MAYFLY ECOLOGY

Glasheen Stream

Freshwater Ecology Survey

Version number 1

14/11/2024

Local Authority Waters Programme

vibrant communities | catchment assessment | healthy waters

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Acronym/ term	Definition
BoCCI	Birds of Conservation Concern Ireland 2020 -2026. This is a list of bird species in Ireland which are either red listed (high conservation concern) or amber listed (medium conservation concern). Please see Gilbert or https://birdwatchireland.ie/birds-of-conservation-concern-in-ireland/ for further information.
CCC	Cork City Council
CSO	Combined Sewer Overflow. A structure or device on a sewerage system designed and constructed for the purpose of relieving the system of excess flows that arise as a result of rain water or melting snow in the sewered catchment, the excess flow being discharged to receiving waters. This term is used interchangeably in Ireland with Storm Water Overflow (SWO) and the two have the same meaning.
d/s	Downstream
EPA	Environmental Protection Agency
European site	Special Areas of Conservation (SAC) and Special Protection Areas (SPA) are sites of European importance which have been designated under European legislation. Collectively they are referred to as European sites. SACs were designated under the Habitats Directive for habitats and species (but not including bird species). The Birds Directive protects all wild birds and their nests, eggs and habitats within the European Union. SPAs are classified under the Birds Directive to protect birds that are rare or vulnerable in Europe as well as all migratory birds that are regular visitors.
GSI	Geological Survey Ireland
GWB	Groundwater Body
IFI	Inland Fisheries Ireland
LAWPRO	Local Authorities Waters Programme
Left bank/ right bank	If standing in the water facing downstream the bank to the left is referred to as the left bank.
NBDC	National Biodiversity Data Centre
NPWS	National Parks and Wildlife Service
OSI	Ordnance Survey Ireland
pNHA	Proposed Natural Heritage Area
Rhizomes	Some plants have modified underground stems that send out roots and shoots e.g., Japanese knotweed
Riparian zone	An area of vegetation which acts as the interface between terrestrial and river ecosystems. These zones are important in providing bank stability, flood attenuation, habitats for range of species and water quality management but also as green spaces for people.
River birds	This is a term used to describe birds that are strongly associated with rivers and streams. In this report the term mainly refers to dipper, grey wagtail and kingfisher.
Third Schedule Invasive Species	This is a list of invasive species appearing on the third schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I.477/2011]. The regulations prohibit the planting, dispersal or allowing to disperse or spread or causing to grow of any plant listed within the third schedule.
u/s	Upstream
WFD	Water Framework Directive

1. INTRODUCTION

1.1. Background

Mayfly Ecology was commissioned by Green Spaces for Health to undertake a freshwater ecology survey of the Glasheen Stream, Cork. The purpose of the survey was to gather baseline information regarding the biological quality of the stream from source to its outfall into the Curragheen River.

The survey included kick sampling for macroinvertebrates and a general assessment of the aquatic habitat. This information was then used to help understand pressures acting upon the stream and develop actions to help improve the quality of the stream.

Green Spaces was awarded funding from the Local Authorities Waters Programme (LAWPRO) for this project. All survey work and reporting were undertaken by Letizia Cocchiglia of Mayfly Ecology.

1.2. Glasheen Location & Description

The Glasheen is a relatively short stream (5.3km) rising on the southwestern boundary of Cork City. It flows toward the city centre and enters the Curragheen River at Orchard Court. **Figure 1-1** below shows the location of the Glasheen stream.

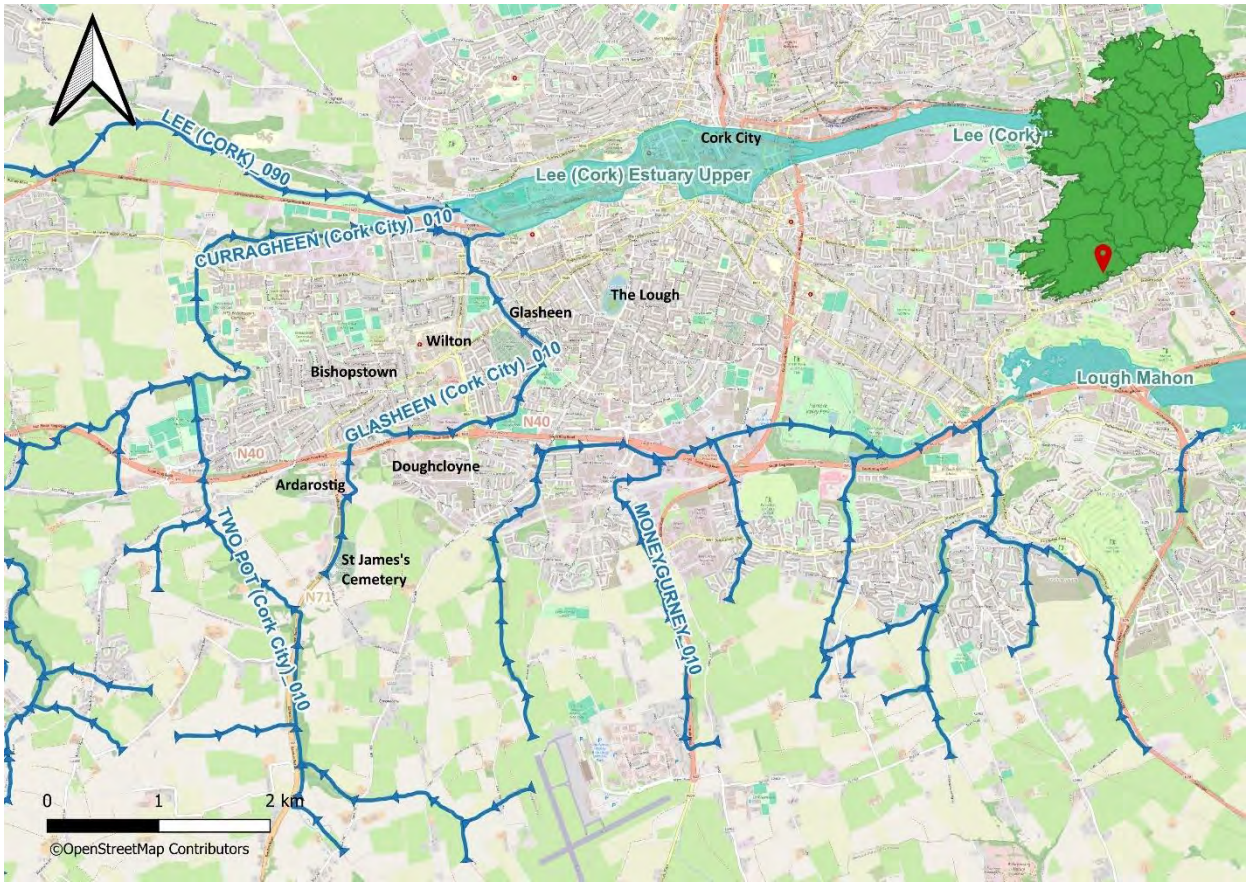


Figure 1-1: Map showing the location of the Glasheen Stream and adjacent waterbodies.

Current mapping (EPA) shows the source of the Glasheen at the south-eastern boundary of St James's Cemetery beside the Bandon Road (N71). A review of historic mapping (25", 1898) however shows a small stream rising near Chetwynd House by the old railway embankment and a well is also marked here. This would represent the highest point of the Glasheen and therefore the main source (see **Figure 1-2**).

Land use in the upper reaches of the Glasheen is a mixture of agricultural pasture, the cemetery and scattered housing. The stream flows in a northward direction and EPA mapping shows it flowing parallel with the eastern side of the Bandon Road. In fact, it is diverted under this road and back again. It is diverted again under Dunnes Stores and the South Link Road (N40) then turns abruptly eastward following the South Link Road. Very quickly the stream becomes urbanised flowing through industrial areas, housing estates and under some of Cork cities major roads.

From the South Link Road, it passes through Woodhaven estate and the boundary of the ESB networks complex. After passing under Sarsfield Road, it flows between Saint Finbars National Hurling and Football Club and housing estates before passing through Clashduv Park. From here the stream turns northwards and it's sandwiched between Clashduv Estate and Glendale Grove. From here it enters the linear park at Schoolboys Lane. Finally, it flows under Magazine Road skirting around Tescos and enters the Curragheen at Orchard Court.

Historically the Glasheen supported several industries. There was a flour mill near Waterfall Road and both the Glasheen Spinning Mill and the Brookfield Chemical Works were located in the city near the Curragheen confluence. Historic mapping (first edition 6" mapping 1845) shows a **channel connecting the Two Pot River to the Glasheen** where the viaduct spans the Bandon Road. This was a man-made connection used to convey more water into the Glasheen to support the millponds and millraces. A control valve was present to ensure flows within the Two Pot did not get too low[1]. Today this connection, the millponds and millrace no longer exist but part of the old connecting channel can still be seen (**Plate 1-2**). In addition, historic mapping shows a series of drainage ditches feeding into the Glasheen along most of its length. Further downstream at Schoolboys Lane a millrace was also present to support the Glasheen Spinning Mill, today it is dry but part of this old channel is still visible at the entrance to the park.

Plate 1-1: Old pipes which brought water from the Two Pot to the Glasheen.

Plate 1-2: Photo taken standing in the old channel which brought water from the Two Pot to the Glasheen. The channel is now vegetated with ferns and broadleaved trees.

Geological Survey Ireland (GSI) have mapped a **glacial meltwater channel** following what is now the Bandon Road (**Figure 1-3**). This opens the question of whether the Two Pot and Glasheen were naturally

[1] Information received with thanks from J. Little who had been in correspondence with engineer from CCC. The exact location of the valve is yet to be confirmed.

connected and if so was the disconnection natural long before any major settlement or anthropogenic? It is a question which cannot be answered in this report but the industrial heritage and history of the Glasheen is itself an interesting topic worthy of further assessment. As it currently stands, the Glasheen now rises near Chetwynd House.

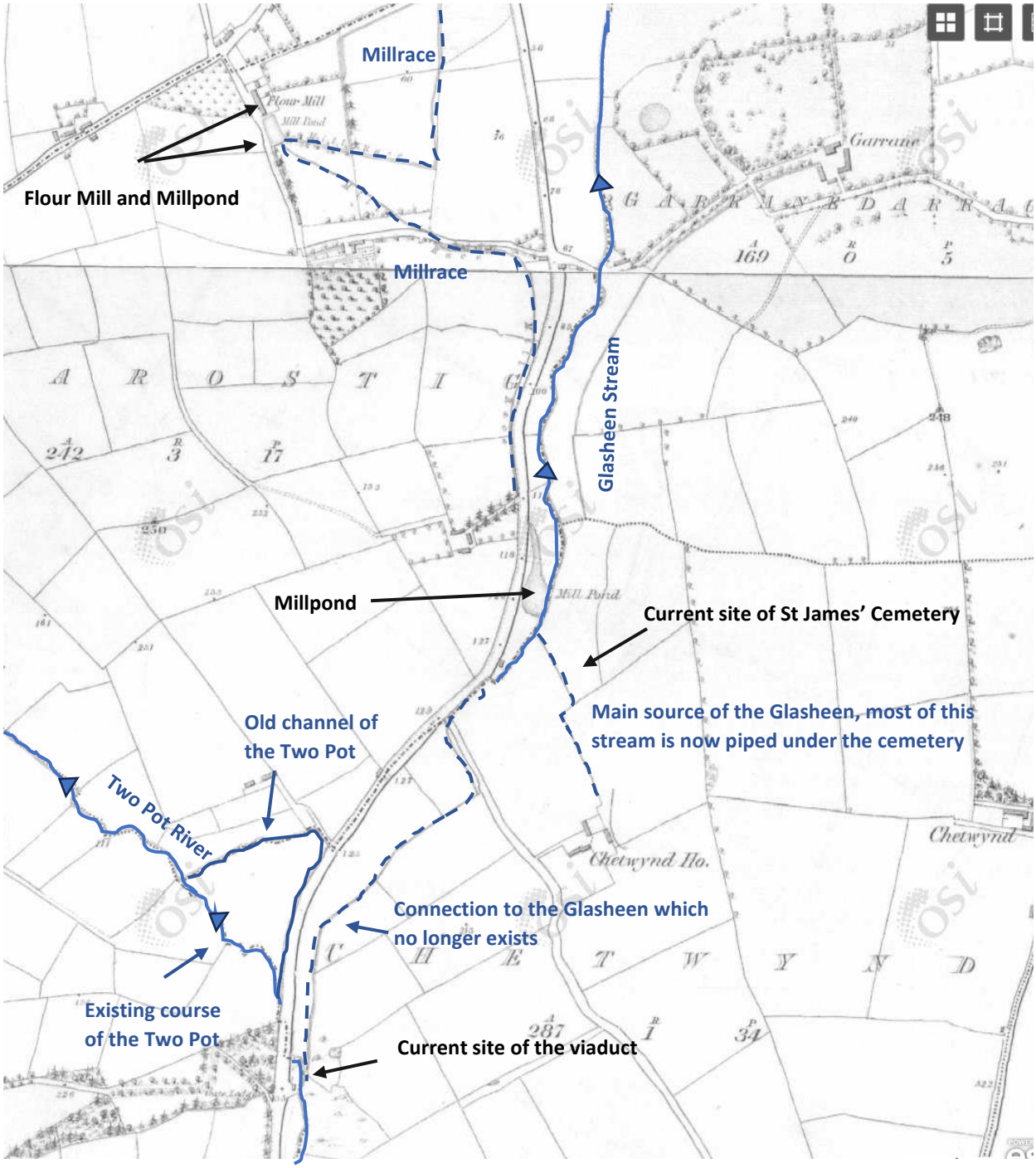


Figure 1-2: First edition 6" mapping showing the source of the Glasheen and connection from the Two Pot to feed the millponds and millrace. Watercourses are highlighted in blue for reference.

