summary of springs recorded at Dodder Valley Park in 2020 survey

Spring number	Description	Detailed assessment?	Photo
Spring D01	Small spring arising in lower part of wooded riverbank. Steady flow of water despite recent dry weather. Two small channels which join and flow downstream into the river. Cascade tufa formation dominant with some paludal and stream crust tufa formation.	**Yes**. 3 positive indicator species + tufa formation = **Annex I Petrifying spring**	
Spring D02	Main spring in area. Arises in upper part of wooded riverbank, two channels join and then flow down towards river in a single channel. At the riverbank it widens to flow over an area c5m wide with significant tufa formation. Strong flow despite recent dry weather. Cascade and paludal tufa formation in the upper part of the channel and large tufa cascades at the riverbank.	**Yes**. 4 positive indicator species + tufa formation = **Annex I Petrifying spring**	

Spring number	Description	Detailed assessment?	Photo
Spring D03	Small iron seepage/ spring below rocks on lower riverbank near to spring D04. Tufa formation on bank under vegetation.	Assessed as part of the D03-D04-D08 seepage area.	
Spring D04	Small spring arising from a group of rocks in lower riverbank. Flows into small 'beach' area which is reasonably heavily used. The tufa formation is limited to the spring source which is near vertical on the rocks. Spring and vegetation less than 1m^2. However, some tufa formation present with typical spring species.	**Yes**. 3 positive indicator species + tufa formation = **Annex I Petrifying spring**	

Spring number	Description	Detailed assessment?	Photo
Spring D05	Seepage area onto path above wooded riverbank. Seepage arises in small bank above path and flows through tall herb swamp vegetation and onto path below. No signs of seepage below the path down to riverbank.	**No**. No positive indicator species or tufa formation present.	
Spring D06	Seepage area onto path above wooded riverbank. Seepage arises in small bank above path and flows through tall herb swamp vegetation and onto path below. In contrast to spring D05, tufa formation is locally abundant in the form of oncoids/ ooids.	**Yes**. 0 positive indicator species but good tufa formation = **potential Annex I Petrifying spring**	

Spring number	Description	Detailed assessment?	Photo
Spring D07	Small seepage area on wooded bank. No obvious flow but ground damp. Vegetation dominated by *Carex remota* with *Agrostis stolonifera*. No tufa formation or petrifying spring indicator species present.	**No**. No positive indicator species or tufa formation present.	
Spring D08	Small iron seepage/ spring on lower riverbank near to spring D03 and D04. Some sparse tufa formation on rocks.	Assessed as part of the D03-D04-D08 seepage area.	

3.2 Detailed relevé surveys and condition assessment

3.2.1 Detailed spring survey summary

Four springs were surveyed in detail; one detailed spring relevé was undertaken in each of these springs/ spring complexes. A summary of the results is shown in Tables 3.2 and 3.3. and the full results of the detailed relevés and condition assessment are shown in **Appendix A**. These results can be also used as a baseline for any future monitoring.

Table 3.2. Table 3.2. Main tufa formation, vegetation type and species richness in each relevé

Spring no.	Relevé no.	Vegetation community[1]	Tufa formation	Relevé species richness	Average sp. richness for vegetation community[2]
D01	R01	Group 3	Cascade (30%); paludal (5%); stream crust (5%)	27	13.8
D02	R02	Group 3	Cascade (15%); paludal (15%)	17	13.8
D04	R03	Group 2	Cascade (10%); paludal (5%)	11	14.1
D06	R04	Group 3	Paludal (3%); Oncoids/ ooids (40%)	11	14.1

Table 3.3. Conservation score, ranking and condition assessment summary for each relevé

Spring no.	Relevé no.	Annex I spring	Conservation score	Conservation ranking	Condition assessment result
D01	R01	Yes	5	High	FAIL (invasive species)
D02	R02	Yes	5	High	FAIL (invasive species)
D04	R03	Yes	4	Moderate	FAIL (trampling)
D06	R04	No	3	Moderate	FAIL (positive indicator species; invasive species; Negative herbaceous and bryophyte indicator species, vegetation height and trampling)

Springs D01, D02 and D04 are considered to be examples of the **Annex I priority habitat** 'Petrifying springs' due to the presence of typical tufa vegetation with tufa formation. The spring vegetation communities recorded in these springs has also been recorded in Glenasmole Valley SAC (Lyons 2015), which is located within 2km upstream of the survey area and is also associated with the River Dodder.

3.3 Condition summary

- Springs D01 and D02 failed the invasive species criteria as Monbretia *Crocosmia x crocosmiiflora* was present within the springs. There are only a few plants at present.
- Spring D02 passed the water quality criteria as water sampling in 2020 indicated low levels of nitrate and phosphate in the spring. However, filamentous algae is frequent in the spring and seepage area which suggests recent higher nutrient levels.
- Spring D04 fails on trampling as it discharges onto a small beach area which is heavily used by people and dogs. There was also litter present in the spring. The springhead is located on a vertical boulder face and is therefore protected from most damage. The spring seepage areas D03 and D08, which are associated with D04 were adjacent to a small woodland path and had some trampling damage, but this was much more localised.
- Spring D06 is not considered to be an example of the Annex I habitat 'petrifying springs'. Tufa is frequent in the spring, but nutrient levels are high and the spring is dominated by tall-herb swamp vegetation and fails several of the condition assessment criteria. This spring originates in the bank above the river and may only recently have become wooded.

