# HYDROMORPHOLOGICAL QUALITATIVE TECHNICAL ASSESSMENT

**for**

# A PROPOSED DEVELOPMENT LOCATED AT GOWAN HOUSE, CARRIGLEA BUSINESS PARK, NAAS ROAD, DUBLIN 12, D12 RCC4

Technical Report Prepared For

**Malclose Limited**

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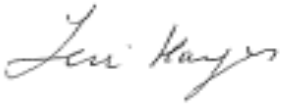
| Signature |  |  |
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# 1.0 INTRODUCTION

## 1.1 Background

AWN have been requested by Malclose Limited to carry out a Hydromorphological Qualitative Technical Assessment for a development at Gowan Motors, Gowan House, Carriglea Business Park, Naas Road, Dublin 12.

Malclose Limited intend to apply to Dublin City Council for a 7-year permission for a large-scale residential development principally comprising student accommodation at this 0.962 Ha site at Gowan House, Carriglea Business Park, Naas Road, Dublin 12, D12 RCC4.

Works to upgrade of the access road to the west of the site on an area measuring c. 0.081 Ha are also proposed comprising new surfacing to the carriageway, the provision of inbound and outbound bicycle lanes from the development entrance to the Naas Road, the provision of a controlled pedestrian crossing on the access road at the Naas Road junction, and the provision of a further uncontrolled pedestrian and bicycle crossing linking the subject site with the approved Concorde SHD development (ABP Ref: TA29S.312218) to the west.

On the Naas Road, works are proposed on an area measuring c. 0.086 Ha comprising the realignment and widening of the existing pedestrian footpath along the westbound carriageway of the Naas Road and the provision of linkages from the realigned footpath to the development site, and the provision of new controlled pedestrian crossings across the eastbound and westbound carriages of the Naas Road and the provision of a new uncontrolled crossing of the Luas tracks.

The development site area and roadworks areas will provide a total application site area of c. 1.13 Ha.

The proposed development will principally consist of: the demolition of the existing two-storey office/warehouse building and outbuilding (5,172 sq m); and the construction of a development in two blocks (Block 1 (eastern block) is part 2 No. storeys to part 15 No. storeys over lower ground floor and basement levels with roof plant over and Block 2 (western block) is part 9 No. storeys to part 11 No. storeys over basement with roof plant over) principally comprising 941 No. Student Accommodation bedspaces (871 No. standards rooms, 47 No. accessible studio rooms and 23 No. studios) with associated facilities, which will be utilised for short-term lets during student holiday periods. The 871No. standard rooms are provided in 123 No. clusters ranging in size from 3 No. bedspaces to 8 No. bedspaces, and all clusters are served by a communal living/kitchen/dining room.

The development also provides: ancillary internal and external communal student amenity spaces and support facilities; cultural and community floor space (1,422 sq m internal and 131 sq m external) principally comprising a digital hub and co-working space with ancillary cafe; a retail unit (250 sq m); public open space; the daylighting of the culverted River Camac through the site; an elevated walkway above the River Camac at ground floor level; a pedestrian bridge link at first floor level between Blocks 1 and 2; vehicular access at the south-western corner; the provision of 7 No. car-parking spaces, 2 No. motorcycle parking spaces and 2 No. set down areas; bicycle stores at ground and lower ground floor levels; visitor cycle parking spaces; bin stores; substations; hard and soft landscaping; green and blue roofs; new telecommunications infrastructure at roof level of Block 1 including antennas and microwave link dishes, 18 No. antennas and 6 No. transmission dishes, together with all associated equipment; boundary treatments; plant; lift overruns; and all associated works above and below ground.

The gross floor area of the development is c. 33,140 sq m comprising c. 30,386 sq m above lower ground and basement level.

The surrounding area comprises industrial lands which include light industrial buildings, large warehouse-type units and offices (particularly onto Naas Road). In addition, the Carriglea residential development is located adjacent to the south and is nearing completion. The Gowan Motors facility consists of a single, large 2-storey building with at grade car parking facilities. There are also two minor, ancillary structures located within the southwest and southeast corners of the site: an outbuilding which is being demolished and a substation that is being retained.

The Camac River flows culverted underground the subject site and the adjacent Carriglea lands (Phase 1 Planning Ref. 2203/18 and Phase 2 SHD TA29S.311606) before re-emerging immediately east of these lands where it drains north-eastwards through Landsdowne Valley.