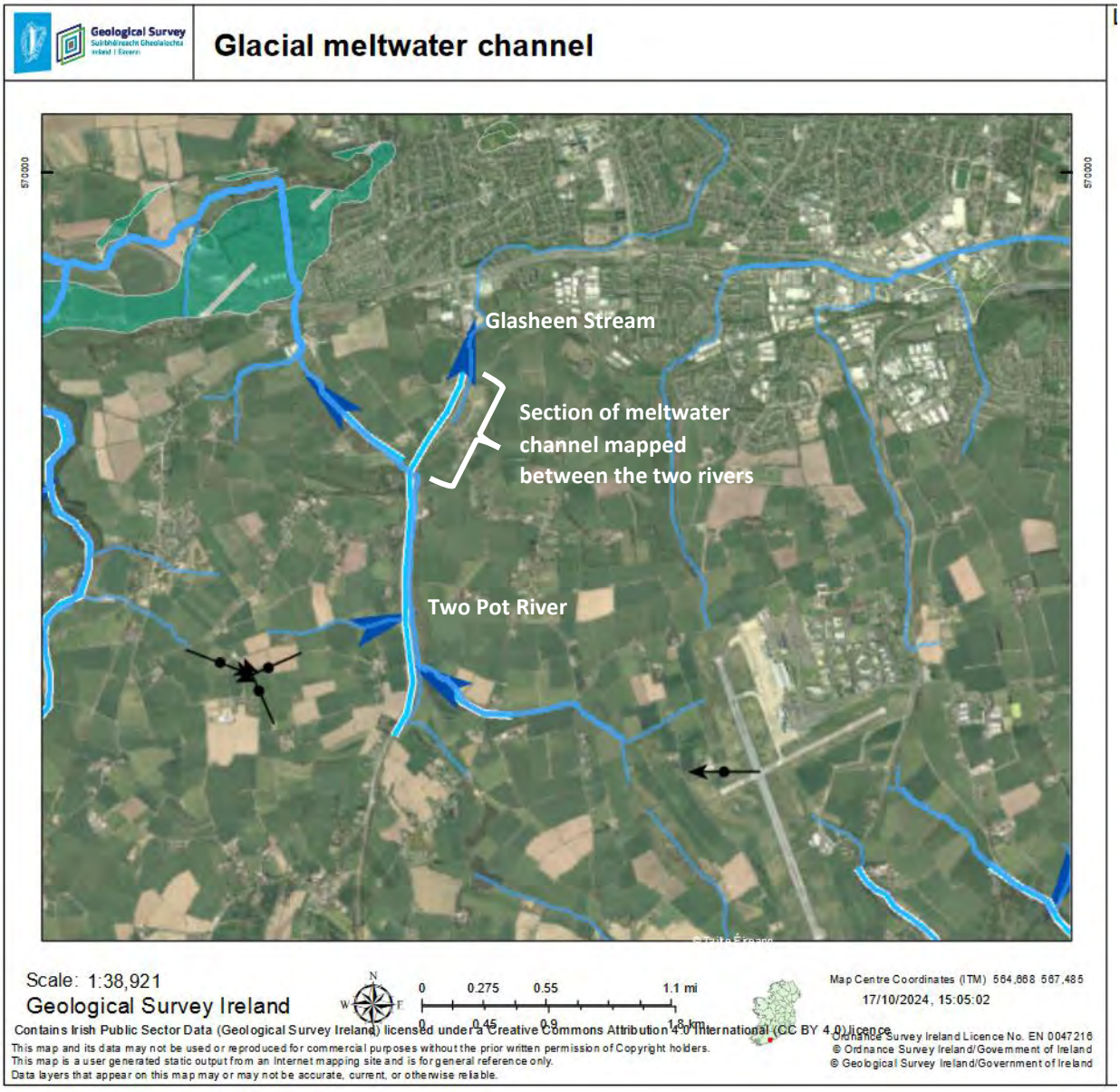


Figure 1-3: Glacial meltwater water channel mapped by GSI between the Two Pot and Glasheen streams. The channel is indicated by the thicker light blue line and blue arrows.

The Glasheen from Woodhaven to Magazine Road is classed as an **OPW drainage district channel**. Drainage districts were formed by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding. Rivers and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified and various other work was carried out. The purpose of these schemes was to improve land for agriculture, by lowering water levels during the growing season to reduce waterlogging on the land beside watercourses. Along the Glasheen the benefited lands from this scheme have now largely been built upon with housing estates or form parkland and playing pitches. Local authorities are charged with responsibility to maintain drainage districts. The Arterial Drainage Act, 1945 contains a number of provisions for the management of Drainage Districts in Part III and Part VIII of the act.

GSI have classified the **bedrock geology (100k)** as sandstone with mudstone and siltstone upstream of the N40 and unbedded lime mudstone and massive and chrinoidal fine limestone downstream. SIS National soils classification system shows upstream of the N40 the soil is classified as Fine loamy drift with siliceous stone - brown earth well drained mineral soils. Downstream of the N40 soils are classed as Urban – soil concreted over.

2. METHODOLOGY

2.1. Desktop Review

A desktop review was completed to gather baseline water quality and ecological information for the Glasheen Stream. The review included a search of current Water Framework Directive (WFD) status and summary of EPA biological monitoring results (as available).

The review also included a search of records for protected aquatic species which are listed on Annex II of the EU Habitats Directive (92/43/EEC) such as; Atlantic salmon (*Salmo salar*), river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*), sea lamprey (*Petromyzon marinus*), freshwater pearl mussel (*Margaritifera margaritifera*) and white-clawed crayfish (*Austropotamobius pallipes*) as applicable and also included otter (*Lutra lutra*).

Records for any other fish species were also noted. For example, European eel (*Anguilla anguilla*) is not listed on Annex II of the Habitats Directive but numbers of juvenile eel reaching coastlines of Europe have undergone significant declines and it has now been classed as critically endangered on the IUCN Red List of Threatened Species.

The desktop review included a search for any aquatic/ riparian habitats listed on Annex I of the Habitats Directive such as water courses of plain to montane levels with the *Ranunculion fluitantis;* and *Callitricho-Batrachion* vegetation or aquatic mosses. It also included a search of any aquatic plants under the Flora Protection Order (S.I 235, 2022).

The characterisation process for the 3rd Cycle River Basin Management Plan has been completed and the report for this catchment was reviewed and results summarised. Areas for Action (AFA) are areas where action will be carried out in the River Basin Management Plan (RBMP). The Areas for Action were selected based on the priorities in the RBMB, the evidence from the WFD characterisation process, and the expertise, data and knowledge of public body staff with responsibilities for water and the different pressure types. The Local Authority Waters Programme (LAWPRO) conduct assessment work within the AFA. EPA mapping tools were used to assess if the relevant water bodies lie within an AFA. The following sources were consulted to conduct the desktop review.

- Environmental Protection Agency (EPA) online mapping tools (https://gis.epa.ie/EPAMaps) and (https://www.catchments.ie/maps/) for water body information and mapping;
- Environmental Protection Agency (EPA) catchment characterisation report (EPA, 2024) Available online (https://catchments.ie/wp-content/files/catchmentassessments/19%20Lee,%20Cork%20Harbour%20and%20Youghal%20Bay%20Catchment%20Summary%20WFD%20Cycle%203.pdf) ;
- Inland Fisheries Ireland online mapping tool (https://opendata-ifigis.hub.arcgis.com/);
- National Parks and Wildlife (NPWS) website for Conservation Objectives, Site Synopsis and any other relevant reporting for European sites (https://www.npws.ie/protected-sites);
- NPWS online mapping and data resources for latest European site boundaries and relevant species/habitat mapping (https://www.npws.ie/maps-and-data);
- NPWS published report regarding conservation status of habitats and species in Ireland protected under the Habitats Directive (NPWS 2019a, 2019b and 2019c);
- National Biodiversity Data Centre (NBDC) online mapping tool for distribution records of protected species or invasive species (https://maps.biodiversityireland.ie/Map);
- Any local surveys of flora, fauna and habitat available using the Heritage Councils mapping website (https://heritagemaps.ie/WebApps/HeritageMaps/index.html).

2.2. Field Survey

On the 26th July and 17th September 2024 a freshwater survey was conducted at eight sites along the Glasheen from the source to end. Other points along the river were investigated to gain an understanding of the river but not sampled. **Table 2-1** below gives the GPS coordinates for each survey site and **Figure 2-1** below shows a map highlighting the sampling locations.

At each sample location the stream was walked at least 100m up and downstream of the access point to gain an understanding of habitats. The following information was collected during the survey and detailed methodology for each is given in the sections below.

- General habitat survey
- Macroinvertebrate kick sampling
- Aquatic or riparian invasive species observations
- Other species/ features

Table 2-1: Coordinates for each site surveyed on the Glasheen Stream.

Site code	Description	GPS coordinate (lat/long)
Site 1	St James's Cemetery	51.86719, -8.52239
Site 2	Ardarostig Woodland	51.86906, -8.52256
Site 3	Upstream of Dunnes	51.87250, -8.52136
Site 4	Woodhaven Estate	51.87619, -8.51878
Site 5	Sandbrook Estate	51.87709, -8.50364
Site 6	Upstream Clashduv Park	51.88014, -8.49848
Site 7	Schoolboys Lane	51.88770, -8.50280
Site 8	Tesco Carpark	51.88928, -8.50476

Figure 2-1: Map showing the location of survey sites along the Glasheen and location of Combined Sewer Overflow (CSOs).

2.2.1. General river habitat characteristics

At each sampling location the general river habitat characteristics were recorded which included;

- Substrate type, degree of overlying sediment and note of sediment generated when substrate disturbed.
- Flow conditions and velocity.
- Riparian zone structure which includes a list of the dominant bankside vegetation and degree of shading along the river.
- Any aquatic macrophytes observed were recorded and percentage cover noted. This included submerged/ emergent plants and those growing along the bankside.
- General hydromorphological characteristics including; river depth, width, bank height, signs of erosion or modification and barriers to connectivity.

In addition, handheld probes were used to record physico-chemical parameters in situ. Probes used included Oxygaurd Handy Polaris and Hanna Combo which were calibrated before use. Parameters measured included; dissolved oxygen (% and mg/l), pH (pH unit), temperature (°c) and conductivity (µS/cm).

2.2.2. Biological quality survey - Macroinvertebrates

Macroinvertebrates were collected using a two-minute (or longer may be required in certain substrate conditions) kick sampling method with a standard hand net (0.5 mm mesh). The survey technique adhered to ISO Standard 10870:2012 and CEN FprEN 16150:2011 for kick sampling and utilised the EPAs standard protocol. Stone washing (1 minute) was also undertaken to ensure collection of species which cling to rock surfaces. The collected sample was tipped into a white tray and macroinvertebrates identified in the field to the lowest taxonomic level possible.

Q-values were assigned as per EPA published guidance (McGarrigle *et al*., 2002, Toner *et al*., 2005) with the surveyor taking into account river typology, seasonality and habitat conditions as per EPA guidance. The information collected during the general river habitat characteristic survey was used to inform Q-value assignment. The Q-value is based on macroinvertebrate sensitivity to pollution with Group A taxa being the most sensitive and Group E taxa being the most tolerant.

Group A – Sensitive
Group B – Less sensitive
Group C – Tolerant
Group D – Very tolerant
Group E – Most tolerant

The Q-value mainly reflects the effects of organic pollution (i.e., deoxygenation and eutrophication) but where a toxic effect is apparent or suspected the suffix '0' is added to the biotic index (e.g., Q1/0, 2/0 or 3/0). An asterisk after the Q value (e.g., Q3*) indicates heavy siltation of the substratum.

The macroinvertebrate survey for this report was conducted in July and September. The Q-value is usually applied in summer/autumn when anthropogenic pressures are greatest on macroinvertebrates due to lower flows and higher temperature. Therefore, no adjustments for seasonality needed to be applied.

Table 2-2: Relationship between the Q-value and water quality (Table adapted from EPA river quality survey reports).

Q-value	Biological Quality[2]	Pollution Status	Condition
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

2.2.3. Invasive species survey

Any invasive aquatic or riparian plants listed on the Third schedule of the EC (Birds and Natural Habitats) Regulations 2011 (S.I.477/2011) were noted.

2.2.4. Other species and habitats of note

Any signs of Annex I habitat or Annex II species or other protected species if present were noted such as those protected under the Wildlife Act 1976 (as amended), Flora Protection Order 1980 (as amended) or any other species or habitats that are rare.

2.3. Biosecurity

For all freshwater ecological surveys, the surveyor employs strict biosecurity methodology. The surveyor is familiar with invasive plant and animal species that occur in Ireland and before any site is visited a review of any aquatic or terrestrial invasive species records is conducted using the National Biodiversity Data Centres (NBDC) online mapping tool to assist in biosecurity planning. Once on site, should any invasive plant species be present their location is recorded and disturbance of the area avoided. The surveyor has completed "Better Biosecurity" online training course run by the University of Leeds.

The surveyor employs the Check – Clean – Dry protocol as recommended by Inland Fisheries Ireland. Before leaving the river all equipment (waders, nets, buckets, trays etc) are checked and any visible debris removed. Equipment is then cleaned using a solution approved for use near water and recommended dosage (Virkon® Aquatic or Milton bleach). All equipment is then stored and allowed to dry thoroughly before reuse. The surveyor holds a second set of gear which is used if sampling more than one catchment in a day. The surveyor will start in the upper reaches to avoid transmission of any invasive species in an upstream direction. The surveyor is aware of the current outbreak of crayfish plague (*Aphanomyces astaci*) which is easily spread on contaminated equipment. The Glasheen is not known to contain white-clawed crayfish however all equipment is cleaned as standard practice.

[2] The Q-value has been developed for rivers only. It does not equate to WFD Status however, in Ireland it is often the driving element in status assignment. It is the most common biological index that is used to calculate Ecological Status for rivers. The other biological indicator used in rivers is fish and monitored by Inland Fisheries Ireland.

3. DESKTOP REVIEW RESULTS

3.1. Existing Water Quality

The Glasheen Stream is part of the Lee, Cork Harbour and Youghal Bay Catchment, Hydrometric Area 19. It is a small tributary of the Curragheen Stream which flows into the Lee (Cork) Estuary Upper in the centre of Cork City. To facilitate surveying and river management the EPA divide rivers into smaller units called waterbodies. The entire Glasheen Stream is mapped as the Glasheen (CorkCity)_010 waterbody.

In the upper reaches of the Glasheen the underlying groundwater body (GWB) is named the Ballinhassig East GWB. The bedrock aquifer here is moderately productive only in local zones i.e., capable of supplying smaller public water supplies or group schemes. The Ballincollig GWB underlies the middle and lower reaches. The bedrock aquifer here is regionally important -karstified i.e., capable of supporting regionally important supplies like large public water supplies. The groundwater vulnerability along most of the Glasheen is classed as being high, meaning that groundwater here has natural characteristics that make it highly vulnerable to contamination by human activities. There are also small areas which are either moderately or extremely vulnerable.

A Combined Sewer Overflow (CSO) is structure or device on a sewerage system designed and constructed for the purpose of relieving the system of excess flows that arise as a result of rainwater in the sewered catchment, the excess flow being discharged to receiving waters. A CSO can also be referred to as a Storm Water Overflow (SWO) in Ireland. EPA mapping shows four CSOs on the Glasheen (see **Figure 2-1** above)

There are no EPA biological monitoring points on the Glasheen or the Curragheen and therefore Q-value information (the macroinvertebrate quality) is not available. The Water Framework Directive (WFD) objective for the Glasheen_010 is to achieve at least Good Ecological Status by 2027. The current WFD status (2016-2021) is Poor and therefore the Glasheen has been classed as being "At Risk" of failing its WFD objective (3rd cycle risk). The significant issue identified by the EPA is Nutrients (**Table 3-1**).

Table 3-1: Summary of WFD status (2016-2021) for Glasheen and connected waterbodies.

Waterbody	WFD status (2016-2021)	WFD objective	Risk of failing objective	Significant issue (if at risk)	Note
Glasheen (Cork City)_010	Poor	Good	At Risk	Nutrients- main pressure is unknown	No biological monitoring conducted and the WFD status is based on modelling.
Curragheen (CorkCity)_010	Moderate	Good	At Risk	Nutrients- main pressure is unknown	No biological monitoring conducted and the WFD status is based on expert judgement.
Lee (Cork) Estuary Upper IE_SW_060_0950	Moderate	Good	At Risk	Nutrients, organic – urban wastewater, Urban runoff pressures.	Transitional waterbody in a nutrient sensitive area.
Ballinhassig East IE_SW_G_004	Good	Good	Not at Risk		Groundwater body in a drinking water protected area.
Ballincollig IE_SW_G_002	Good	Good	Not at Risk		Groundwater body in a drinking water protected area.