3.4 Ecological evaluation

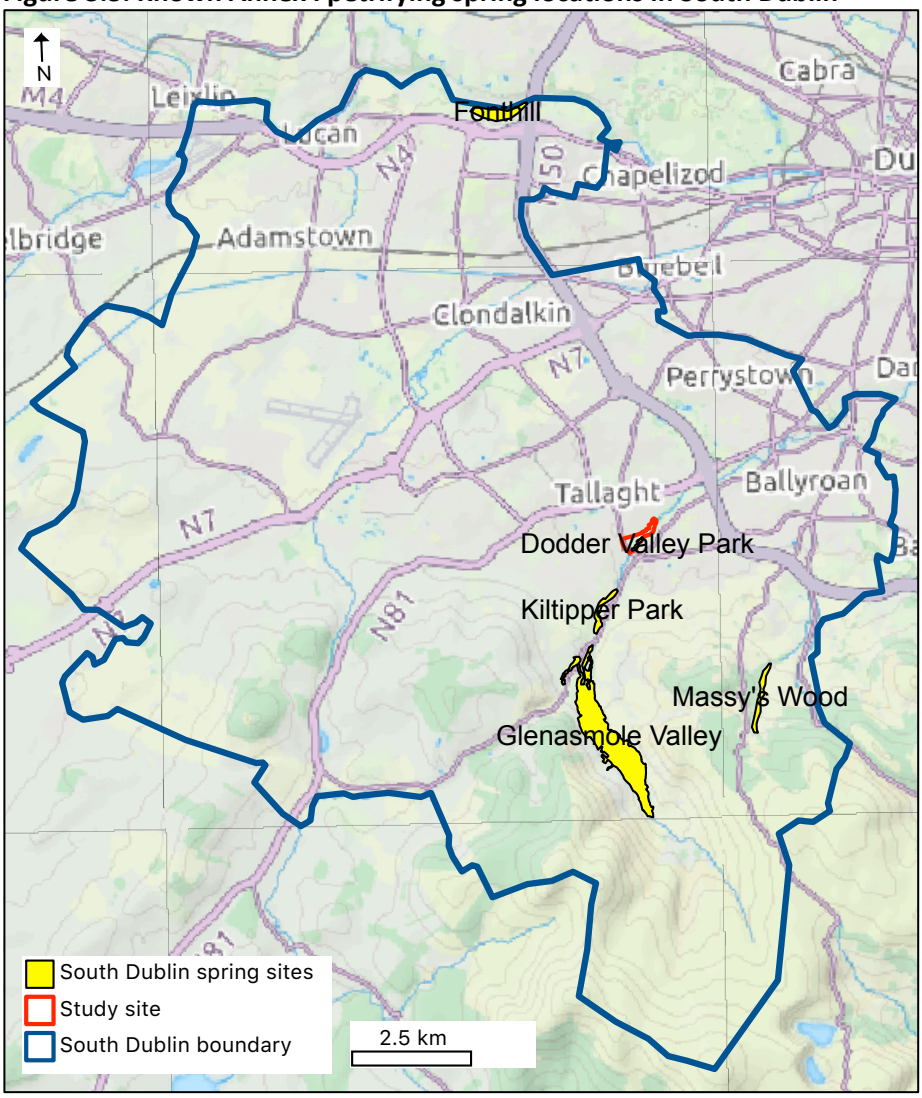
3.4.1 Springs within South Dublin

Known petrifying springs in South Dublin are restricted to three river valleys (Figure 3.3). There are two recorded springs at Fonthill in the River Liffey valley and a series of 3-4 springs along the Glendoo Brook (a tributary of the River Dodder) in Massy's Wood. The main area of petrifying springs is along the River Dodder valley from Glenasmole Valley SAC approximately 2km downstream to Dodder Valley Park. These are concentrated in three areas: Glenasmole Valley SAC; Kiltipper Park and Dodder Valley Park (Figure 3.3).

Glenasmole Valley SAC is designated for the Annex I priority habitat 'petrifying springs'. The springs in this SAC were surveyed in detail as part of a national survey of tufa springs (Lyons, 2015; 2016). There are *c.* 20 springs and the spring vegetation communities recorded by Lyons (2015; 2016) were: Group 2 *Palustriella commutata-Geranium robertianum* springhead; Group 4 *Palustriella commutata-Agrostis stolonifera* springhead and Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes (Lyons, 2016). The main tufa formations recorded were tufa cascades, stream crust tufa and oncoids / ooids (Lyons, 2016). Lyons (2015) found that one spring in Glenasmole had conspicuous discolouration from iron. Water chemistry analysis showed that this spring had 1.85 mg/l iron (Lyons, 2015). This is the second highest iron concentration recorded in 68 samples from tufa springs across Ireland (90% of samples contained <0.050 mg/l) (Lyons, 2015). This may be linked to the iron staining in the Dodder Valley park spring complex D03-D04-D08 and was also recorded in springs at Kiltipper Park. The condition assessment for the springs in Glenasmole Valley SAC failed only on phosphate concentration in the spring water (19 µg/l recorded which is above the 15 µg/l threshold) (Lyons, 2016). As an SAC, this site is of International ecological importance, is considered to be in Favourable condition and is given a very high rank and conservation score.

At Kiltipper Park (Dodder Valley from from Old Bawn Bridge to Fort Bridge) there is a series of at least 12 springs/ spring complexes along the River Dodder Valley (Denyer Ecology, 2017). Some of these cover large areas of the riverbank, whilst two springs are unusual for their apparent iron staining and lack of tufa vegetation. The spring recorded in this area have similar vegetation communities and characteristics to those within Glenasmole Valley SAC. This area of springs is considered to be of at least National ecological importance (Denyer Ecology, 2017). It has frequent springs with extensive tufa formation and is linked (by the River Dodder to Glenasmole Valley SAC.

Figure 3.3. Known Annex I petrifying spring locations in South Dublin



3.4.2 Dodder Valley Park springs

In this 2020 survey, three examples of Annex I petrifying springs were recorded from the Dodder Valley Park survey area (Table 3.4). Three other springs had tufa formation and seepages are frequent along this stretch of riverbank (Table 3.4). Tufa formation was significant in spring D02 where it discharges into the River Dodder. The springs rank from moderate to high national conservation ranking (Table 3.4). The springs have similar vegetation communities and tufa formation to those found at Kiltipper Park and Glenasmole Valley SAC. However, the springs in the Dodder Valley Park have generally less tufa formation, are more localised and the number of positive indicator species is lower. The site is considered of County ecological importance in relation to petrifying springs as: it supports a number of examples of this Annex I priority habitat; is part of an extensive spring system along the River Dodder valley, which includes Glenasmole Valley SAC; and, it contains the most downstream known petrifying spring along the River Dodder valley (spring D02) (Figure 3.3).