Dublin City Council has set out in its Development Plan 2022-2028 a number of different policies to address a broad range of supporting infrastructure and services, providing for improvements in water quality and water services, sustainable waste management, greater energy security and efficiency, enhanced digital connectivity, and a more holistic and nature-based approach to flood risk and surface water management, all while safeguarding environmental quality and providing for climatic resilience. In this regard, the DCC has established the following policy for *Managing Development Within and Adjacent to Camac River Corridor*:

- *SI11: To manage all development within and adjacent to the Camac River Corridor in a way that enhances the ecological functioning and water quality of the river and aligns with the principles for river restoration. All development shall provide for a minimum set-back distance of 10-25m from the top of the river bank depending on site characteristics. Large development sites in excess of 0.5ha should provide a minimum set-back of 25m from the top of the river bank where informed by a hydromorphological study*.

However, as can be seen in sections below, as a result of the proposed daylighting of the culverted Camac River included in the new development the hydromorphological condition would be significantly improved from '*Poor*' to '*Good*' at the site, as established in the River Hydromorphology Assessment Technique (RHAT) guidelines. As such, this report determined that the 25 metres set-back distance is not essential as the ecological functioning and water quality of the river are expected to be improved at a local scale.

The river corridor restoration seeks to support the restoration of natural processes and historical functioning of a river as far as possible, thereby improving its water quality and ecology in line with the requirements of the Water Framework Directive (WFD), River Basin Management Plan (RBMP) and climate change adaptation. Providing more 'room for the river' is central to the concept.

It should be noted that the Naas Road Lands LAP (adopted January 2013, extended until January 2023 and now expired) identifies the de-culverting of the Camac River as an objective.

## 1.2 Objective of Report

The scope of this report is to carry out a hydromorphological assessment of the daylighting of the Camac River as part of the proposed development based on the River Hydromorphology Assessment Technique (RHAT) approved by the Environmental Protection Agency (EPA) in the Republic of Ireland and the Northern

Ireland Environment Agency (NIEA). The assessment relies on information regarding design provided by Malclose Limited as follows:

- Civil Engineering Infrastructure and Surface Water Management Report. Development at Gowan House, Carriglea Business Park, Naas Road, Dublin 12. Barrett Mahony Consulting Engineers, August 2023.
- Flood Risk Assessment Report. Development at Gowan House, Carriglea Business Park, Naas Road, Dublin 12. Barrett Mahony Consulting Engineers, August 2023.
- Utility Survey Report. Gowan House. Murphy Geospatial. July 2022.
- The proposed development design site plans and drawings; and
- Consultation with the project design engineers and ecologists.

This report was prepared by Marcelo Allende (BSc, BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is a Senior Environmental Consultant with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

## 2.0 HYDROLOGICAL AND GEOMORPHOLOGICAL SETTING

The proposed development site lies within the Liffey and Dublin Bay Catchment (Hydrometric Area 09) and River Liffey sub-catchment (WFD name: Liffey_SC_090, Id 09_15) (EPA, 2023).

The Environmental Protection Agency (EPA, 2023) on-line mapping presents the available water quality status information for water bodies in Ireland. The Camac River in the development area belongs to the '*Camac_040*' WFD surface waterbody which has a '*Poor*' Status (WFD 2016-2021 status, EPA, 2023) and its WFD risk score is *'At Risk*' of not achieving good status. This '*Poor*' status is related to its biological (invertebrate) status or potential (refer to www.catchments.ie).

According to the WFD Cycle 3 report for the Liffey and Dublin Bay Catchment, hydromorphology is the most significant pressure in this waterbody as it is mostly culverted. Urban Run-off and Urban Waste Water is also a significant pressure in this river. A Flood Alleviation Scheme is currently being developed for the Camac River (refer to https://www.camacfas.ie/) with DCC as the lead authority together with South Dublin City Council (SDCC) and the OPW.

The Camac River in this area flows from the South Dublin County Council area at the Old Naas Road. There are four stretches where the river channel is open and natural but these are so short and far apart that the river is essentially a heavily modified water body and has been designated as such in the River Basin Management Plan (RBMP). The river passes through a number of industrial estates and then flows through Lansdowne Valley Park. The Robinhood Stream, the Gallblack River (including the Blackditch and Gallanstown streams) and the Walkinstown Stream all discharge to the Camac River. In addition, an extensive surface water drainage

network discharges to the Camac River and a significant number of combined sewer overflows also discharge to the river and its tributaries. The area is heavily developed by a mixture of industrial and commercial development. Increasingly residential development is being built in this area. Some land owned by DCC and others near the river are required for flood storage. Developments are likely to be infill or brownfield sites. A significant portion of the river is culverted under the old and new Naas Roads as well as under Davitt Road and the Grand Canal.