There are monitoring points where chemical analysis is conducted. These monitoring sites are spread along the channel from the Bandon Road down to Glasheen Bridge.

The average results for the most recent year of sampling are shown below in **Table 3-2** and the standards stipulated within the European Communities Environmental Objectives (Surface Waters) Regulations (S.I. 272/2009 as amended) for Good status are given as reference. In summary, nutrients (ortho-P) are very high within the Glasheen and conditions degrade as one moves downstream. The levels of ammonia (another nutrient) are very elevated from Sandbrook Estate to Glasheen Bridge and dissolved oxygen levels ranged from low to extremely low. When oxygen is freely available ammonia is quickly transformed to oxidised forms. High levels of ammonia such as those within the Glasheen would indicate a severe organic input where bacteria have used up available oxygen and therefore ammonia cannot be transformed. The results indicate high organic loading to the Glasheen with anoxic conditions particularly at Glasheen Bridge.

Areas for Action (AFA) are areas that are proposed for focused action and collaboration by local authorities, public bodies, and stakeholders as part of implementation of the 3rd Cycle WFD in Ireland. The Glasheen has not been classed as an AFA.

Table 3-2: Average results of water chemistry monitoring at five stations along the Glasheen. The year of sampling is indicated as well as the minimum and maximum values recorded in that year. For reference the standards for Good status as stipulated within the EC Surface Water Regulations (S.I. 272/2009 as amended) are given.

	M04 Bandon Road (2017)	M05 Woodhaven Estate (2017)	Glasheen (Cork City) - Sandbrook Estate (2017)	M07 Clashduv road (2017)	M08 Glasheen Bridge (2024)	Surface Water Regulations standards for Good status
Alkalinity-total (as CaCO3) mg/l					193.67 (min 184, max 204)	-
Ammonia-Total (as N) mg/l		0.06 (min 0.06, max 0.07)	0.22 (min 0.12, max 0.34)	0.18 (min 0.12, max 0.24)	0.43 (min 0.14, max 0.96)	≤0.065 mean
BOD - 5 days (Total) mg/l	0.99 (min 0.57, max 2.07)	1.42 (min 0.45, max 5.76)	1.48 (min 0.91, max 2.35)	1.47 (min 1, max 2.9)	1.9 (min 1.4, max 2.7)	≤1.5 mean
Chloride mg/l					30 (min 24.5, max 38.6)	-
Conductivity @25°C µS/cm					500.33 (min 449, max 542)	-
Dissolved Oxygen %	79.27 (min 71.62, max 91.59)	73.72 (min 61.87, max 87.683)	53.78 (min 38.78, max 69.58)	51.99 (min 31.37, max 66.79)	26.35 (min 2.9, max 63)	>80 <120 95%ile
ortho-Phosphate (as P) - unspecified mg/l	0.05 (min 0.04, max 0.078)	0.06 (min 0.05, max 0.12)	0.08 (min 0.06, max 0.1)	0.08 (min 0.05, max 0.13)	0.092 (min 0.037, max 0.19)	≤0.035 mean
pH	7.15 (min 6.83, max 7.43)	7.75 (min 7.5, max 8.1)	7.57 (min 7.47, max 7.87)	7.6 (min 7.51, max 7.86)	7.5 (min 7.3, max 7.6)	>6.0 <9.0
Temperature °C	11.66 (min 8.4, max 14.2)	11.91 (min 8.1, max 15.2)	12.21 (min 7.9, max 16.2)	12.29 (min 7.6, max 16.5)	12.57 (min 8.8, max 15.8)	-
Total Hardness (as CaCO3) mg/l					212.33 (min 191, max 224)	-
Total Nitrogen mg/l	2.98 (min 1.13, max 4.58)	3.02 (min 1.8, max 4.33)	3.01 (min 1.11, max 4.94)	2.52 (min 1.19, max 4.1)		-
Total Oxidised Nitrogen (as N) mg/l	2.85 (min 1.11, max 4.19)	2.75 (min 1.54, max 4.12)	2.53 (min 0.67, max 4.41)	2.09 (min 0.89, max 3.53)	2.69 (min 0.27, max 4.9)	-

3.2. Records of Protected Species and Habitats

The Glasheen Stream is not located within any European Site, Natural Heritage Area or any other protected site. The closest site is The Lough proposed Natural Heritage Area (pNHA 001081) approximately 910m west of the Glasheen. The Lough is a small spring fed lake which supports important numbers of wintering birds like shovler, tufted duck, pochard and mallard.

Cork Harbour Special Protected Area (SPA 004030), Great Island Channel Special Area of Conservation (SAC 001058), Douglas Estuary pNHA (001046), Dunkettle Shore pNHA (001082), Rockfarm Quarry Little Island pNHA (001074) and are located 7.2km-11.7km downstream of where the Glasheen enters the Curragheen in the Lee estuary. The Glasheen does form an important wildlife corridor through the urban and suburban areas of Cork and connecting into the wider countryside.

The available information for the Glasheen Stream was quite limited but please note that an absence of records does not necessarily mean a species or habitat is absent from the area. The desktop search was for publicly available records online, other records may exist within private databases. The Glasheen is a relatively small river which has not been extensively monitored or studied and is one reason why records are limited. As is the case for a lot of small river habitats in Ireland, records are often reliant on keen eyed local members of public.

A summary of the desktop review for protected or invasive species and habitats is given below in **Table 3-3.** The search included aquatic species and habitats but also species who are closely associated with river habitats for example birds like the dipper nest along rivers and specialise in feeding on aquatic macroinvertebrates.

The culvert which diverts the Glasheen under Orchard Road and Orchard Court has been mapped by Inland Fisheries Ireland (IFI) as a barrier to the movement of fish. This culvert is located right on the lower section of the stream meaning that the entire Glasheen is inaccessible to migratory fish species. A record for only one single fish species was identified, European eel (Ryan Hanley 2016). The eel was found upstream of the barrier indicating that eel can navigate through this barrier or at least in certain flow conditions they can. The report noted that pollution, siltation and physical alterations to the Glasheen all contributed to the very low fish species diversity observed (Ryan Hanley 2016).

Table 3-3: Summary of desktop review for protected or invasive aquatic species and habitats along the Glasheen.

Species/Habitat	Designation[3]	Records
Otter (*Lutra lutra*)	-Annex II & IV of the EU Habitats Directive (92/43/EEC).	In a 2021 study of otter in Cork City signs of otter were identified (spraints) along the Glasheen at three locations, Woodhaven, Glasheen Road and Magazine Road (Dalton et al., 2021).
	-Irish Wildlife Act (1976 as amended).	There are numerous records of otter within the Curragheen and River Lee close to the Glasheen confluence. The closest to the Glasheen is at O'Neill Crowley Bridge 230m from the Glasheen (NBDC record 2018)
Common frog (*Rana temporaria*)	-Annex V of the EU Habitats Directive (92/43/EEC).	There are historic records of common frog near Dunnes (NBDC record 1970).

[3]Annex I – habitat types whose conservation requires the designation of Special Areas of Conservation.
Annex II – animal or plant species whose conservation requires the designation of Special Areas of Conservation.
Annex IV – animal or plant species in need of strict protection
Annex V – animal or plant species b whose taking in the wild and exploitation may be subject to management measures.

Species/Habitat	Designation[3]	Records
	-Irish Wildlife Act (1976 as amended).	
Salmon (*Salmo salar*)	-S.I. 293: European Communities (Quality of Salmonid Waters) Regulations, 1988. -Annex II & V of the EU Habitats Directive (92/43/EEC)	The Glasheen is not designated as salmonid water under the Salmonid Regulations (S.I. 293,1988) however the main channel of the River Lee is from the Kingsley Hotel to Inniscarra Dam. There are no records of salmon within the Glasheen. A 2014 fish survey of the lower Glasheen at Ashbrook noted the habitat quality was very reduced with pollution, siltation and channel alterations contributory factors. As a result, it was concluded that salmonids had been extirpated from the stream (Ryan Hanley 2016) The same survey did identify salmon within the lower reaches of the Curragheen at Carrigrohane Bridge, the Concrete Works and GAA playing fields. Salmon were also recorded in the River Lee at Lee Road and the Kinglsey Hotel. IFI surveys within the River Lee also identified salmon at Lee fields (Kelly et al., 2010a & 2013).
Brown trout / Sea trout (*Salmo trutta*)	-	Although trout are not protected under Irish or European legislation records are noted as they are an important part of freshwater ecosystems and are a food source for protected species such as otter. There are no records of trout within the Glasheen. A 2014 fish survey of the lower Glasheen at Ashbrook noted the habitat quality was very reduced with pollution, siltation and channel alterations contributory factors. As a result, it was concluded that salmonids had been extirpated from the river (Ryan Hanley 2016). The same survey did identify brown trout within the lower reaches of the Curragheen at Carrigrohane Bridge, the Concrete Works and GAA playing fields. Brown trout were also recorded in the River Lee at Lee Road and the Kinglsey Hotel. IFI surveys within the River Lee identified salmon at Lee fields in 2010 and 2013 (Kelly et al., 2010a & 2014). Sea trout have been identified in the upper lee estuary near city hall approximately 3.1km downstream of the Glashene/Curragheen confluence (Kelly et al., 2010b)
European eel (*Anguilla anguilla*)	-IUCN Red listed as a critically endangered species	European eel were identified in the lower Glasheen at Ashbrook during a 2014 survey conducted as part of the Lower Lee (Cork City) Drainage Scheme. It was noted that habitat quality was very reduced with pollution, siltation and channel alterations contributory factors (Ryan Hanley 2016). The same survey identified eel in the Curragheen River at Carrigrohane Bridge, the Concrete Works and GAA playing fields. Eel were also recorded in the River Lee at Lee Road and the Kinglsey Hotel. IFI surveys within the River Lee identified eel at Lee fields in 2010 and 2013 (Kelly et al., 2010a & 2014).

Species/Habitat	Designation[3]	Records
Sea/river/brook lamprey (*Petromyzon marinus, Lampetra fluviatilis, Lampetra planeri*)	-Annex II of the EU Habitats Directive (92/43/EEC) (all three species) -Annex V of the EU Habitats Directive (92/43/EEC) (river only)	There are no records of lamprey within the Glasheen. A 2014 fish survey recorded both river and brook lamprey in the lower reaches of the Curragheen (Ryan Hanley 2016). IFI surveys within the River Lee identified lamprey (*Lampetra* sp.) at Lee fields in 2010 and 2013 and they were the most common species in 2010 (Kelly et al., 2010 & 2014). There are historical records of sea lamprey within the River Lee near Inniscarra (Kurz & Costello, 1999). While closer to the Glasheen/Curragheen confluence sea lamprey have been observed spawning below Lee fields (an observation noted within Ryan Hanley, 2016).
Japanese knotweed (*Reynoutria japonica*)	-Third schedule of the EC (Birds and Natural Habitats) Regulations 2011 (S.I.477/2011)	There are a number of records of Japanese knotweed along the Glasheen. Starting at the most upstream record, knotweed is mapped in Ardarostig growing along the roadside approximately 30m from the Glasheen (NBDC record 2017). Knotweed is recorded again further downstream by Clashduv Park but it is a little unclear where exactly it was found. It appears to be near or within the northern section of Clashduv Park and noted to be in an area of amenity grassland (NBDC record 2023). The plant was recorded again along the Glasheen at the southern and northern end of thepark by Schoolboys Lane (NBDC records 2015). The next record is mapped along Linaro Avenue (NBDC record 2016) Finally, there is a record just south of Victoria cross approximately 68m from the Glasheen (NBDC record 2014).
Habitats	-Annex I of the EU Habitats Directive (92/43/EEC)	There are no Annex I habitats mapped along the Glasheen Stream. The wetland habitat in Lough Mahon (part of the Lee estuary) is protected as part of the Cork Harbour SPA and is used as a resource for regularly occurring migratory waterbirds that utilise it.

4. FIELD SURVEY RESULTS

Eight sites in total were surveyed along the Glasheen. The following section details the results of the macroinvertebrate and general habitat survey. For quick reference the macroinvertebrate results are summarised in **Section 5**. A species list of the macroinvertebrates identified is presented in **Appendix A** and full details for the general river habitat characteristics are presented in **Appendix B.**

4.1. Sites 1 - St James's Cemetery

4.1.1. General characteristics

The Glasheen rises only a short distance (approximately 450m) upstream of Site 1. At Site 1 the Bandon Road follows along the left bank while the cemetery lands are located along the right bank. The channel was dry near the entrance to the cemetery, but the caretaker noted that after heavy rains water the channel can be full. Water appears a short distance downstream and flow began in earnest at a 1m drop in the channel which appears to be a manmade feature. Site 1 is located just before the stream is diverted under the Bandon Road. Here the stream is still very shallow (0.05m depth) but with a steady flow. Given the straightened channel and shallow depth there was a uniform glide habitat.

The channel is narrow (1.5m bankfull width) and has been deepened and straightened leading to high vertical banks (1-3m height) and no connection to a floodplain. A concrete pipe is located along the right bank which was discharging a steady flow of water on the day of survey. This is the stream that is marked on historic maps rising by a well near Chetwynd House which is now diverted under the cemetery. While the water coming from the pipe was clear there was a strong paraffin/petroleum smell. A second pipe is present along the right bank just before the stream is diverted under the Bandon Road, this was dry but there was a foul odour coming from the pipe.

The stream substrate is gravel dominated with cobbles present but no larger boulders. Siltation was moderate (10%) with a heavy plume generated when disturbed indicating siltation of the gravel interstices. The channel here is quite shaded and no instream vegetation was observed. There is a narrow woodland present along both banks with willow (*Salix* sp.), alder (*Alnus glutinosa*), butterfly bush (Buddleja davidii) and an understory of ivy (*Hedera hibernica*), bracken (*Pteridium aquilinum*), bramble (*Rubus fruticosus* agg.), hart's tongue fern (*Asplenium scolopendrium*) and common hogweed (*Heracleum sphondylium*). This is a very narrow (<5m) along the left bank sandwich between the stream and Bandon Road but is wider on the right bank (10-15m) with informal pathways and littering. The woodland along both banks forms an important wildlife corridor. Directly downsteam of Site 1 the Glasheen turns at a near 90-degree angle and is diverted under the Bandon Rd. via a concrete pipe culvert. Flow through the pipe is very shallow (0.02m).

The results of the physico-chemical parameters recorded are summarised in **Appendix B**. Oxygen, pH temperature and conductivity readings were within the normal range and as expected for this river. Oxygen was slightly low at 8.57mg/l but considering the shallow depth and fact that the stream rises only a short distance upstream this is not unexpected.

4.1.2. Biological water quality

The kick sample showed low macroinvertebrate diversity (13 taxa). No sensitive (Group A) taxa were present. Two less sensitive (Group B) taxa were present in low numbers, the cased caddisfly (*Sericostoma personatum*) and a mayfly (*Aliaintes muticus*). Pollution tolerant (Group C) taxa made up the highest density with numerous blackfly larvae (Simulliidae) and common freshwater shrimp (*Gammarus* sp.) and the mayfly (*Baetis rhodani*).

One very tolerant (Group D) and one most tolerant (Group E) taxa were present but in low numbers. These were the water hoglouse (*Asellus aquaticus*) and worm (Tubificinae). As no Group As were present,

low diversity and the sample was largely made up of Group C taxa **Q3** was assigned indicating **Poor macroinvertebrate quality**. Please see **Appendix A** for full list of macroinvertebrates and abundances. It should be noted that the sample was taken close to the stream source and the Q-value is not designed for samples taken close to a stream source.