Table 3.4. Summary of conservation ranking of spring/ seepages

Spring no.	Spring/ seepage*	Tufa present	Positive indicator spp.	Summary	Annex I spring	Conservation ranking
D01	Spring	Yes	3	Small spring arising in lower part of wooded riverbank	**Yes**	High
D02	Spring (primary and secondary springs)	Yes	4	Main spring, arises in upper part of wooded riverbank	**Yes**	High
D03-D04-D08	Seepages (D03 & D04) and spring (D08)	Yes	3	Several small iron seepages/ springs arising below rocks on lower riverbank	**Yes**	Moderate
D06	Seepage	Yes	0	Seepage area onto path above wooded riverbank	No	Moderate
D05	Seepage	No	0	Seepage area onto path above wooded riverbank	No	n/a
D07	(Seepage**)	Yes	0	Small seepage area on wooded bank.	No	n/a

*From hydrogeological report (CDM, 2020);**Spring 07 not relocated in the hydrogeological survey

3.5 Ecological sensitivities

The main factors affecting the condition of petrifying springs are water quality (e.g. pH, mineral composition and nutrient levels) and quantity (e.g. flow rate). In addition, factors such as artificial disturbance; trampling; river engineering works; and, illegal dumping are potential negative pressures. The surveyed springs appear to be negatively impacted by possible nutrient enrichment, invasive species and localised trampling by recreational users of the park. Water flow appeared good in all Annex I spring examples, with very high flow in spring D02. It is therefore considered that the main current and future pressure on these springs is likely to be increased nutrient levels, spread of invasive species and localised trampling pressure.

Any development in the vicinity of the spring/ stream should avoid direct disturbance to the spring/ stream, changes to spring water quality and quantity and any increase in access to the riverbank. Surface water should not be discharged where it can flow into the spring/ stream, as this can lead to changes in pH and water chemistry and affect tufa formation and species composition.

3.6 Management recommendations

- Springs D01 and D02 failed the invasive species criteria as Monbretia *Crocosmia x crocosmiiflora* was present within the springs. There are only a few plants at present and these would be simple to remove. The springs would then pass the condition assessment.
- Spring D02 passed the water quality criteria as water sampling in 2020 indicated low levels of nitrate and phosphate in the spring. However, filamentous algae is frequent in the spring and seepage area which suggests recent higher nutrient levels. Continued water quality monitoring is therefore important to assess any changes. The flow levels in this spring have also increased over the last 5-6 years which would also be useful to monitor.
- Spring D04 fails on trampling as it discharges onto a small beach area which is heavily used by people and dogs. There was also litter present in the spring. The springhead is located on a vertical boulder face and is therefore protected from most damage. Given the location of this small spring, it may not be possible to protect the seepage area from trampling. The spring

seepage areas D03 and D08, which are associated with D04 were adjacent to a small woodland path and had some trampling damage, but this was much more localised.

- Spring D06 is not considered to be an example of the Annex I habitat 'petrifying springs'. Tufa is frequent in the spring but nutrient levels are high and the spring is dominated by tall-herb swamp vegetation and fails several of the condition assessment criteria. This spring originates in the bank above the river and may only recently have become wooded. This spring (and spring D05) have some trampling damage as they are adjacent to a surfaced path. The springs flow onto the path, creating a muddy area, but do not appear to continue the downslope of the path. It may be possible to create a channel under the path (or raise the path) to avoid damage to the spring and to facilitate flow down the hill. This would also make the path more accessible to path users. This should be discussed with a hydrogeologist to ensure a design which would not impact on the two springs.

4 INTEGRATED CONSTRUCTED WETLAND (ICW) DEVELOPMENT

4.1 Proposed project

As outlined in Section 1.1 (Project details), the DURL Project intends to consider applying for Part 8 approval for the construction of two Integrated Constructed Wetlands (ICWs) at Dodder Valley Park, South Dublin. The aim of the ICW's is to treat stormwater contaminated with misconnections from domestic dwellings which currently discharge directly into the Dodder River. The works include installation of ICWs, landscaping works and all necessary associated ancillary works on the site and adjacent areas.

4.2 Potential impacts to petrifying springs

Petrifying springs/ seepages are sensitive to impacts that cause direct disturbance or alter water quantity and/ or quality (Section 3.5). A detailed hydrogeological assessment of the proposed ICW and potential impacts on the recorded springs was undertaken in 2020 (CDM, 2020). The potential impacts to the petrifying spring/ seepages resulting from the proposed ICW development are summarised in Table 4.1. Refer to the hydrogeological report (CDM, 2020) for full details.

Table 4.1. Summary of potential impacts to spring/ seepage areas from the proposed ICW (hydrogeological impacts summarised from CDM, 2020)

Potential impact	Notes	Mitigation measure(s)
Construction stage		
Direct damage to springs [*Potential habitat loss/ disturbance*]	No overlap of ICW footprint and spring/ seepage locations	Ensure that no construction activities are undertaken in the 'spring zone' (Figs 3.1 & 3.2)
Disruption to bedrock aquifer from which springs discharge [*Potential changes to water quantity*]	Available information indicates that subsoils across the proposed ICW area may be several metres thick. The base of the ICW will be shallow, only approximately 0.5 m below ground. Accordingly, excavation of ICW basin(s) will not extend to bedrock. This means there no risk of physical damage or other construction-related impact to the bedrock aquifer.	n/a
Indirect impact from sediment release during excavations [*Potential changes to water quality*]	Sediment release into the spring zone could decrease water quality and increase nutrients.	Use standard best practice measures (e.g. silt fences) to prevent release of sediment into spring zone
Spills of fuel or other chemicals [*Potential changes to water quality*]	Risk of contamination to soils and shallow groundwater.	Use standard best practice measures (e.g. bunding of fuel/chemical tanks, re-fuelling at offsite location only, keeping chemicals away from the site)
Alteration of gravel layers and replacement with clay liner materials [*Potential changes to water quantity*]	Potential to lead to altered leakage fluxes from the ICW to the shallow groundwater environment. This could result in the backing up of water, with potential ponding or flooding of surrounding terrain.	Ensure that construction is implemented as intended, especially that the designed thickness, composition and permeability of liner materials are achieved. Precise elevations of key design features (notably the base of liners) should be achieved and maintained. Thus, high-accuracy elevation surveys will be needed prior to, during and following construction, so that corrective actions can be taken before operations. Only pre-approved liner materials (source and type) should be used that match technical specifications. Emplacement and installation require supervision by a suitably qualified and experienced individual.
Operation stage		
Leakage of water in the ICW through the clay liner [*Changes to water quantity and quality*]	Leakage water will migrate in the shallow groundwater environment under the prevailing hydraulic gradients towards the river (and spring D02). This will marginally increase the shallow groundwater flux towards the river. There are currently no observations of escarpment seeps from shallow groundwater pathways following storm events. However, even if it is assumed that all of the ICW leakage water will discharge at the petrifying springs, the influence would be minor as the estimated leakage represents only c. 1.7% of the total spring discharge. Under normal, operations, the water will be relatively free of any pollutants, and any pollutants that may be present will undergo some attenuation in the shallow groundwater environment (e.g. mixing/dilution and filtration).	n/a

4.3 Conclusions

The results of the hydrogeological assessment (CDM, 2020) show that there are **no proposed residual impacts to the springs/ seepages recorded at this site** as a result of the ICW construction and operation. During construction, standard best practice guidelines and strict adherence to the project design (Table 4.1 and CDM, 2020) is required.

It will be useful to undertake **regular monitoring** of the Annex I petrifying springs at the site as they were not considered to be in good ecological condition during the 2020 survey. The ecological monitoring would follow the methodology used in the 2020 survey. Ideally this would be undertaken every 2-3 years. The hydrogeological assessment report details recommended hydrogeological monitoring criteria (CDM, 2020).

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APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

SPRING DETAILS: D01

Site name: Dodder Valley Park, South Dublin	**Spring name:** Spring D01	**Relevé No.:** R01
Survey date: 20/05/20	**Relevé dimensions:** 1m x 4m	**Relevé area:** 4m^2
Grid reference: O 09812 26380	**Spring type:** Springhead	
Slope: 10-90°	**Altitude (m):** c 91 m	**Aspect:** NNW
pH: 7.5	**EC:** 1040 µS/cm	**Temp.:** 12.2°

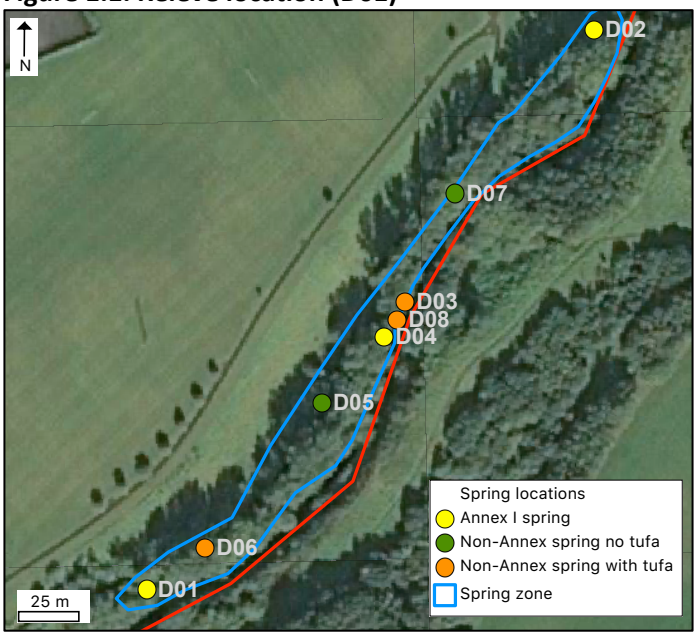
Spring description:

Small spring arising in lower part of wooded riverbank. There are two small channels arising amongst boulders, which join and flow downstream into the river. Cascade tufa formation is dominant (30%) with some paludal (5%) and stream crust tufa formation (5%). There was a steady flow of water despite recent dry weather. The spring arises amongst boulders where bryophytes such as *Palustriella commutata* and *Pellia endiviifolia* are dominant. This then flows through a marshy channel with abundant Hemlock Water-dropwort *Oenanthe crocata* and wetland species such as Angelica *Angelica sylvestris,* Water Figwort *Scrophularia auriculata,* Fool's-water-cress *Helosciadium nodiflorum* and Water-cress *Nasturtium officinale. Pellia endiviifolia* and *Cratoneuron filicinum* are the dominant bryophytes in the relevé location. Three positive petrifying spring indicator species were recorded: *Didymodon tophaceus* (<1%), *Palustriella commutata* (3%) and *Pellia endiviifolia* (15%). The vegetation has most affinity to **Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (red arrow, Photograph 1.1) is located in the eastern part of the 'spring zone' (Figure 1.1).

Figure 1.1. Relevé location (D01)



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Photograph 1.1. Relevé location (view to N)

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	30	Flowing/ trickling	70	Living field/ ground flora	60
Paludal (1)	5	Pool/ standing water	10	Bare tufa (active/ recent)	5
Stream crust	5	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	10	Leaf litter/ standing dead	5
Dam	-	Dry, not impacted by spring	10	Bare soil	20
Cemented rudites	-	Other:	-	Bare stone	10
Non-tufa	60			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

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

Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Alnus glutinosa	80	5	1.0m
	-	-	-
	-	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 85		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			**c 10m**

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Angelica sylvestris	3	*Agrostis stolonifera*	3	*Brachythecium rivulare*	1	*Fraxinus excelsior*	<1
C. x crocosmiflora	3	*Brachypodium sylvaticum*	1	*Cratoneuron filicinum*	8	*Hedera hibernica*	1
Epilobium hirsutum	<1	*Carex remota*	3	*Didymodon tophaceus*	<1		
Ficaria verna	<1	*Lolium perenne*	1	*Eurhynchium striatum*	1		
Helosciadium nodiflorum	3			*Fissidens taxifolius*	<1	**TOTAL WOODY <50cm**	**2**
Heracleum sphondylium	3			*Oxyrrhynchium hians*	<1		
Nasturtium officinale	1			*Palustriella commutata*	3	**PTERIDOPHYTES**	
Oenanthe crocata	8			*Pellia endiviifolia*	15	*Equisetum arvense*	3
Scrophularia auriculata	1			*Plagiomnium rostratum*	<1		
Tussilago farfara	<1					**TOTAL PTERIDOPHYTES**	**3**
Urtica dioica	<1					**ALGAE**	
						Filamentous algae	3
						TOTAL ALGAE	**3**
TOTAL FORBS	**23**	**TOTAL GRAMINOIDS**	**8**	**TOTAL BRYOPHYTES**	**29**	**TOTAL COVER**	**60**