Plate 4-1: Glasheen upstream of the cemetery close to its source.

Plate 4-2: Glasheen as it drops 1m down a concrete ledge and piped under the cemetery.

Plate 4-3: Glasheen Stream at Site 1 facing upstream.

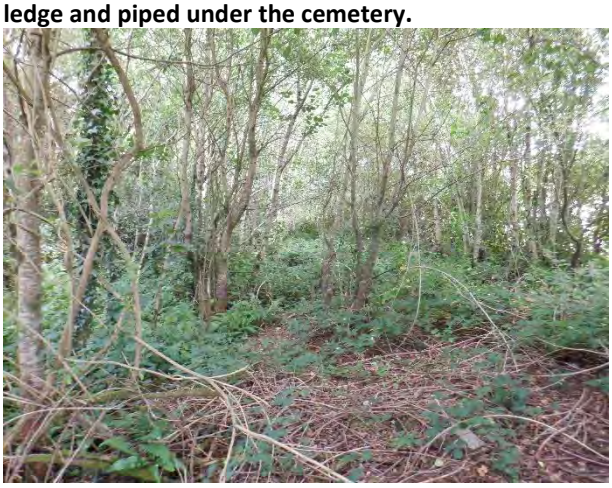


Plate 4-4: Narrow woodland present between the Glasheen and St James's Cemetery serving as a good riparian habitat and wildlife corridor, however heavy littering is present.

Plate 4-5: Outfall of a small stream to the Glasheen which is piped under the cemetery. See Figure 1-2 for historic mapping of this channel.

Plate 4-6: The Glasheen just before it is diverted under the Bandon Rd through a pipe culvert.

4.2. Site 2 – Ardarostig Woodland

4.2.1. General characteristics

As the Glasheen emerges from the pipe under the Bandon Road the flow is backed up in a pool at the outfall. Flow does quickly returns downstream and here the Glasheen is markedly different to the straightened channel upstream at Site 1. The water depth was still shallow (0.05m depth) but the channel appears to have regained some natural characteristics with a good riffle/glide sequence and occasional pools.

The stream width is narrow (1.2m bankfull width) with varied bank height from 0.4m on the left bank to steep nearly 2m high banks on the right. The river substrate was dominated by cobble and gravel with no larger boulders. There was the occasional outcrop of bedrock visible. Siltation was moderate (10%) with a heavy plume generated when disturbed indicating siltation of the gravel interstices. The Glasheen here flows through a mixed broadleaved woodland with hazel (*Corylus avellana*) dominating but elder (*Sambucus nigra*), sycamore (*Acer pseudoplatanus*), willow (*Salix* sp.), alder (*Alnus glutinosa*) and beech (*Fagus sylvatica*) are also present. Bracken (*Pteridium aquilinum*) and ivy (*Hedera hibernica*) dominate the understory. This woodland is approximately 25-30 wide along the left bank and then a high set back embankment is present along the laneway. On the right bank the woodland is present on a high set back embankment approximately 10m in width and then the Bandon Road is present.

The left bank represents an excellent riparian buffer zone. The stream has access to a floodplain along a section of the left bank. Here the ground is wet in places with yellow iris (*Iris pseudacorus*), wild angelica (*Angelica sylvestris*), guelder rose (*Viburnum opulus*), willow (*Salix* sp.) and alder (*Alnus glutinosa*) which are characteristic of a **wet woodland habitat**. There is potential for this habitat to correspond with the **Annex I habitat – Alluvial Woodland (91E0)** however further detailed survey is required to confirm. The woodland not only provides an area for natural flood retention but also helps to buffer pollutants and supports both terrestrial and aquatic biodiversity.

One third schedule invasive species was observed, **Japanese knotweed** (*Reynoutria japonica*), please see **Section 5** for further detail. Aquatic vegetation consisted of hemlock water-dropwort (*Oenanthe crocata*) and fool's watercress (*Apium nodiflorum*) growing along the margins.

From Site 2 the Glasheen is diverted back under the Bandon Road via a concrete pipe culvert. Flow is very shallow through the pipe (0.02m) and appears undersized to accommodate higher flows.

The results of the physico-chemical parameters recorded are summarised in **Appendix B**. Oxygen, pH temperature and conductivity readings were within the normal range and as expected for this river. No significant readings of note were recorded.

Plate 4-7: Glasheen as it emerges from under the Bandon Road.

Plate 4-8: Glasheen at Site 2 facing downstream

Plate 4-9: Broadleaved woodland along the Glasheen forming an important habitat supporting the stream and wildlife.

Plate 4-10: Japanese knotweed growing along the laneway at Ardarostig.

Plate 4-11: Glasheen as it enters the second pipe under the Bandon Road.

4.2.2. Biological water quality

The kick sample showed a higher macroinvertebrate diversity (18 taxa) compared to Site 1. No sensitive (Group A) taxa were present. Three less sensitive (Group B) taxa were present in low numbers, the cased caddisfly (*Sericostoma personatum*), mayfly (*Aliaintes muticus*) and stonefly (*Leuctra* sp.). Pollution tolerant (Group C) taxa made up the highest density with numerous freshwater shrimp (*Gammarus* sp.). No very tolerant or most tolerant (Groups D or E) were present.

As no Group As were present and the sample was largely made up of Group C taxa a **Q3** was assigned indicating **Poor macroinvertebrate quality**. However, this was very close to the upper boundary and was almost achieving a Q3-4 indicating slightly improved conditions compared to upstream at Site 1. Please see **Appendix A** for full list of macroinvertebrates and abundances.

4.3. Site 3 – Upstream of Dunnes

4.3.1. General characteristics

This site is located just upstream of the Dunnes Stores shopping centre sandwiched between industrial units and a car park. The characteristics of the Glasheen change as it starts to become urbanised. The stream banks are high (3-3.5m) with no floodplain connection and have been reinforced with boulders in sections. Some light erosion of the banks was evident. The channel is narrow (1.5m bankfull width) and depth is shallow but has increased slightly (0.12m) compared to Site 1 and 2 upstream. A narrow broadleaved treeline is present on the steep bank slopes with sycamore (*Acer pseudoplatanus*), hawthorn (*Crataegus monogyna*), butterfly bush (*Buddleja davidii*) and ash (*Fraxinus excelsior*) with rushes (*Juncus* sp.) bittersweet (*Solanum dulcamara*), bramble (*Rubus fruticosus* agg.), common figwort (*Scrophularia nodosa*) and nettle (*Urtica dioica*) in the understorey. There is no riparian zone on the left back with industrial units built up to the bank edge (e.g., petrol station, storage facility, car dealership). Along the right bank there is a narrow buffer zone with 5m strip of wildflower planting before a carpark. However further upstream there is a 20m wider buffer zone with a broadleaved treeline making this section important to protect from further development.

The stream substrate was cobble/gravel dominated and slightly compacted with heavy siltation (20%). Flow habitat was mainly riffle/glide with occasional pools. The water had a slight discolouration (grey) on the day of survey indicating potential misconnection to the stream. Aquatic vegetation consisted of fool's watercress (*Apium nodiflorum*) which was quite dominant in slower flowing sections, hemlock water-dropwort (*Oenanthe crocata*) and liverwort (*Pelia* sp.). Nearly 10% of the substrate was covered in sewage fungus and in places it was combined with iron bacteria forming an organic mat on the substrate. A foul odour was present in the stream at the time of survey.

From here the stream is diverted under the South Link Road via a concrete pipe which is directed at a downward angle. A concrete apron is present at the pipe inlet with very shallow flow (<0.01m). This pipe would represent a full barrier for the movement of any aquatic or terrestrial species effectively separating the upper reaches of the Glasheen from the rest of the stream downstream.

The results of the physico-chemical parameters recorded are summarised in **Appendix B.** While most parameters were within normal range the oxygen levels were low (48.3%, 4.99mg/l). The discoloured water, sewage fungus, low oxygen, dominant fool's watercress and foul odour all indicate an organic pollution within the Glasheen and quality has declined between Site 2 and Site 3.

4.3.2. Biological water quality

The kick sample showed very low macroinvertebrate diversity with only 8 taxa present. No sensitive or less sensitive taxa (Groups A or B) were present in the sample. One very tolerant (Group D) taxon was present and was also numerous, (*Asellus aquaticus*). Two most tolerant taxa (Group E) were also present but in low numbers (Chironomus and *Eistalis* spp.). Both these taxa are adapted for low oxygen conditions. The remainer of the sample was made of tolerant taxa (Group C) which were either in low numbers or common. As no Group A or B taxa were present and there were numerous *A. aquaticus* (Group D) a **Q2-3** was assigned indicating **Poor macroinvertebrate quality**. Please see **Appendix A** for full list of macroinvertebrates and abundances.

Plate 4-12: Glasheen at Site 3 facing upstream where channel is almost entirely covered with fool's watercress.

Plate 4-13: Glasheen at Site 3 facing downstream.

Plate 4-14: Example of sewage fungus growth at Site 3.

Plate 4-15: Glasheen just before it enters the culvert diverting it under the carpark at Dunnes and the N40 road.

4.4. Site 4 – Woodhaven Estate

4.4.1. General characteristics

After the Glasheen is diverted under the South Link Road (N40) it flows through Woodhaven estate where Site 4 is located. At the outfall for the pipe under the South Link a second long pipe culvert joins the Glasheen. This had a steady flow of clear and shallow water on the day of survey. A review of historic mapping does not show any streams here but there was a millrace system nearby. Further investigation would be needed to identify the extent of this second pipe system and where the water is coming from.

At Site 4 the stream is narrow (1m bankfull width) and constrained within a straightened and deepened channel leading to high steep banks (1.5m) and no connection to a floodplain. Substrate is cobble/gravel dominated with heavy siltation (25%). A very heavy plume of silt was generated when the substrate was disturbed indicating siltation of the gravel interstices. Water levels were low at 0.05m depth and flow was a slow uniform glide.

The surrounding land-use is suburban. A mixed broadleaved treeline is located along both banks with lime (*Tilia* sp.), hawthorn (*Crataegus monogyna*), sycamore (*Acer pseudoplatanus*) and ash (*Fraxinus excelsior*). Along the left bank there is a 25m buffer with amenity grass before suburban housing estates. On the right bank there is a very narrow 1-2m buffer of amenity grass however further downstream this increases to 100m where there is an amenity area with scrub, grassland, mature trees and walking trails.

This forms an important habitat and space for wildlife in the increasing suburban environment along the Glasheen. The river bird **grey wagtail** (*Motacilla cinera*) was observed in the Glasheen on the day of survey

One third schedule invasive species was observed, **Rhododendron** (*Rhododendron ponticum*), please see **Section 5** for further detail. Aquatic vegetation was sparse with small amounts of fool's watercress (*Apium nodiflorum*), watercress (*Nasturtium officinale*), hemlock water-dropwort (*Oenanthe crocata*), liverwort (*Pelia* sp.) and Kneiff's feather moss (*Leptodictyum riparium*). A small amount of filamentous green algae (*Vaucheria* sp.) was present. Sewage fungus was also observed growing in small tufts along the stream bed.

Seven **outfall pipes** were identified along the left bank and three on the right. The pipes on the right bank where small waven pipes and appear to be associated with road drainage only. On the left bank three of the pipes were discharging water at the time of survey while two others were of note. Details of these outfalls are summarised below in **Table 4-1.**

While most parameters were within normal range the oxygen levels declined further and were very low (26.9%, 2.67mg/l). The discoloured (grey) water, sewage fungus, low oxygen and foul odours all indicate a continuation of the organic pollution issue first noted at Site 3. The site was sampled on a dry day and the preceding day was also dry, therefore it was not expected that any CSO would be in operation. The pipes discharging water on the day of survey appears to be a misconnection discharging foul water directly to the Glasheen. The other pipes are also potentially misconnections and warrant investigation.

Table 4-1: Details of outfalls which were of interest on the day of survey at Site 4.

Location	GPS Coordinate (Lat/Long)	Description
Left bank 5m d/s bridge over Glasheen	51.87634, -8.51851	This is where a CSO is mapped by the EPA and a low flow of clear water was outfalling to the Glasheen, no discolouration or sewage fungus was observed.
Left bank 35m u/s bridge over Glasheen	51.87614, -8.51902	Steady trickle of discoloured (grey) water. A foul odour was noted and sewage fungus was present around the outfall and in the stream under the pipe (see **Plate 4-18**). Bits of tissue were also present along the stream bed downstream.
Left bank, 95m u/s bridge over Glasheen	51.87583, -8.51971	Small (20cm diameter) pipe in a precast concrete box. Outfall was not active but discoloured (grey) standing water was present in the box and vegetation along the stream bank had a grey coating indicating this outfall discharges foul water.
Left bank, 95m u/s bridge over Glasheen	51.87564, -8.52025	Two pipes within a precast concrete box. The larger pipe has a control valve which was half open. Outfall was not active on day of survey but rags were caught on the valve and vegetation along the stream bank had a grey coating indicating this outfall discharges foul water.
Left bank, 175m u/s bridge over Glasheen	51.87549, -8.52067	Another large concrete pipe which appears to be an unmapped CSO. Trickle of water outfalling to the stream. The survey day was dry and preceding day was dry therefore it would not be expected that a CSO would be discharging. Deep black silt below the pipe with sewage fungus on the stream bed below the pipe. Rags were caught on the vegetation along the stream bank. All characteristic of an outfall which discharges foul water.

4.4.2. Biological water quality

The kick sample showed low macroinvertebrate diversity with 12 taxa present. No sensitive taxa (Group A) were present in the sample. One less sensitive (Group B) taxon was present in very low numbers, and this was the stonefly (*Leuctra* sp.). The non-biting midge (Chironomidae) was numerous which is a tolerant taxon (Group C). Three very tolerant (Group D) taxa were present, these were water hoglouse (*Asellus aquaticus*) which was common and two freshwater leeches (*Glossiphonia complanata* and *Helobdella stagnalis*) which were present in low numbers. Two most tolerant taxa (Group E) were also present in low numbers (Chironomus and Tubificinae). The rest of the sample was made up of tolerant (Group C) taxa that were common or in low numbers. A **Q3** was assigned indicating **Poor macroinvertebrate quality.** Please see **Appendix A** for full list of macroinvertebrates and abundances.

Plate 4-16: Pipe culvert on the left is the outfall of the Glasheen after it is diverted under the South Link Rd. Pipe on the right is an unknown piped stream.

Plate 4-17: Glasheen Stream at Site 4 facing upstream.

Plate 4-18: Outfall pipe discharging grey water on the day of survey. Grey water in the stream is visible in the bottom half of the photograph

Plate 4-19: Close up of the pipe in previous image with sewage fungus visible around the outfall.

Plate 4-20: Outfall with control valve. This was not active on day of survey but rags are visible in the pipe (yellow circle) indicating it discharges foul water.

Plate 4-21: Example of tissue on the stream substrate indicative of untreated discharges.