Photos

Photo 1.2. Relevé, view NNW

Photo 1.3. Cascade tufa with *Palustriella commutata* in relevé

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	3 species recorded: *Didymodon tophaceus, Palustriella commutata* and *Pellia endiviifolia*	3 species AND no loss from baseline number of species	Result = 3 positive indicator species **PASS**
Typical accompanying species (neutral indicators)	3 species recorded: *Agrostis stolonifera, Nasturtium officinale* and *Tussilago farfara*	n/a	For information only
Invasive species	1 species recorded *Crocosmia x crocosmiiflora*	Absent	Result = Present **FAIL**
Negative herbaceous indicator species	4 species recorded: *Epilobium hirsutum, Helosciadium nodiflorum, Heracleum sphondylium, Urtica dioica*	Total cover should not be dominant or abundant	Result = Total cover occasional to frequent **PASS**
Negative bryophyte indicator species	2 species recorded: *Brachythecium rivulare* and *Cratoneuron filicinum*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 1 rare, 1 frequent **PASS**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Not determined	No increase from baseline and not above 10 mg/l	n/a (no water flow)
Phosphate level	Not determined	No increase from baseline and not above 15 µg/l	n/a (no water flow)
Water flow	Not determined	No alteration of natural flow	Unknown **PASS**
Impacts of grazing			
Field layer height	10 to 50cm	Height between 10 and 50cm	Result = <50cm **PASS**
Trampling/dung	No trampling observed	Impact should not be abundant/dominant	**Result =** Absent **PASS**
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	**Result** = 1 fail **UNFAVOURABLE INADEQUATE**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
I02 Other invasive alien species (other than species of Union concern)		Low negative impact	**Result = low intensity impact FAVOURABLE**

Conservation Score

Criteria	Result	Score
Species diversity score	3 positive indicator species (=low)	1
HQ Indicator Species	0	0
Tufa-forming capacity	Smaller consolidated deposits (= high)	3
Other positive characteristics	Part of wider Dodder River spring complex	1
Conservation Score		5
Rank		**High**

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

SPRING DETAILS: D02

Site name: Dodder Valley Park, South Dublin	**Spring name:** Spring D02	**Relevé No.:** R02
Survey date: 20/05/20	**Relevé dimensions:** 2m x 2m	**Relevé area:** 4m^2
Grid reference: O 09997 26612	**Spring type:** Flush below springhead	
Slope: 25°	**Altitude (m):** c 87 m	**Aspect:** NNW
pH: 7.36	**EC:** 1210 µS/cm	**Temp.:** 12.3°

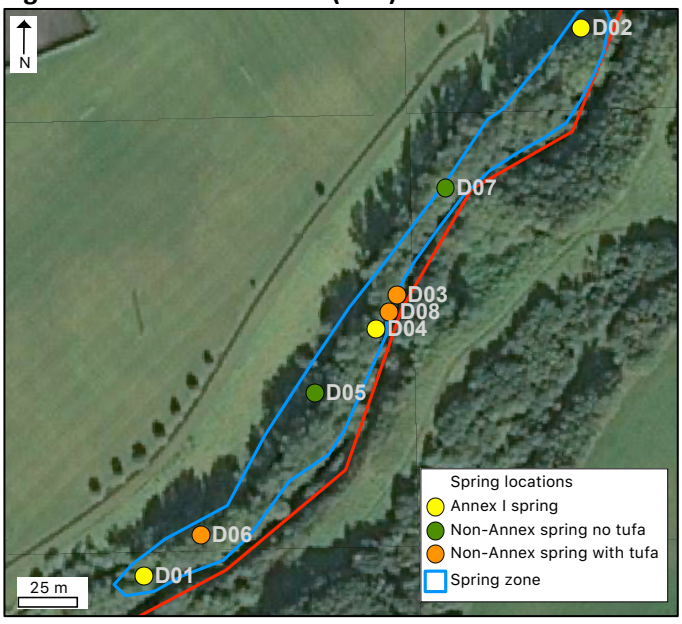
Spring description:

This is the main spring in the complex. It arises in the upper part of the wooded riverbank, two channels join and then flow down towards river in a single channel. At the riverbank it widens to flow over an area c5m wide with significant tufa formation. There was a strong water flow in the spring despite recent dry weather. Information from the SDCC Heritage Officer suggests that this spring may have arisen in the last 5-6 years. It had very minor water levels initially and water was not always present. Since then, the emergence location has become more stable and the flow increased to a steady, but low volume spring. In the last 12-18 months this has increased and at the time of survey there was a very strong flow. Water quality data (SDCC, 2020) suggests low nitrate and phosphate levels in the spring water. However, the vegetation in the spring levels (including frequent filamentous algae) indicates elevated nutrients. It may be that water quality has increased with the increased flow, but that the vegetation has not had sufficient time to recover from a past nutrient load. There is cascade and paludal tufa formation in the upper part of the channel and large tufa cascades at the riverbank. The springhead is in a grassy area with no typical spring vegetation. The relevé was therefore placed in the flush/ spring a few metres below the springhead. A tree had recently fallen in this area. The main species in the relevé location are the vascular plant species are *Scrophularia auriculata* and *Helosciadium nodiflorum* with the bryophyte species are *Palustriella commutata* and *Cratoneuron filicinum.* Four positive petrifying spring indicator species were recorded: *Didymodon tophaceus* (<1%), *Palustriella commutata, Palustriella falcata* (1%) and *Pellia endiviifolia* (3%). Filamentous algae is frequent in the channel and on the riverbank. The vegetation has most affinity to **Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (red arrow, Photograph 2.1) is located in the western part of the 'spring zone' (Figure 2.1).

Figure 2.1. Relevé location (D02)



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Photograph 2.1. Relevé location (view to NNW)

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	15	Flowing/ trickling	60	Living field/ ground flora	85
Paludal (1)	15	Pool/ standing water	3	Bare tufa (active/ recent)	5
Stream crust	-	Dripping	2	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	35	Leaf litter/ standing dead	<1
Dam	-	Dry, not impacted by spring	-	Bare soil	5
Cemented rudites	-	Other:	-	Bare stone	15
Non-tufa	70			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Acer pseudoplatanus	5	-	-
Populus tremula	3	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 8		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			**5-15 m**

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Epilobium hirsutum	3	*Agrostis stolonifera*	5	*Cratoneuron filicinum*	8		
Geranium robertianum	<1			*Didymodon tophaceus*	<1		
Helosciadium nodiflorum	20			*Lunularia cruciata*	5		
Jacobaea vulgaris	3			*Palustriella commutata*	8		
Ranunculus repens	3			*Palustriella falcata*	1	**TOTAL WOODY <50cm**	**0**
Rumex obtusifolius	1			*Pellia endiviifolia*	3	**PTERIDOPHYTES**	
Scrophularia auriculata	20			*Platyhypnidium riparioides*	3	*Equisetum palustre*	<1
Sonchus oleraceus	<1					**TOTAL PTERIDOPHYTES**	**<1**
						ALGAE	
						Filamentous algae	1
						TOTAL ALGAE	**1**
TOTAL FORBS	**50**	**TOTAL GRAMINOIDS**	**5**	**TOTAL BRYOPHYTES**	**30**	**TOTAL COVER**	**85**

Photos

Photo 2.2. Relevé, view NW

Photo 2.3. Filamentous algae on cascade tufa

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

Photo 2.4. *Palustriella commutata* and *Pellia endiviifolia* in relevé

Photo 2.5. Extensive tufa formation at discharge point to Dodder Valley (arrows indicate extent)

Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	4 species recorded: *Didymodon tophaceus, Palustriella commutata, P. falcata* and *Pellia endiviifolia*	3 species AND no loss from baseline number of species	Result = 4 positive indicator species **PASS**
Typical accompanying species (neutral indicators)	2 species recorded: *Agrostis stolonifera* and *Ranunculus repens*	n/a	For information only
Invasive species	1 species recorded *Crocosmia x crocosmiiflora* (outside of relevé)	Absent	Result = Present **FAIL**
Negative herbaceous indicator species	3 species recorded: *Epilobium hirsutum, Helosciadium nodiflorum* and *Rumex obtusifolius*	Total cover should not be dominant or abundant	Result = Total cover abundant **FAIL**
Negative bryophyte indicator species	1 species recorded: *Cratoneuron filicinum*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 1 frequent **PASS**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Not determined	No increase from baseline and not above 10 mg/l	Data from 2020 = 1.85 mg/l **PASS**
Phosphate level	Not determined	No increase from baseline and not above 15 µg/l	Data from 2020 = <0.01 mg/l **PASS**
Water flow	Not determined	No alteration of natural flow	Flow has fluctuated in recent years, cause unknown **UNDETERMINED**
Impacts of grazing			
Field layer height	10 to 40cm	Height between 10 and 50cm	Result = <40cm **PASS**
Trampling/dung	No trampling observed	Impact should not be abundant/dominant	**Result =** Absent **PASS**
Overall Structure & Functions Assessment			

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

Criteria	Result	Target value	Result and pass/ Fail
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	**Result** = 1 fail **UNFAVOURABLE INADEQUATE**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
I02 Other invasive alien species (other than species of Union concern)		Low negative impact	**Result = low intensity impact FAVOURABLE**

Conservation Score

Criteria	Result	Score
Species diversity score	4 positive indicator species (=low diversity)	1
HQ Indicator Species	0	0
Tufa-forming capacity	Smaller consolidated deposits or strongly formed paludal tufa (high)	3
Other positive characteristics	Part of wider Dodder River spring complex	1
Conservation Score		5
Rank		**High**

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

SPRING DETAILS: D03-D04-D09 seepage area

Site name: Dodder Valley Park, South Dublin	**Spring name:** Spring D03/04/08	**Relevé No.:** R03 (D04)
Survey date: 20/05/20	**Relevé dimensions:** 1m x 1m	**Relevé area:** 1m^2
Grid reference: O 09910 26485	**Spring type:** Springhead	
Slope: 90^o	**Altitude (m):** c 91 m	**Aspect:** NWW
pH: n/a (insufficient flow)	**EC:** n/a	**Temp.:** n/a

Spring description:

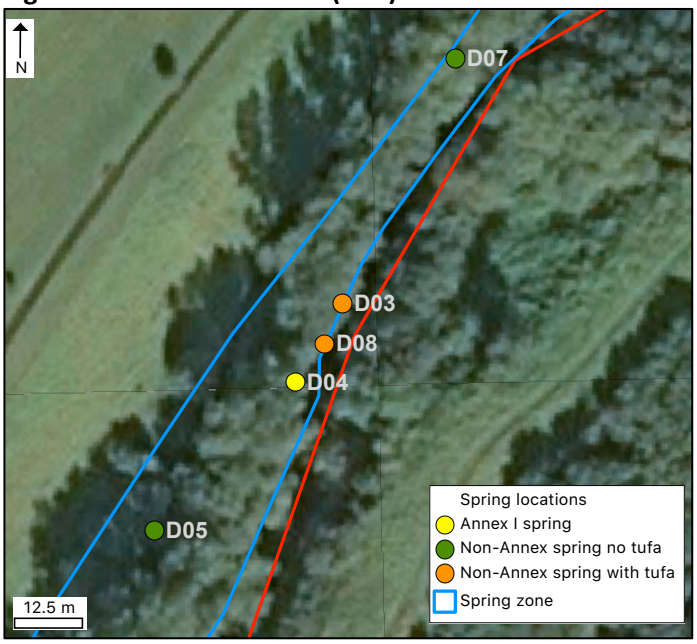
This is a small complex of springs with similar characteristics (D03, D04 and D08). They are small springs arising from rocks within the riverbank. There is iron staining in all of the seepage areas. Spring D04 is located in a small 'beach area' and D03 and D08 are above a small path leading north from the beach within the woodland, parallel the river. Each spring has a small amount of tufa formation but this is best developed in spring D04 and this is the only spring to have three positive indicator species. Vascular plants species present in the spring zone include *Angelica sylvestris, Filipendula ulmaria* Meadowsweet, Great Horsetail *Equisetum telmateia,* Remote Sedge *Carex remota,* Herb-Robert *Geranium robertianum,* Atlantic Ivy *Hedera hibernica,* Pendulous Sedge *Carex pendula,* Marsh-marigold *Caltha palustris* and Cuckooflower *Cardamine pratensis.* The main bryophytes is *Pellia endiviifolia.*