4.5. Site 5 -Sandbrook Estate

4.5.1. General characteristics

The Glasheen flows parallel to the South Link Road and is diverted under Sarsfield Road via an arch culvert. It then enters Sandbrook Estate where Site 5 is located. This section of the Glasheen is part of an OPW drainage district. Here the channel is wider compared to the upstream sites (4m bankfull width). The channel has been straightened and deepened leading to very high vertical banks (3m) and no floodplain connection. Water depth is still quite shallow (0.25m) and flow is very slow to almost stagnant. A conifer treeline is present along both banks creating moderate to heavy shading along the channel.

At this site the quality of the stream declines significantly. From the culvert at Sarsfield Road the water was very discoloured (grey). The stream substrate was 100% silt with no coarse substrate present. When disturbed the sediment was black and anoxic. The entire substrate was also covered in a mixture of sewage fungus and what appeared to be and a whitish/blue substance that had settled on the substrate and detritus. The entire stream at this site had a very foul odour which was perceptible from the housing estate. It was clear that there is another significant pollution input between Site 4 and Site 5.

The Glasheen was walked from Site 4 downstream to investigate a possible source of pollution. Discoloured (grey) water and the same whitish silty deposit was apparent upstream of the ESB networks on the boundary with Cardinal Court. This continued downstream as far as Sarsfield Road with some sewage fungus present. No discharge pipes were visible where the grey water started but heavy bankside and instream vegetation obscured some parts. There is also another channel which joins the Glasheen under Sarsfield Road. It starts along the northern boundary of the Doughcloyne Industrial Estate and a housing estate. It then flows through the middle of Sarsfield Road roundabout. The discoloured water and sewage fungus becomes more apparent from Sarsfield Road and therefore there are potentially three sources of pollution, 1) a hidden outfall to the Glasheen near Cardinal Court 2) outfall(s) to the Doughcloyne tributary channel which joins the Glasheen at the Sarsfield Road roundabout, 3) CSO mapped under the Sarsfield Road which was not visible. Given the day of survey was dry and preceding day was also dry it was not expected to be discharging unless misconnection to it exist.

Dissolved oxygen levels plummeted at this site (4.2% 0.41mg/l) indicating very high anaerobic bacteria activity. Conductivity increased slightly to 581 µS/cm where it was between 456- 486 µS/cm at the upstream sites. The results indicate a further deterioration and gross organic pollution in the Glasheen.

Moorhen (*Gallinula chloropus*) and a grey heron (*Ardea cinerea*) were observed on the day of survey.

4.5.2. Biological water quality

Owing to the steep banks and deep silted conditions a kick sample could not be taken but a sample was taken from the bank using an extension net technique. The results of the macroinvertebrate survey reflected the poor conditions described above. Macroinvertebrate diversity was very low with only 4 taxa present. Only very tolerant and most tolerant taxa (Groups D & E) were present. The Group E taxa Tubificinae were numerous while Chironomus were common. The other two taxa were present in low numbers. No Group A, B or C taxa were present and Group E taxa were common to numerous and therefore a **Q1-2** was assigned indicating **Bad macroinvertebrate quality.**

Plate 4-22: Glasheen between sites 4 & 5 where grey coloured water appears for the first time

Plate 4-23: Example of the substrate with sewage fungus between sites 4 & 5.

Plate 4-24: Glasheen just before it passes under Sarsfield Road

Plate 4-25: Glasheen as it emerges from the culvert under Sarsfield Road.

Plate 4-26: Glasheen at Site 5.

Plate 4-27: Close up of the Glasheen at Site 5.

4.6. Site 6 – Upstream of Clashduv Park

4.6.1. General characteristics

Site 6 is located before Clashduv Park just downstream of the pedestrian bridge at Sandymount Drive. This section of the Glasheen is part of an OPW drainage district and it has been widened (4m bankfull width) and deepened resulting in 2m vertical banks with no floodplain connection. Water was shallow on the day of survey (0.15m depth) with slow to almost stagnant flow. The stream substrate was dominated by deep black silts with all coarse substrate having been removed

Along the left bank there is a 25m buffer zone with the majority of this managed as amenity grass and a mature broadleaved treeline. A fence separates the last 5m of the bank and river and here bankside vegetation is dominated with grasses and herbs such as dock (*Rumex* sp.), nettle (*Urtica dioica*), bindweed (*Calystegia sepium*) and willowherb (*Epilobium* sp.). Grasses and herbs are also present along the narrow right bank (5m). Cherry laurel (*Prunus laurocerasus*) and tall conifers screen the councils/parks yard. One third schedule invasive species was observed, **Japanese knotweed** (*Reynoutria japonica*), please see **Section 5** for further detail.

Instream aquatic vegetation was sparse with a small amount of starwort (*Callitriche* sp.). In a conversation with a parks worker they noted that some dredging did occur in 2024 which would explain the lack of aquatic vegetation. Filamentous green algae covered 30% of the silted substrate indicating enriched conditions. The water colour was very discoloured (grey) and a foul odour was again noticeable at this site. Wet wipes and small pieces of plastic were present instream all indicating untreated foul water discharging to the Glasheen.

Dissolved oxygen levels were again very low (9.1% 0.95mg/l) indicating very high anaerobic bacteria activity. Conductivity increased slightly again 597 µS/cm. The results indicate a continuation of gross organic pollution of the Glasheen.

The Glasheen flows through Clashduv Park and past Togher Community Garden where volunteers have created a new pond in 2023. From the garden the Glasheen is constrained between housing and is no longer publicly visible. The stream appears briefly at Glendale Road and here the water was still discoloured, slow to almost stagnant and shallow (0.15m). Substrate was dominated with silt and there was some aquatic vegetation with branched bur-reed (*Sparganium erectum*) and starwort (*Callitriche* sp.), see **Plate 4-30**. The stream then flows through a trash screen and under the Glendale Road. At Glasheen Road conditions are similar with sewage fungus visible and a sheen of iron oxidising bacteria floating on the surface.

4.6.2. Biological water quality

Owing to the steep banks and very silted conditions a kick sample could not be taken at Site 6 but a sample was taken from the bank using an extension net technique. The results of the macroinvertebrate survey reflected the poor conditions described above. Macroinvertebrate diversity was very low with only 5 taxa present. Chironomus dominated the sample which is a most tolerant (Group E) taxon. Tubicinae and Chironomidae were common (Group E and Group D respectively). Two pollution tolerant (Group C) taxa were present in few numbers. These were mosquito larvae (Culicidae) and water boatman (Corixidae). Although Group C taxa were present these were in very low numbers a **Q2** was assigned owing to the dominance of Chironomus indicating a very slight improvement upon the results at Site 5 but still **Bad macroinvertebrate quality.**

Three-spined stickleback fish (*Gasterosteus aculeatus*) was present in the sample. This species is tolerant of a range of water quality conditions and can survive in low oxygen conditions. Mallard (*Anas platyrhynchos*) was also observed.

Plate 4-28: Glasheen at Site 6 looking upstream at the pedestrian bridge.

Plate 4-29: Glasheen at Site 6 looking downstream. Note the very grey water. Stand of knotweed is highlighted in the yellow circle.

Plate 4-30: Glasheen at Glendale Road with grey water visible.

Plate 4-31: Glasheen Stream at Glasheen Road just before it passes along private housing estates. Grey water and sewage fungus present.

4.7. Site 7 Schoolboys Lane

4.7.1. General characteristics

From a private housing estate the Glasheen enters a linear park along Schoolboys Lane and this is where Site 7 is located. The channel has been straightened and widened (3m bankfull width) with 1m high banks on the left and 5m high banks on the right. Water was shallow on the day of survey (0.15m depth) with a slow to almost stagnant flow. The stream substrate was dominated by deep black silts with all coarse substrate having been removed.

The park forms a 25m wide buffer zone with grasses and herbs along the left bank. A beech (*Fagus sylvatica*) treeline runs along the right banks which overhang the stream creating moderate shading. Moderate bank erosion is visible with exposed sediment along the right bank and it appears water can flow quite fast in this section in times of higher flows

One third schedule invasive species was observed, **Japanese knotweed** (*Reynoutria japonica*), please see **Section 5** for further detail. Aquatic vegetation was sparse with some lesser duckweed (*Lemna. minor*), starwort (*Callitriche* sp.) and fool's watercress (*Apium nodiflorum*). The water was still discoloured (grey) and slightly turbid.

Dissolved oxygen increased slightly (17.5% 1.78mg/l) compared the crash in oxygen levels first observed at Sites 5. However, oxygen was still very low and indicative of high anaerobic bacteria activity.

4.7.2. Biological water quality

As with Sites 5 and 6 a kick sample was not possible owing to the deep silt, but a sample was taken from the bank using an extension net technique. The results of the macroinvertebrate survey reflected the poor conditions described above. Macroinvertebrate diversity was very low with only 6 taxa present. The sample was largely made up of very tolerant taxa and most tolerant taxa (Group D and E). Chironomus was numerous within the sample (Group E). Tubicinae (Group E), the bivalve Sphaeridae (Group D) and Chironomidae (Group C) were all common. Finally, water hoglouse (*Asellus aquaticus*) and mosquito larva (Culicidae) were present in few numbers (Group D and C respectively). Although a Group C taxon was present, the high numbers of Chironomus and common Tubificinae are more reflective of a **Q2** indicating **Bad macroinvertebrate quality.**

Plate 4-32: Glasheen at Site 7 facing upstream.

Plate 4-33: Glasheen at Site 7 as it enters the culvert diverting it under Magazine Road.

Plate 4-34: Example of Japanese knotweed growing along the left bank.

4.8. Site 8 Tesco Carpark

4.8.1. General characteristics

From Schoolboys Lane the Glasheen passes under Magazine Road and skirts behind Tesco. This is the final site where a macroinvertebrate sample was taken. Although some straightening and deepening has occurred it has not been as significantly modified as previous sites. The channel is narrower compared to Site 5-7 upstream (1.5m bankfull width) and water depth is still shallow (0.15m). Banks were approximately 1m high. Flow velocity increased slightly with a slow to moderate flow and some riffle habitat is present but still dominated with glide. Coarse substrate appears for the first time since Site 4 with gravels (coarse and fine) present. Siltation of the substate is still heavy (20%) with slight compaction.

The site is quite shaded with sycamore (*Acer pseudoplatanus*), cherry laurel (*Prunus laurocerasus*), beech (*Fagus sylvatica*) and holly trees (*Ilex aquifolium*) overhanging both banks. A very narrow riparian zone (3m) is present along the left bank before buildings and hardstanding. On the right bank there is a narrow broadleaved woodland where the old millrace supporting the mill would have flowed. No aquatic vegetation was observed on the day of survey and the heavy shading may help to explain the absence of any vegetation.

The recovery of oxygen levels continues at this site but again it is still low (37.4%, 3.83mg/l). The water also continued to be discoloured (grey).

From this site the Glasheen passes through Ashbrook Heights and conditions appear very similar but with even denser vegetation tunnelling the stream in sections. It is then diverted under the car park at Orchard Court before it discharges into the Curragheen. The outfall is visible from the petrol station and here the water colour is once again discoloured (grey) joining the Curragheen which was also very discoloured indicating the issues affecting the Glasheen are also present in the Curragheen.

4.8.2. Biological water quality

A kick sample was possible at Site 8 and macroinvertebrate density increased with 12 taxa present. The sample was made up of Group C, D and E taxa with no sensitive taxa present. Water hoglouse (*Asellus aquaticus*) completely dominated the sample which is a most tolerant taxon (Group D). A mixture of Group C, D and E taxa were common while the remainder of the sample was largely made up of Group C taxa in few numbers. Tubificinae (Group E) were also present in few numbers. A **Q2-3** was assigned indicating **Poor macroinvertebrate quality.**

Three-spined stickleback fish (*Gasterosteus aculeatus*) was present in the sample. This species is tolerant of a range of water quality conditions and can survive in low oxygen conditions.

Plate 4-35: Glasheen at Site 8 facing downstream.

Plate 4-36: Glasheen at Ashbrook Heights tunneled with vegetation.

Plate 4-37: Confluence of the Glasheen (yellow arrow) with the Curragheen.

Plate 4-38: Grey water within the Curragheen just upstream of the Glasheen confluence (yellow arrow) indicating the water quality issues observed are not confined to the Glasheen.

5. THIRD SCHEDULE INVASIVE PLANTS

Two plants listed on the third schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 [S.I.477/2011] were identified during the survey. These were **Japanese knotweed** (*Reynoutria japonica*) and **Rhododendron** (*Rhododendron ponticum*). Both these species are classed as having a risk of high impact in a risk assessment of invasives of Ireland (Kelly et al*.,* 2013). **Table 5-1** below summaries the details for the invasive plants observed and **Figure 5-1** shows the mapped location.

Knotweed was identified at three sites along the Glasheen (Site 2,6 and 7). The main risks associated with knotweed growing along stream banks is that it outcompetes native plants creating stands of a single species rather than a mixed riparian habitat. When the plant dies back in winter it leaves banks exposed and vulnerable to erosion introducing sediment into the river system. Knotweed spreads easily when disturbed via fragmentation of rhizomes (underground modified stems) and should not be cut or trimmed as a control method. It should be treated using proper application of herbicides approved for use near water by a qualified user. If not in place already, a management plan should be developed by those responsible for the lands to map the extent of the infestation and outline the method of control.

A single rhododendron bush was identified at Site 4. Rhododendron can form very dense thickets and out-compete native plants for space and resources, especially for sunlight. It can also prevent access to sites by the shear mass of plant material blocking paths and right of way. The main mechanism of dispersal is that it spreads by layering and suckering. The fruits may also be eaten and dispersed by birds. Unlike knotweed the rhododendron identified here can be easily removed and replaced with a native tree species.

Table 5-1: Summary of third schedule invasive plants observed during the survey.

Site Code	Species	GPS coordinates (Lat/Long)	Note
Site 2	Japanese knotweed	51.8685, -8.52326	At top of embankment along laneway approximately 30m from the left bank. A “do not cut” sign was present. Dead and live plants visible.
Site 4	Rhododendron	51.8758, -8.51979	Right bank at Woodhaven, single bush growing.
Site 6	Japanese knotweed	51.88017, -8.49826	Right bank growing along the boundary of the parks compound. Healthy stand 5-6m in length.
Site 7	Japanese knotweed	51.88742, -8.50259	Left bank
		51.88666, -8.50184	Left bank, area disturbed with vegetation removal.