Spring D04 was sampled as it had the most positive indicator species present. In this spring the tufa formation is limited to the spring source which is near vertical on the rocks. The spring and vegetation cover less than 1m^2. There was no obvious flow but most of the relevé area was damp from seepage. There is a small amount of cascade tufa (10%) with paludal tufa (5%). The spring is bryophyte dominated with *Pellia endiviifolia* and *Palustriella commutata* the main bryophytes. Vascular plants are less prominent and include *Carex remota, Equisetum telmateia* and *Tussilago farfara.* Some iron staining present in spring at base of rocks. The vegetation has most affinity to **Group 2 *Palustriella commutata-Geranium robertianum* springheads** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (red arrow, Photograph 3.1) is located in the mid-section of the 'spring zone' (Figure 3.1). Spring D03, D04 and D08 are part of a small seepage zone in this area.

Figure 3.1. Relevé location (D04)



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Photograph 3.1. Relevé location (view to NW)

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	10	Flowing/ trickling	25	Living field/ ground flora	40
Paludal (1)	5	Pool/ standing water	-	Bare tufa (active/ recent)	3
Stream crust	-	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	-	Damp	70	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	5	Bare soil	57
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	85			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

Paludal tufa: 1 = weak/ thin/ discontinuous, 3 = strongly forming/ continuous/ conspicuous
Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Alnus glutinosa	80	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 80		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			**5-7 m**

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Cardamine pratensis	1	*Brachypodium sylvaticum*	3	*Brachythecium rivulare*	1		
Tussilago farfara	3	*Carex remota*	3	*Oxyrrhynchium hians*	1		
		Holcus lanatus	3	*Palustriella commutata*	3		
				Pellia endiviifolia	20		
				Plagiomnium undulatum	<1	**TOTAL WOODY <50cm**	**2**
						PTERIDOPHYTES	
						Equisetum telmateia	3
						TOTAL PTERIDOPHYTES	**3**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**4**	**TOTAL GRAMINOIDS**	**9**	**TOTAL BRYOPHYTES**	**25**	**TOTAL COVER**	**41**

Photos

Photo 3.2. Relevé, view NWW

Photo 3.3. *Pellia endiviifolia* in relevé with iron staining (red arrow) and tufa formation (orange arrow)

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	3 species recorded: *Equisetum telmateia, Palustriella commutata* and *Pellia endiviifolia*	3 species AND no loss from baseline number of species	Result = 3 positive indicator species **PASS**
Typical accompanying species (neutral indicators)	3 species recorded: *Agrostis stolonifera, Cardamine pratensis* and *Tussilago farfara*	n/a	For information only
Invasive species	None recorded	Absent	Result = Absent **PASS**
Negative herbaceous indicator species	None recorded	Total cover should not be dominant or abundant	Result = Absent **PASS**
Negative bryophyte indicator species	1 species recorded: *Brachythecium rivulare*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 1 rare **PASS**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Not determined	No increase from baseline and not above 10 mg/l	n/a (no water flow)
Phosphate level	Not determined	No increase from baseline and not above 15 µg/l	n/a (no water flow)
Water flow	Not determined	No alteration of natural flow	Unknown **PASS**
Impacts of grazing			
Field layer height	5 to 20cm	Height between 10 and 50cm	Result = <50cm **PASS**
Trampling/dung	Extensive trampling around relevé by people accessing riverbank	Impact should not be abundant/dominant	**Result =** Abundant **FAIL**
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	**Result** = 1 fail **UNFAVOURABLE INADEQUATE**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
F07 Sports, tourism and leisure activities		Moderate negative impact	**Result = moderate intensity impact UNFAVOURABLE INADEQUATE**

Conservation Score

Criteria	Result	Score
Species diversity score	3 positive indicator species (=low diversity)	1
HQ Indicator Species	0	0
Tufa-forming capacity	Patchy paludal tufa (moderate)	3
Other positive characteristics	Part of wider Dodder River spring complex	1
Conservation Score		4
Rank		**Moderate**

APPENDIX A - DODDER VALLEY PARK: SPRING SURVEY AND CONDITION ASSESSMENT RESULTS 2020

SPRING DETAILS: D06

Site name: Dodder Valley Park, South Dublin	**Spring name:** Spring D06	**Relevé No.:** R04
Survey date: 20/05/20	**Relevé dimensions:** 2m x 2m	**Relevé area:** 4m^2
Grid reference: O 09836 26397	**Spring type:** Springhead	
Slope: 10-90°	**Altitude (m):** c 95 m	**Aspect:** NW
pH: n/a (insufficient flow)	**EC:** n/a	**Temp.:** n/a

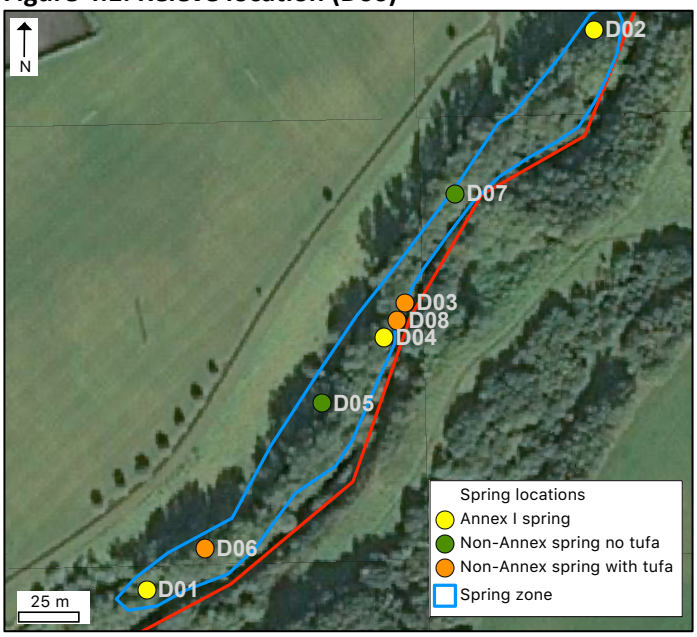
Spring description:

Spring arises in small bank above path above wooded riverbank. Source of spring diffuse and not obvious. Seepage arises in small bank c3m above path and flows through tall herb swamp vegetation and onto path below. Tufa formation is locally abundant in the form of oncoids/ ooids (40%). The main vascular plants species are Great Willowherb *Epilobium hirsutum* and Creeping Buttercup *Ranunculus repens.* There is a sparse bryophyte layer with *Brachythecium rivulare, Cratoneuron filicinum* and *Oxyrrhynchium hians.* The flushed area is very wet with soft mud which is easy to disturb. The vegetation has most affinity to **Group 3 *Brachythecium rivulare-Platyhypnidium riparioides* tufaceous streams and flushes** vegetation community (Lyons & Kelly, 2017).

Relevé location:

The relevé (red arrow, Photograph 1.1) is located in the eastern part of the 'spring zone' (Figure 1.1).

Figure 4.1. Relevé location (D06)



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Photograph 4.1. Relevé location (view to W)

DETAILED RELEVÉ

Physical characteristics

Tufa	% Cover	Water	% Cover	Surface	% Cover
Cascade	-	Flowing/ trickling	-	Living field/ ground flora	80
Paludal (1)	3	Pool/ standing water	-	Bare tufa (active/ recent)	10
Stream crust	-	Dripping	-	Ancient/ inactive tufa	-
Oncoids/ ooids	40	Damp	100	Leaf litter/ standing dead	-
Dam	-	Dry, not impacted by spring	-	Bare soil	10
Cemented rudites	-	Other:	-	Bare stone	-
Non-tufa	57			Other:	-
TOTAL	**100**	**TOTAL**	**100**	**TOTAL**	**100**

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

Cover values: record to nearest 5%. If <5% then use 3%, 1% 0.5%, 0.1%

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Shrub/ canopy layer

Species	Routed outside Canopy (%)	Routed inside Canopy (%)	Routed inside Height (m)
Alnus glutinosa	30	-	-
Populus tremula	50	-	-
TOTAL CANOPY (ROOTED INSIDE + ROOTED OUTSIDE) %	**TOTAL %:** 80		
MAX HEIGHT (m) ABOVE QUADRAT (ROOTED INSIDE + ROOTED OUTSIDE):			**c 10m**

Field/ ground flora

FORBS	%	GRAMINOIDS	%	BRYOPHYTES	%	WOODY	%
Epilobium hirsutum	25	*Agrostis stolonifera*	1	*Brachythecium rivulare*	5	*Hedera hibernica*	15
Ranunculus repens	15	*Poa trivialis*	1	*Cratoneuron filicinum*	5	*Rubus fruticosus* agg.	5
Urtica dioica	1			*Oxyrrhynchium hians*	3	*Sambucus nigra*	1
						TOTAL WOODY <50cm	**21**
						PTERIDOPHYTES	
						TOTAL PTERIDOPHYTES	**0**
						ALGAE	
						TOTAL ALGAE	**0**
TOTAL FORBS	**41**	**TOTAL GRAMINOIDS**	**2**	**TOTAL BRYOPHYTES**	**13**	**TOTAL COVER**	**80**

Photos

Photo 4.2. Relevé, view W

Photo 3.3. Oncoids/ ooids in relevé

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Condition assessment

Criteria	Result	Target value	Result and pass/ Fail
Species assessment criteria			
High quality indicator species	None recorded	n/a (included below)	n/a (included with positive indicator species)
Positive indicator species	0 species recorded:	3 species AND no loss from baseline number of species	Result = 0 positive indicator species **FAIL**
Typical accompanying species (neutral indicators)	3 species recorded: *Agrostis stolonifera, Poa trivialis, Ranunculus repens*	n/a	For information only
Invasive species	1 plant of unknown species (garden escape, not flowering) adjacent to relevé	Absent	Result = Present **FAIL**
Negative herbaceous indicator species	2 species recorded: *Epilobium hirsutum, Urtica dioica*	Total cover should not be dominant or abundant	Result = Total cover dominant **FAIL**
Negative bryophyte indicator species	2 species recorded: *Brachythecium rivulare* and *Cratoneuron filicinum*	No one species dominant or abundant; if ≥2 species present) then fails if ≥2 are frequent or 1 is abundant	Result = 2 species co-dominant **FAIL**
Negative woody indicator species	n/a as wooded spring	Absent (except in wooded springs)	n/a
Spring water composition and flow			
Nitrate level	Not determined	No increase from baseline and not above 10 mg/l	n/a (no water flow)
Phosphate level	Not determined	No increase from baseline and not above 15 µg/l	n/a (no water flow)
Water flow	Not determined	No alteration of natural flow	Unknown **PASS**
Impacts of grazing			
Field layer height	50-60cm	Height between 10 and 50cm	Result = >50cm **FAIL**
Trampling/dung	Large area of trampling by path (mainly by dogs)	Impact should not be abundant/dominant	**Result =** Abundant **FAIL**
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	**Result = 6** fail **UNFAVOURABLE BAD**
1 - 2 Fail		Amber - Unfavourable Inadequate	
>2 Fail		Red – Unfavourable Bad	
Future prospects: Negative activities			
F07 Sports, tourism and leisure activities		Moderate negative impact	**Result = moderate intensity impact UNFAVOURABLE INADEQUATE**

Conservation Score

Criteria	Result	Score
Species diversity score	3 positive indicator species (=low diversity)	0
HQ Indicator Species	0	0
Tufa-forming capacity	Patchy paludal tufa (moderate)	2
Other positive characteristics	Part of wider Dodder River spring complex	1
Conservation Score		3
Rank		**Moderate**