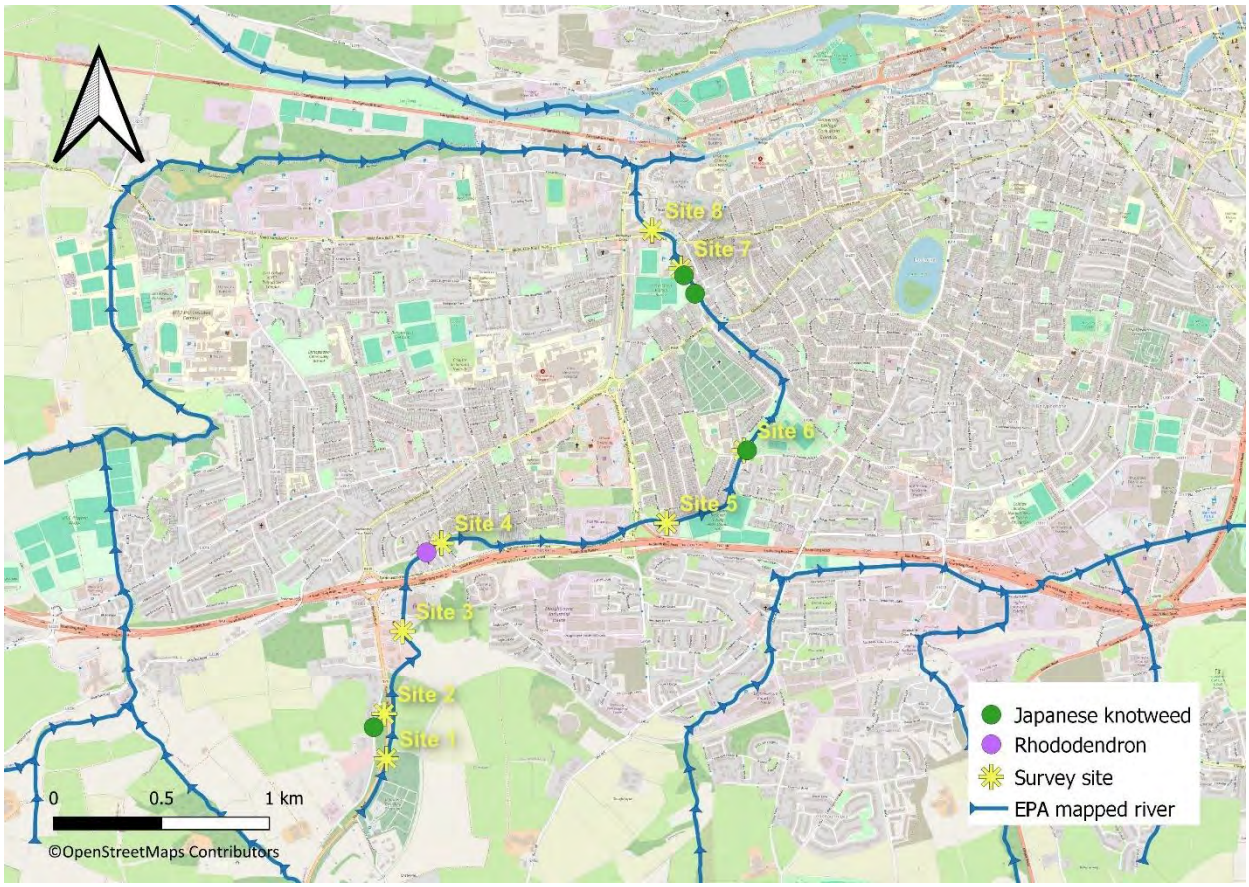


Figure 5-1: Map showing the location of the Third Schedule invasive plants identified during the survey.

6. SUMMARY OF MACROINVERTEBRATE RESULTS

The macroinvertebrate quality of the Glasheen is impacted from the source down to the confluence with the Curragheen. Poor macroinvertebrate quality (Q3 or Q2-3) was recorded at Sites 1 to 4 with signs of organic pollution at Site 3 (upstream of Dunnes) where the Glasheen first meets the urban environs of Cork. Here, sewage fungus, a decline in dissolved oxygen and dense macrophyte growth was visible.

A significant decline to bad macroinvertebrate quality (Q2 or Q1-2) occurred at Site 5 (Sandbrook Estate). Here gross organic pollution was evident with discoloured (grey) water, extensive sewage fungus, extremely low oxygen and anoxic sediments. This pollution appeared to begin between Site 4 and 5. Misconnections were identified at Site 4 with sewage fungus, tissues and small pieces of plastic on the stream substrate. It is clear however there is another source or sources of pollution to the Glasheen between Site 4 and 5 and a tributary channel joining the Glasheen under the Sarsfield Road should be investigated. The gross pollution continued until Site 7 (Schoolboys Lane). At the final Site 8 (Tesco Carpark) a small recovery to poor (Q2-3) was observed and although still very low the oxygen level were showing signs of recovery.

Table 6-1: Summary of the macroinvertebrate survey results.

Site Code	Description	Q-value	Macroinvertebrate quality
Site 1	St James's Cemetery	Q3	Poor
Site 2	Ardarostig Woodland	Q3	Poor – on upper boundary close to a Q3-4 Moderate
Site 3	Upstream of Dunnes	Q2-3	Poor
Site 4	Woodhaven Estate	Q3	Poor
Site 5	Sandbrook Estate	Q1-2	Bad
Site 6	Upstream Clashduv Park	Q2	Bad
Site 7	Schoolboys Lane	Q2	Bad
Site 8	Tesco Carpark	Q2-3	Poor

7. DISCUSSION

The water quality across the entire Glasheen Stream is very degraded. Just over one third of the stream length is seriously polluted (Q1-2, Q2) and this was so significant that at some sites very little macroinvertebrate life could be supported representing a complete breakdown of the trophic system. The remaining stream length was slightly better but still very polluted (Q2-3, Q3).

The results of the macroinvertebrate survey, the discoloured (grey) water, sewage fungus, low oxygen review of available water chemistry and other direct observations all show the Glasheen is not in a healthy state. In reality, the stream is functioning as an open drainage system for the direct discharges of untreated water from various sources. Not only does this have significant negative effects on water quality and biodiversity but potentially poses a public health risk. It is a truly shocking situation for a stream that has huge biodiversity and amenity potential.

Despite flowing through housing estates, parks and beside public footpaths the Glasheen is largely hidden by fencing and dense vegetation. This has created a public disconnect from the stream and a situation where its degradation has largely gone unnoticed, or it has become the perceived “normal” state.

It is suspected that there are multiple point sources of pollution to the Glasheen. For example, **misconnections** from housing estates and business are one very likely issue. A building is typically serviced by foul and surface water drainage. The foul drain conveys wastewater from washing machines, dishwashers, showers and toilets to a wastewater treatment plant. While the surface water drain conveys clean water (e.g., rainwater) to local streams. A misconnection occurs when a foul drain is incorrectly plumbed to the surface water network leading to pollution of the connected stream. Many residents and business owners may not even know they have a misconnection, see **Figure 8-5** for a diagram.

Another likely source of pollution are discharges from **Combined Sewer Overflows (CSOs)**. Cork like many other cities and towns across Ireland has an ageing sewer and drainage network which is unable to cope with increased development of impermeable surfaces and higher intensity rainfall events. As more hardstanding is constructed there are fewer natural surfaces to help filter and attenuate surface water. As a result, the drainage network is receiving more and more surface water and CSOs are triggered more often. Addressing misconnections and CSOs is a complex task but improvements are achievable provided there is a concerted effort and importantly public bodies are funded and motivated to carry out such projects.

The next most significant issue observed in the Glasheen was **hydromorphology**. This is a measure of the naturalness of a stream and interaction with surrounding lands. The more anthropogenic pressures and influences on a stream the poorer the hydromorphology will be. The entire channel of the Glasheen has been heavily modified with straightening and deepening. This coupled with the water pollution has led to a degradation or a complete absence of key ecosystem functions. This is most apparent from Woodbrook Grove (just downstream of Site 4) to Site 7 (Schoolboys Lane). This section is part of an OPW drainage district and as a result there are very few natural physical characteristics left. All coarse substrate has been removed, there is no interaction with a riparian zone and the flow is slow to almost stagnant. This has all resulting in homogenous habitat which supports much lower biodiversity that a complex habitat with good water quality would.

Originally the drainage district was to increase land for agriculture, but a proportion of the benefited lands have now been built upon leading to the requirement for continued drainage (as well as the fact that the Arterial Drainage Act 1945 states that maintenance is mandatory). The aim of this type of drainage activity is to move water as fast as possible downstream. However, this can often be to the detriment of biodiversity and ineffective with undersized culverts and trash screens on the Glasheen which may act as pinch points for flood waters.

There are more modern **nature based solutions** for surface water management that can be explored. These not only benefit biodiversity but also provide attenuation of flood waters and alleviate pressures on CSOs releasing water at a much slower rate back to the Glasheen. This is commonly coined **“slowing**

the flow" and the natural slowing and filtration of storm water runoff from our roofs, streets and public realm can be assisted using a variety of initiatives such as green building surfaces, green roofs, raingardens, swales, permeable surfaces, natural water collection and storage ponds. This can be complemented in the broader context of planning of our urban areas through the creation of green spaces and the extensive planting of trees within the public and private realms (DHLGH, 2021).

It should be noted that as with any river project, nature based solution plans must be conducted following the appropriate studies. Consultation with residents and business owners is an integral part of the process. Despite being heavily urbanised there are still areas along the Glasheen where nature based solutions could be investigated. While this would be an ambitious project the issues on the Glasheen are serious and in the long run nature based solutions may prove cheaper than infrastructural pipe projects. Ireland has an obligation under the Water Framework Directive for surface waters to achieve at least Good Status by 2027 and the Glasheen is currently well below this target.

On a positive note, the habitat at Site 2 (Ardarostig Woodlands) is worth highlighting. Although the macroinvertbrate quality is still impaired it is the only section where the Glasheen begins to show some recovery to more natural conditions. This area shows a snapshot of what the Glasheen could be like. The woodland here also has potential to correspond with **Annex I habitat – Alluvial Woodland (91EO).** It makes this area a valuable habitat to preserve in order to protect biodiversity and serving to filter and slow water.

The Glasheen is a short river with big water quality issues however it has huge potential. The connected rivers downstream support species like salmon, trout and lamprey and improvement of the water quality and habitats could see fish and other species returning to the stream. Its short length could make it a perfect demonstration stream for water quality improvements. Community action supported by the funding and the expertise of public agencies needs to come together to bring about improvements for water quality, biodiversity and people.

8. RIVER ACTIONS

The following section identifies river actions for conserving, restoring and enhancing water quality and biodiversity of the Glasheen Stream. The actions were developed based on the results of the survey work described in this report. The first most significant action that can be undertaken is addressing the water quality issues within the Glasheen. Many of the actions work in tandem with each other, for example an action to improve habitat for biodiversity will also require improvements in water quality.

The plan is split into goals which can be achieved in the sort-term (1-3 years), medium term (3-5 years) and long-term (5+ years). In general, short-term goals can be implemented by individuals and small community groups and are relatively low cost. Medium to long-term goals require greater organisation of resources, planning and co-operation between various agencies and groups.

8.1. Glasheen Stream Action Group

The formation of a **river group** can be an effective way forward in bringing about the improvement of a river. Remediating the Glasheen will require expertise, community support and importantly the motivation and funding from agencies. A river group can help gather community members concerned with the water quality and help formalise a path to drive forward and advocate improvement. A group can also establish a relationship between agencies and experts which is vital for the exchange of information.

The Glasheen is a relatively small stream system and many of the issues facing it are common across other urban streams in Cork city. Therefore, many of the actions supporting the Glasheen could also benefit other streams. There is potential in the longer term to form a wider action group which incorporates corks urban streams or use lessons learned from this stream and exchange information with other groups.

8.2. Raising Awareness of the Glasheen and Issues

The Glasheen has a rich history and with huge potential to not only support biodiversity but also public amenities. **Community support** is intrinsic in driving the restoration of the Glasheen forward. The stream is largely hidden which has unfortunately led to an "out of sight, out of mind" attitude for many. The result is that pollution incidents can go unnoticed and unreported. The first step in the process is to inform the public about the Glasheen and the water quality issues.

Figure 8-1: Example of a sign along the Ballybrack Woods highlighting aquatic and terrestrial species

This can be facilitated by arranging **public walks** along the stream with the public viewing firsthand the water quality issues. **Information talks** can also be arranged where experts from Cork City Council (CCC), Uisce Éireann, OPW and local historians could be invited to help highlight the water quality issues, any constraints in remediating them and history to the public.

It can be residents and community groups who know and understand their stream best. They are often the first to notice signs of pollution or on a positive note an interesting new species. Installing **signage** is another step in highlighting the streams presence and biodiversity potential. Importantly, this signage can highlight what pollution looks like, the agencies to contact if pollution is observed and pertinent information that can be recorded. For example, signage could be installed along the paths between

Woodhaven and Sarsfield Road, Clashduv Park or the park at Schoolboys Lane. A local historian could also be engaged to help create signage highlighting the history of the Glasheen

Formalising a **Glasheen Walking Trail** could also be a method of raising awareness of the stream and it could be developed in tandem with the signage. This would help encouraging people to stop and view the stream.

8.3. Monitor and Support River Birds

Short term goal

Grey wagtail was observed along the Glasheen at Site 4. Grey wagtail breed mainly along streams and rivers with nesting sites usually located in a hole in the riverbank or between boulder crevices. They also take advantage of crevices under bridges and culvert ledges and these artificial structures are particularly important where natural nesting sites are limited. This species is associated with freshwaters and feeds on aquatic insects.

Given the urban nature of the Glasheen, natural nesting locations would be limited, and the species can be supported through a nest box programme. These boxes are usually called dipper boxes but they are suitable for grey wagtail too. Most boxes are designed to install under a bridge or culvert and there a few good examples along the Glasheen. Check that water levels in flood will not wash away the box before installation. Boxes should be checked once a year and any damaged boxes replaced.

Figure 8-2: Example of a grey wagtail (left) which was identified during the freshwater ecology survey. On the right is an example of a woodstone grey wagtail nesting box (Vivara Pro) which is designed to be more durable than wooden boxes.

8.4. Survey of the Ardarostig Woodland

Short term goal

The habitat observed within the Ardarostig Woodland has the potential to conform with Annex I habitat -Alluvial Woodland (3260). A **specialist survey** can be undertaken to confirm this. Regardless of whether the woodland is Annex I habitat it serves as an important habitat supporting wildlife as well as forming a corridor connecting into woodland habitat associated with the Two Pot River which should be protected from any further fragmentation. In addition, the woodland serves as an area that can attenuate flood waters and help slow the flow of water moving downstream into more urbanised areas.

8.5. Identification of Point Source Discharges

Short term goal

A volunteer group has already begun walking the Glasheen and mapping outfalls. This would be useful information to feed to CCC / Uisce Éireann and help start the process of remediating any misconnections.

This work can be further supported by holding an outfall safari. This is a systematic method to survey outfalls for pollution that is being discharged into the Glasheen and can help narrow down locations of potential misconnections. This process has been formalised in the UK by ZSL and the Rivers Trust and they have developed guidance documents detailing how to survey and what information to record.

The outfall safari is run in dry weather only and the previous 48hours should also be dry. This is to ensure surface water runoff doesn't mask any misconnection issues or wash away sewage fungus. Descriptions such as the diameter of the pipe, bankside the pipe is located, rate of flow from the pipe, odour and visible impacts are all recorded. This information can then be formalised into a report and submitted to public agencies.

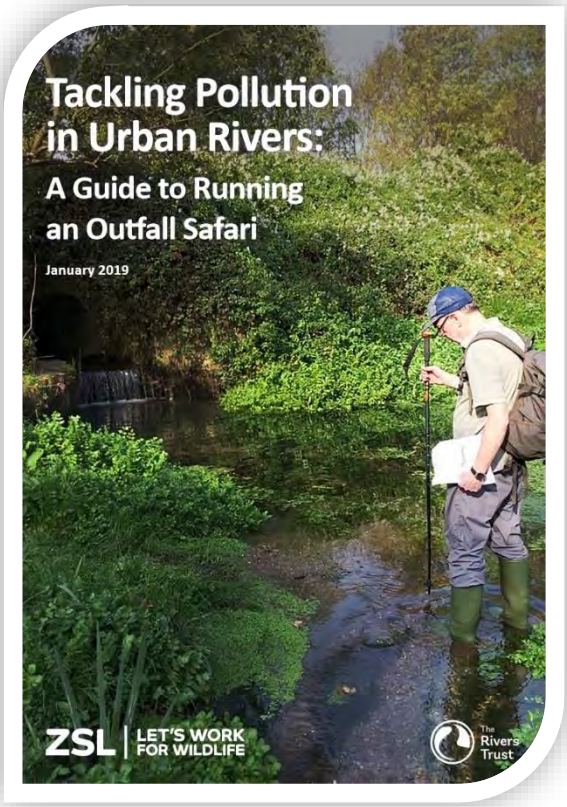


Figure 8-3: Guidance document created by ZSL and The Rivers Trust for running an outfall safari which is available online https://catchmentbasedapproach.org/learn/outfall-safari-guide/

8.6. Citizen Science Stream Index

Medium term goal

An annual programme of macroinvertebrate monitoring could be undertaken along the Glasheen. The Citizen Science Stream Index (CSSI) is a metric designed for public use and can be used to help monitor water quality and detect any changes. Sites 2, 3, 4 and 8 used in this freshwater ecology survey could be used as monitoring points as these are easily accessible

While there are other more detailed indices used in Ireland such as the Q-value or Small Stream Risk Score (SSRS) these involve a more in-depth knowledge of river systems and identification skills. The CSSI has been developed as an index that is accessible to beginners. It can be used to help track water quality changes or trends but also to increase awareness of the Glasheen Stream and can be conducted in tandem with community engagement walks. Monitoring should be conducted at the same time each year to avoid seasonality affecting the scores.

The CSSI is based on the presence or absence of six key aquatic invertebrates. Three pollution-sensitive invertebrates ('good guys') are commonly found in clean streams and three pollution-tolerant invertebrates ('bad guys') are commonly found in polluted streams (see **Figure 8-4**). Training is required but the sampling methodology and scoring system can be easily taught at workshops.

The sampler uses a pond or kick net to take three 30-second kick-samples (the three samples should be a few metres apart) from a shallow (<20cm), gravelly, fast-flowing part of the stream. The invertebrates captured in each sample are examined in a white tray on the bankside. The six key invertebrates are easily spotted amongst the many other species in the tray, by their characteristic shape, colour or movement. The citizen will score each sample depending on which, if any, of the six key invertebrates occur in the tray. The three 'good guys' have a score of +1 each and the three 'bad guys' have a score of -1 each.

The score for each kick-sample can range from +3 (all three good guys and no bad guys) to -3 (all three bad guys and no good guys). When the scores from all three samples are added together, the CSSI ranges from +9 to -9. A traffic light system is used to rate the water quality.

Poor = CSSI score of -9 to -5

Moderate = CSSI score of -4 to +4

Good = CSSI score +5 to +9

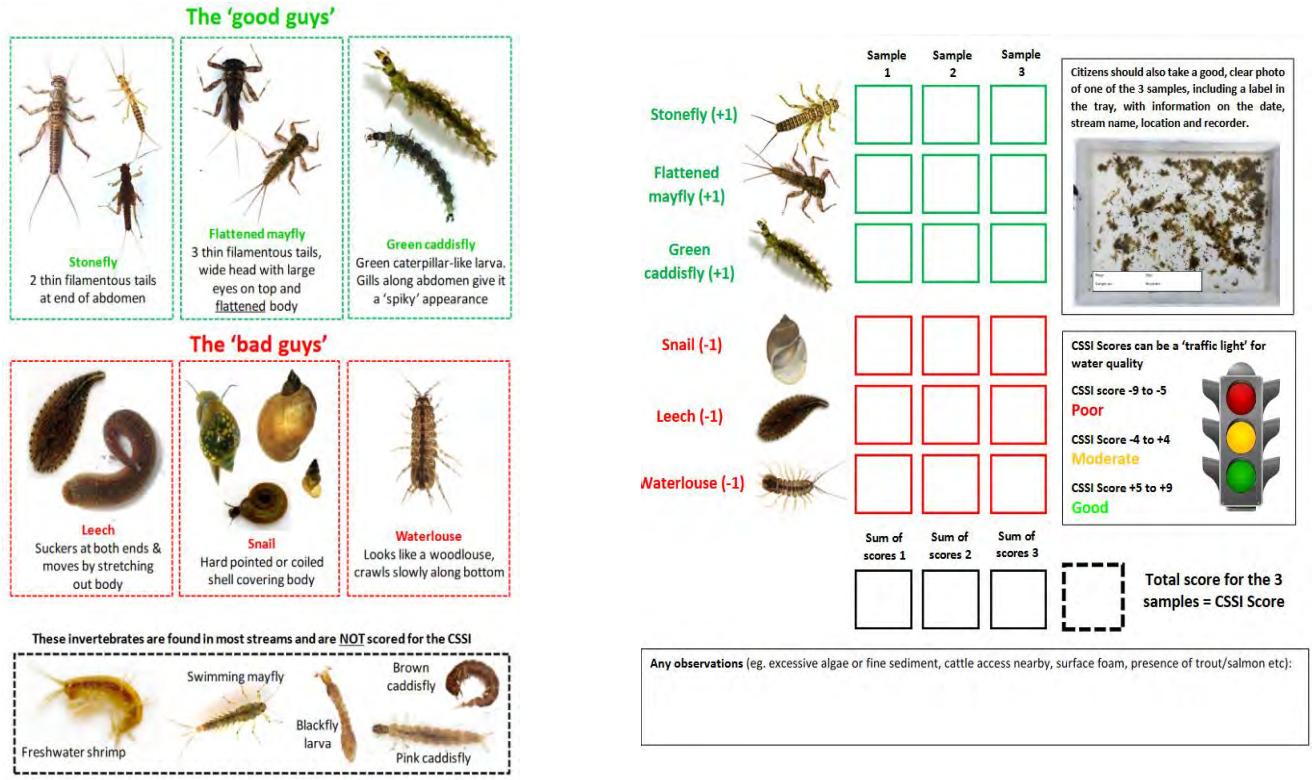


Figure 8-4: Example of the CSSI survey sheet with the macroinvertebrates used to calculate the score.

8.7. Invasive Species Management

Two third schedule invasive species were identified during the freshwater survey, Japanese knotweed and rhododendron. The general approaches to treatment for each species are discussed below. Please note that the following applies to any invasive species management.

- Any treatment of invasive species must be undertaken by a suitably qualified invasive species specialist with appropriate training in herbicide use and following S.I. No. 438/2019 - European Communities (Sustainable Use of Pesticides) (Amendment) Regulations 2019.
- Any chemicals used must be DAFM approved herbicides and approved for use near water.
- Invasive species identified growing on public roads or council lands should be reported and managed by Cork City Council.

Rhododendron

The rhododendron plant identified at Site 4 is a currently medium sized. It can be easily managed by cutting to the stump and **chemical treatment** applied to the stump. This is done either by applying directly to the cut surface as soon as possible or stumps are drilled and the herbicide is applied to the drilled hole. The site should be monitored for any recolonising plants and these can be pulled up. The areas can then be replanted with a native tree.

Japanese knotweed

Signage should be placed in-front of all identified stands and disturbance and cutting should be avoided. This is particularly pertinent at Site 7 where disturbance works and vegetation removal has already occurred. The knotweed should **not be cut or dug**. This is an ineffective method resulting in more vigorous growth the next year and rhizomes can be easily spread. Any cut material cannot be removed from the site unless it is by a licenced invasive species specialist. Therefore, the best method of treatment would be the use of herbicide using a **foliar spray** or **targeted stem injection** method.

While growth may be less vigorous after the first treatment, annual treatment of the knotweed infestation is required until no new growth is visible. **Treatment can last up to five years** and during this time the area should be **inspected annually** to monitor the control and ensure that the infestation has not spread.

8.8. Misconnection project

The action follows on from the identification of outfalls to a proactive remediation action. The Dublin Urban Rivers Life project is a collaboration between South Dublin County Council, Dun Laoghaire-Rathdown County Council and the EU LIFE Programme which provided 50% of the funding. Under this project **a study was conducted to identify potential locations of misconnections** where homes were inspected and residents informed of the results.

A project like this is by no means intended to penalise people for having a misconnection but it would be the responsibility of a home or business owner to rectify the situation. This is usually quite a simple job in moving a downpipe to the correct location.

On a smaller scale, residents and business owners could be **invited to talks** where information is shared on how to check for misconnections and how to rectify them. A representative from the Dublin Urban Rivers Life Project could also be invited to give a talk and share information on how to initiate a project like this.

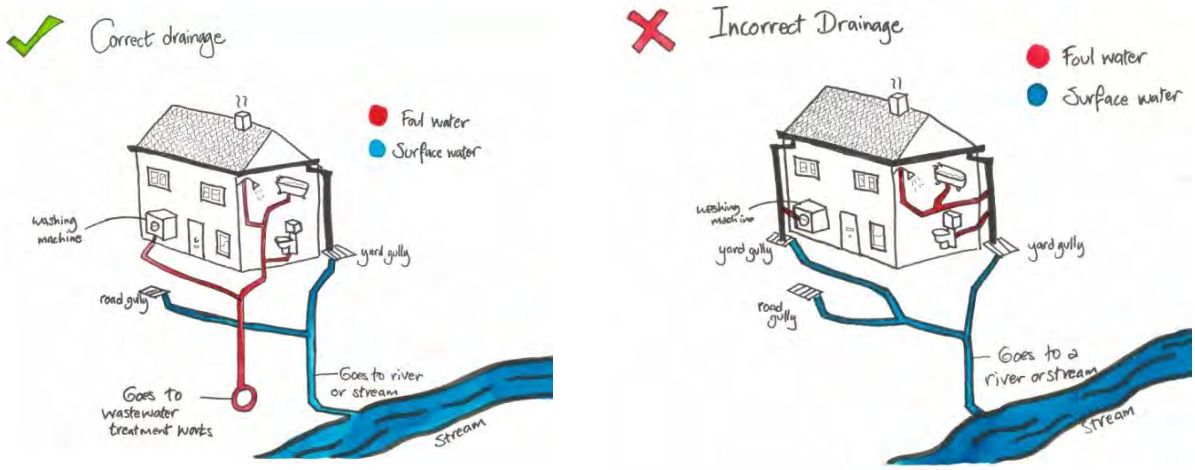
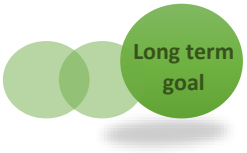


Figure 8-5: Diagram showing a correctly installed foul and surface water network and a misconnected one. Image is reproduced from Dublin City Council website page detailing information about misconnections https://www.dublincity.ie/residential/environment/protection-water-bodies/water-pollution-control/misconnection-programme#a26246-26240

8.9. Slowing the Flow - Nature Based Solutions



A concerted and coordinated effort from the community and public agencies is required to implement more modern solutions for the natural slowing and filtration of storm water runoff from our roofs, streets and public realm. Green building surfaces, green roofs, raingardens, swales, permeable surfaces, natural water collection and storage ponds can all be used to achieve this

Some actions like green paving, green roofing and tree planting individually take up a relatively small footprint but collectively these measures can have a big effect by reducing hardstanding and helping to alleviate the pressure on the existing surface water network. Engagement with CCC to discuss how best to drive forward the increased use of these solutions in the catchment area of the Glasheen could be undertaken.

In addition to the misconnection project discussed above the Dublin Urban Rivers Life project will also build **integrated constructed wetlands** at five strategic locations in South Dublin County. These natural water retention measures will improve the quality of receiving river water, provide flood alleviation, bioretention of particulates and nutrients, improve habitat conditions and biodiversity, and promote the relationship between green infrastructure and public wellbeing.

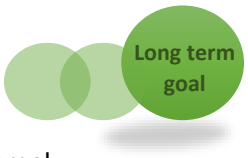
Figure 8-6: Example of green paving solution in the car park at the Marinia in Cork City.

Water flowing into the wetlands comes from stormwater pipes. These stormwater pipes collect rainwater from roads, footpaths and from the roofs and patios of houses. Vegetation within the wetland then filters the water before it flows into the stream.

There are large areas where a project like this can be achieved, e.g., the green areas near Woodhaven, Clashduv Park, Shoolboys Lane Park. In addition, the **Woodland at Ardarostig** is the only area along the Glasheen where there is a natural access to a floodplain and the potential to enhance this could be assessed reducing rate of water entering urban areas downstream during

high flows. It could be assessed if CCC has the capacity to **conduct a similar project** for the Glasheen or work in partnership with CCC and other agencies to **apply for funding.**

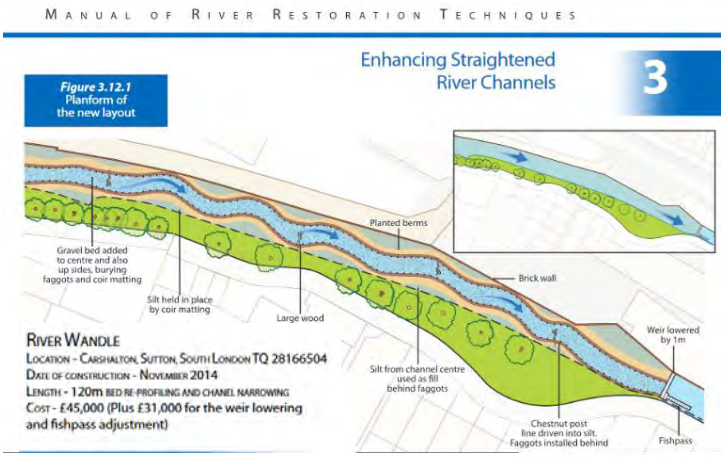
8.10. River Habitat Enhancement



The majority of the Glasheen stream has been modified with straightening, deepening and dredging leading to uniform habitat, flow and depth. Complex habitat such pools, riffles and glides which encourage greater biodiversity are largely absent due to the modified nature of the channel.

In these types of river systems physical intervention is likely required to help restore the river. This may include actions such as reprofiling the stream banks to allow more sinuous flow and marginal aquatic zones. Other actions may include reintroducing substrate and channel roughness to create more natural channel characteristics with varied habitats such as riffle, glides and pools as well as the slow silty margins that are important for lamprey larvae. The aim is to return the stream (or sections of the stream) to a more natural flow creating habitat supporting a diverse range of species. The ecological corridors along the banks of the Glasheen can also be protected and enhanced.

A project like will need planning, assessment and input from experts such as Inland Fisheries Ireland, OPW, CCC and Uisce Éireann. The appropriate planning process also needs to be adhered to following relevant guidance and legislation. It will also require the support of the community and consultation is key to share plans and address queries. This is a long-term project requiring a multiagency effort but the positive biodiversity benefits are significant. It should be noted that this will only work in tandem with actions to improve water quality. A starting point is to engage with IFI to begin discussions on a project like this for the Glasheen.



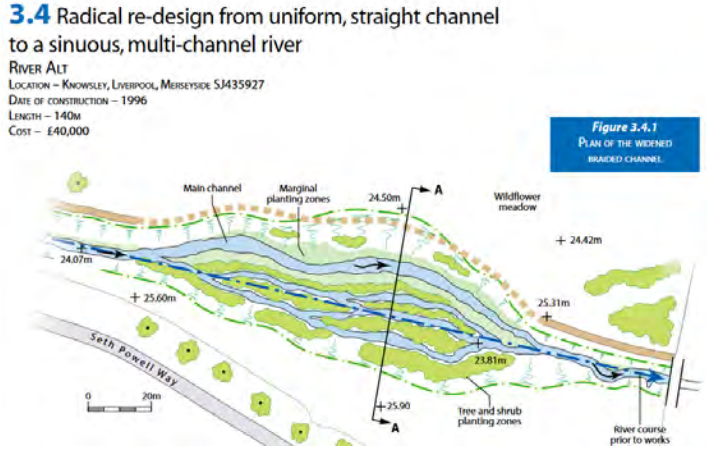
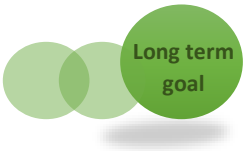


Figure 8-7: Two examples of habitat restoration in a straightened river. Please note that these are examples only and any plan will be specific to the requirements of the Glasheen (Image from Manual of River Restoration Techniques Chapter 3 2021)

8.11. Fish Survey and Barrier Mitigation



A baseline fish survey can be conducted to fully understand the fish community present and barriers to their movement. One barrier has already been identified by IFI at the very end of the Glasheen. While salmon, trout and lamprey are known to occur in the River Lee and Curragheen this barrier would prevent these species from entering the Glasheen.

Barrier mitigation projects in river systems can be a complex process involving a lot of planning, research, surveys and studies, design, budgeting, consultation and innovation to identify the most appropriate management technique to adapt. Engagement with other relevant bodies such as CCC and IFI is necessary to identify the project requirements including the necessary ecological and planning reports. Any barrier mitigation project should consider facilitating the movement of all aquatic species including weaker swimming ones such as lamprey. It is important to ensure the ecosystem as a whole is taken into account and a project is not designed to benefit one species to the detriment of another species or habitat.

It should be noted that currently the water quality and habitat within the Glasheen is not supportive of sensitive species like salmon. Therefore, any barrier remediation project would have to work in tandem with water quality improvement projects and habitat restoration.

9. REFERENCES

Dalton, R., Healy, T. & Murphy, A. (2021). A Study of Otter in Cork City and the Cork Harbour Area. Unpublished report prepared for Cork Nature Network CLG.

DHLGH (2021). Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas. Water Sensitive Urban Design Best Practice Interim Guidance Document.A report prepared by the Department of Housing Local Government and Heritage

Kelly, F., Harrison, A., Matson, R., Connor, L., Feeney, R., Morrissey, E., O'Callaghan, R., Wögerbauer, C., Hanna, G., Rocks, K. & Gallagher, K. (2010a). Sampling Fish for the Water Framework Directive, Rivers 2010. South Western River Basin District. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Kelly, F., Harrison, A., Matson, R., Connor, L., O'Callaghan, R., Feeney, R., Morrissey, E., Wögerbauer, C., Rocks, K., Hanna, G. & Gallagher, K. (2010b). Sampling Fish for the Water Framework Directive, Transitional Waters 2010. Greater Cork Harbour. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Kelly, F.L., Matson, R., Connor, L., Feeney, R., Morrissey, E., Coyne, J. and Rocks, K. (2014). Water Framework Directive Fish Stock Survey of Rivers in the South Western River Basin District. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Kelly, J., O'Flynn, C., & Maguire, C. (2013). Risk analysis and prioritisation for invasive and non-native species in Ireland and Northern Ireland. http://invasivespeciesireland.com/wp-content/uploads/2013/03/Risk-analysis-and-prioritization-29032012-FINAL.pdf.

Ryan Hanley (2016). Environmental Impact Assessment for the Lower Lee (Cork City) Drainage Scheme. Appendix 5e Lower Lee Electro-Fishing Survey and Licence Return Report.

Kurz, I., & Costello, M.J. (1999). An Outline Biology of the Distribution and Conservation of Lampreys in Ireland. Irish Wildlife Manuals, No 5.

McGarrigle, M.L., Bowman, J. J., Clabby, K. J., Lucey, J., Cunningham, P., MacCárthaigh, M., Keegan, M., Cantrell, B., Lehane, M., Clenaghan C. & Toner, P. F. (2002). Water Quality in Ireland 1998 – 2000. Environmental Protection Agency, Johnstown Castle Ireland.

NPWS (2013). The Statis of EU Protected Habitats and Species in Ireland. Habitats Assessments Volume 2. National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin.

NPWS (2019a). The Status of Protected EU Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin.

NPWS (2019b). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished Report, National Parks and Wildlife Service. Department of Arts, Heritage and the Gaeltacht, Dublin.

NPWS (2019c). The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments. Unpublished Report, National Parks and Wildlife Service. Department of Arts, Heritage and the Gaeltacht, Dublin.

Toner, P., Bowman, J, Clabby, K., Lucey, J., McGarrigle M., Concannon, C., Clenaghan C., Cunnunghan, P., Delaney, S., O'Boyle, S., MacCárthaigh, M., Craig, M., and Quinn, R. (2005). Water Quality in Ireland 2001-2003. Environmental Protection Agency, Johnstown Castle Ireland.

APPENDIX A
MACROINVERTEBRATE SPECIES LIST

Table A-1: List of macroinvertebrates identified at Site 1 – St James's Cemetery.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 1	*Sericostoma personatum*	B	Less sensitive	Few	Q3
	Alainites muticus	B	Less sensitive	Few	
St James's Cemetery	*Gammarus* sp.	C	Tolerant	Common	
	Potamopyrgus antipodarum	C	Tolerant	Few	
	Simuliidae	C	Tolerant	Numerous	
	Polycentropodidae	C	Tolerant	Few	
	Ancylus fluviatilis	C	Tolerant	Few	
	Baetis rhodani/atlanticus	C	Tolerant	Common	
	Plantyhelminthes	C	Tolerant	Few	
	Dicranota sp.	C	Tolerant	Few	
	Chironomidae	C	Tolerant	Few	
	Asellus aquaticus	D	Very tolerant	Few	
	Tubificinae	E	Most tolerant	Few	

Table A-2: List of macroinvertebrates identified at Site 2 – Ardarostig Woodland.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 2	*Alainites muticus*	B	Less sensitive	Common	Q3 (upper boundary)
	Leuctra sp.	B	Less sensitive	Few	
Ardarostig Woodland	*Sericostoma personatum*	B	Less sensitive	Few	
	Gammarus sp.	C	Tolerant	Numerous	
	Simuliidae	C	Tolerant	Few	
	Polycentropodidae	C	Tolerant	Common	
	Ancylus fluviatilis	C	Tolerant	Common	
	Baetis rhodani/atlanticus	C	Tolerant	Common	
	Plantyhelminthes	C	Tolerant	Few	
	Dicranota sp.	C	Tolerant	Few	
	Chironomidae	C	Tolerant	Few	
	Hydropsychidae	C	Tolerant	Few	
	Ceratopogonidae	C	Tolerant	Few	
	Philopotamidae	C	Tolerant	Common	
	Lumbricidae	C	Tolerant	Few	
	Hydraenidae	C	Tolerant	Few	
	Hydracarina sp.	C	Tolerant	Few	
	Scirtidae	C	Tolerant	Few	

Table A-3: List of macroinvertebrates identified at Site 3 – Upstream of Dunnes.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 3 Upstream of Dunnes	*Gammarus* sp.	C	Tolerant	Common	**Q2-3**
	Chironomidae	C	Tolerant	Common	
	Dicranota sp.	C	Tolerant	Few	
	Lumbricidae	C	Tolerant	Few	
	Ancylus fluviatilis	C	Tolerant	Common	
	Asellus aquaticus	D	Very tolerant	Numerous	
	Eristalis sp.	E	Most tolerant	Few	
	Chironomus sp.	E	Most tolerant	Few	

Table A-4: List of macroinvertebrates identified at Site 4 – Woodhaven Estate.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 4 Woodhaven Estate	*Asellus aquaticus*	D	Very tolerant	Common	**Q3**
	Leuctra sp.	B	Less sensitive	Few	
	Gammarus sp.	C	Tolerant	Few	
	Ancylus fluviatilis	C	Tolerant	Common	
	Potamopyrgus antipodarum	C	Tolerant	Common	
	Hydracarina sp.	C	Tolerant	Few	
	Chironomidae	C	Tolerant	Numerous	
	Lumbriculidae	C	Tolerant	Few	
	Helobdella stagnalis	D	Very tolerant	Few	
	Glossiphonia complanata	D	Very tolerant	Few	
	Chironomus sp.	E	Most tolerant	Few	
	Tubificinae	E	Most tolerant	Few	

Table A-5: List of macroinvertebrates identified at Site 5 – Sandbrook Estate.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 5 Sandbrook Estate	Helobdella stagnalis	D	Most tolerant	Few	**Q1-2**
	Sphaerium/Pisidium spp.	D	Most tolerant	Common	
	Tubificinae	E	Very tolerant	Numerous	
	Chironomus sp.	E	Very tolerant	Common	

Table A-6: List of macroinvertebrates identified at Site 6 – Upstream at Clashduv Park.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 6 Upstream of Clashduv Park	Culicidae	C	Tolerant	Few	**Q2**
	Corixidae	C	Tolerant	Few	
	Chironomidae	C	Tolerant	Common	
	Chironomus sp.	E	Most tolerant	Dominant	
	Tubificinae	E	Most tolerant	Common	

Table A-7: List of macroinvertebrates identified at Site 7 – Schoolboys Lane.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 7 Schoolboys Lane	Culicidae	C	Tolerant	Few	**Q2**
	Chironomidae	C	Tolerant	Common	
	Sphaerium/Pisidium sp.	D	Very tolerant	Common	
	Asellus aquaticus	D	Very tolerant	Few	
	Chironomus sp.	E	Most tolerant	Numerous	
	Tubificinae	E	Most tolerant	Common	

Table A-8: List of macroinvertebrates identified at Site 8 – Tesco Carpark.

Site name	Macroinvertebrate	Group	Pollution Tolerance	Abundance	Q-value
Site 8 Tesco Carpark	Gammarus sp.	C	Tolerant	Common	**Q2-3**
	Simuliidae	C	Tolerant	Few	
	Chironomidae	C	Tolerant	Common	
	Culicidae	C	Tolerant	Few	
	Planorbidae	C	Tolerant	Few	
	Lumbriculidae	C	Tolerant	Few	
	Dipertan larva	C	Tolerant	Few	
	Asellus aquaticus	D	Very tolerant	Dominant	
	Erpobdella octoculata	D	Very tolerant	Common	
	Glossiphonia complanata	D	Very tolerant	Few	
	Chironomus sp.	E	Most tolerant	Common	
	Tubificinae	E	Most tolerant	Few	

APPENDIX B
SUMMARY OF GENERAL RIVER HABITAT CHARACTERISTICS

Table B- 1: Summary of the general habitat characteristics at each survey site.

Site No.	Bank height (m)	Wet width (m)	Bankfull width (m)	Depth (m)	Substrate (%)	Substrate Siltation	Shading	River habitat (%)	Physico-chem	Macrophytes	Note
Site 1- St James's Cemetery	1 to 3	1	1.5	0.05	Cobble: 25 Coarse gravel:30 Fine gravel: 30 Silt: 15	Heavy with heavy plume when kicked	Moderate	Glide: 100	DO: 85.6% / 8.57mg/l Temp: 15°c Conductivity:458µS/cm pH: 7.10	None	• Outfall pipe with steady discharge of clear water but petroleum like smell. • Very shallow water.
Site 2- Ardarostig Woodland	0.4 to 2	0.9	1.2	0.05	Bedrock: <1 Cobble: 30 Coarse gravel:40 Fine gravel: 20 Silt: 10	Low to moderate with heavy plume when kicked	Light - Moderate	Riffle: 38 Glide: 60 Pool: 2	DO: 88.8% / 9.08mg/l Temp: 14.9°c Conductivity:484µS/cm pH: 7.82	*Angelica sylvestris* *Oenanthe crocata* *Apium nodiflorum* *Iris pseudacorus*	• Broadleaved woodland providing excellent riparian buffer supporting wildlife and the stream. • Invasive species (Japanese knotweed) 30m from stream. • Very shallow water.
Site 3- Upstream of Dunnes	3 to 3.5	1	1.5	0.12	Boulder: 3 Cobble: 24 Coarse gravel:33 Fine gravel: 20 Silt: 20	Heavy with heavy plume when kicked	Light - Moderate	Riffle: 44 Glide: 55 Pool: 1	DO: 48.3% / 4.99mg/l Temp: 14.7°c Conductivity:483µS/cm pH: 7.58	*Oenanthe crocata* *Apium nodiflorum* *Pelia* sp. *Leptothrix* sp. Sewage fungus	• Low oxygen. • Water slightly grey. • Dense macrophytes in sections. • Sewage fungus.
Site 4- Woodhaven Estate	1.5	1	1	0.05	Boulder: 3 Cobble: 30 Coarse gravel:22 Fine gravel: 20 Silt: 25	Heavy with heavy plume when kicked	Light - Moderate	Riffle: 10 Glide: 90 Pool: 0	DO: 26.9% / 2.67mg/l Temp: 16.4°c Conductivity:456µS/cm pH: 7.35	*Oenanthe crocata* *Apium nodiflorum* *Pelia* sp. Leptodictyum riparium *Vaucheria* sp. *Nasturtium officinale* Sewage fungus	• Outfall discharging grey water. • Sewage fungus. • Low oxygen. • Foul odour. • Tissue paper and small bits of plastic instream.

Site No.	Bank height (m)	Wet width (m)	Bankfull width (m)	Depth (m)	Substrate (%)	Substrate Siltation	Shading	River habitat (%)	Physico-chem	Macrophytes	Note
Site 5- Sandbrook Estate	3	4	4	0.25	Silt:100%	Heavy with heavy plume when kicked	Moderate - Heavy	n/a near stagnant flow	DO: 4.2% / 0.41mg/l Temp: 17.2°c Conductivity:581µS/cm pH: 6.98	Sewage fungus	• Almost stagnant flow • Extremely low oxygen • Anoxic conditions • Very grey water • Sewage fungus covering almost entire substrate. • Foul odour
Site 6- Upstream Clashduv Park	2	4	4	0.15	Silt:100%	Heavy with heavy plume when kicked	None	Glide: 100%	DO: 9.1% / 0.95mg/l Temp: 14.1°c Conductivity:597µS/cm pH: 7.33	Filamentous green algae *Callitiche* sp. *Apium nodiflorum*	• Extremely low oxygen • Slow to stagnant flow • Very grey water • Foul smell • Three-spined stickleback • Part of channel dredged in 2024
Site 7- Schoolboys Lane	1 to 5	3	3	0.15	Silt:100%	Heavy with heavy plume when kicked	Moderate	Glide: 100%	DO: 17.5% / 1.78mg/l Temp: 15.3°c Conductivity:549µS/cm pH: 7.34	*Lemna minor* *Callitriche* sp. *Apium nodiflorum*	• Low oxygen • Very grey water • Slow to stagnant flow
Site 8- Tesco Carpark	1	1	1.5	0.15	Cobble: 30 Coarse gravel:30 Fine gravel: 20 Silt: 20	Heavy with heavy plume when kicked	Moderate - Heavy	Riffle: 20 Glide: 80 Pool: 10	DO: 37.4% / 3.83mg/l Temp: 15°c Conductivity:518µS/cm pH: 7.09	None	• Low oxygen • Grey water