As mentioned above, a culverted section of the Camac River runs diagonally through the site, flowing in a south-easterly direction. It should be noted that the Naas Road Lands LAP (adopted January 2013, extended until January 2023 and expired in January 2023) identifies the de-culverting of the Camac River as an objective (refer to Figure 2.1 below).

Regionally, the Camac River naturally meanders pathway through its course through the Bluebell area. The approximated meander belt (taken from the open areas in Bluebell and Lansdowne Valley Park) is c. 560 m. At the local scale, as the Camac River runs diagonally and culverted through the site, meanders cannot be defined.

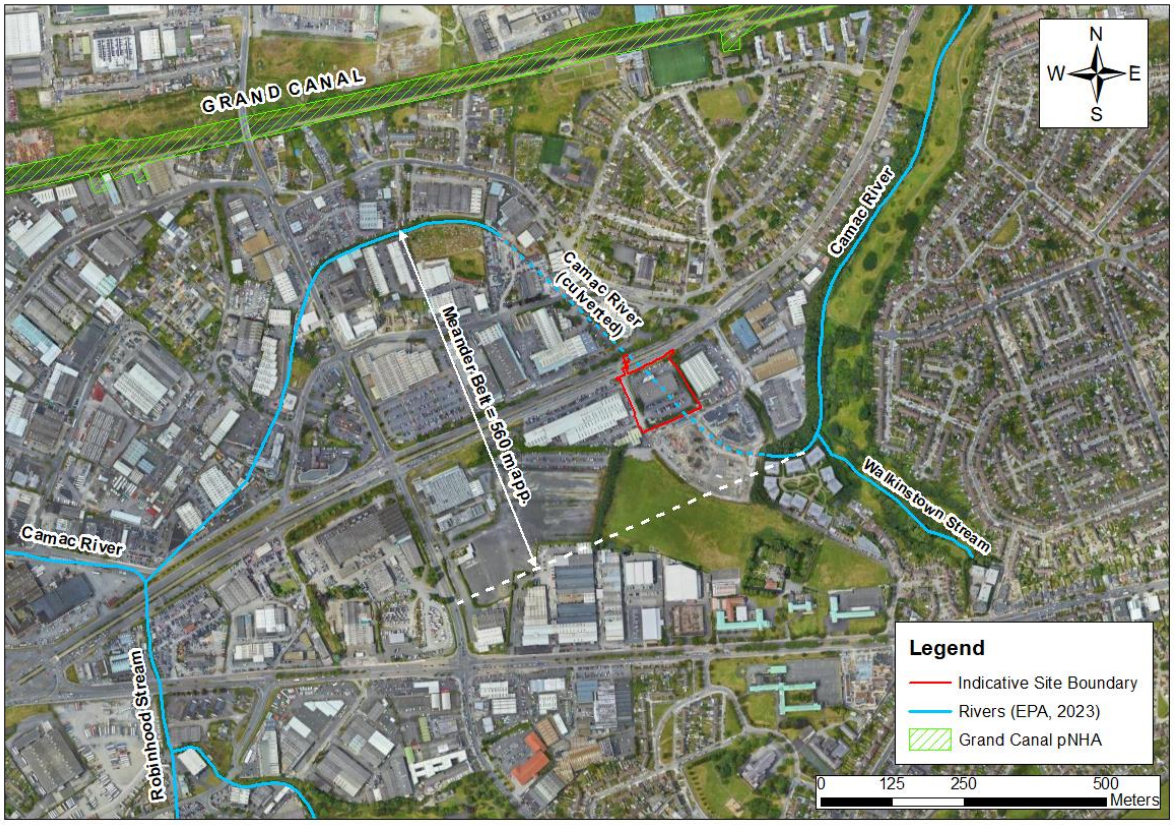


***Figure 2.1 Hydrological Environment***

In terms of flow, there are no gauging stations in the surrounding area of the project. However, the Hydronet tool developed by the EPA (Hydrotool, https://epawebapp.epa.ie/hydronet/#Flow) estimates the flows that would be expected in rivers under naturalised conditions for different hydrological conditions. According to the Hydrotool, the Camac River before entering the Lansdowne Valley Park (i.e., downstream of Carriglea Development) has a dry weather flow (95%ile flow) of 0.19 $m^3/s$ and a mean condition flow (50%ile) of 0.506 $m^3/s$ (refer to Figure 2.2 below).

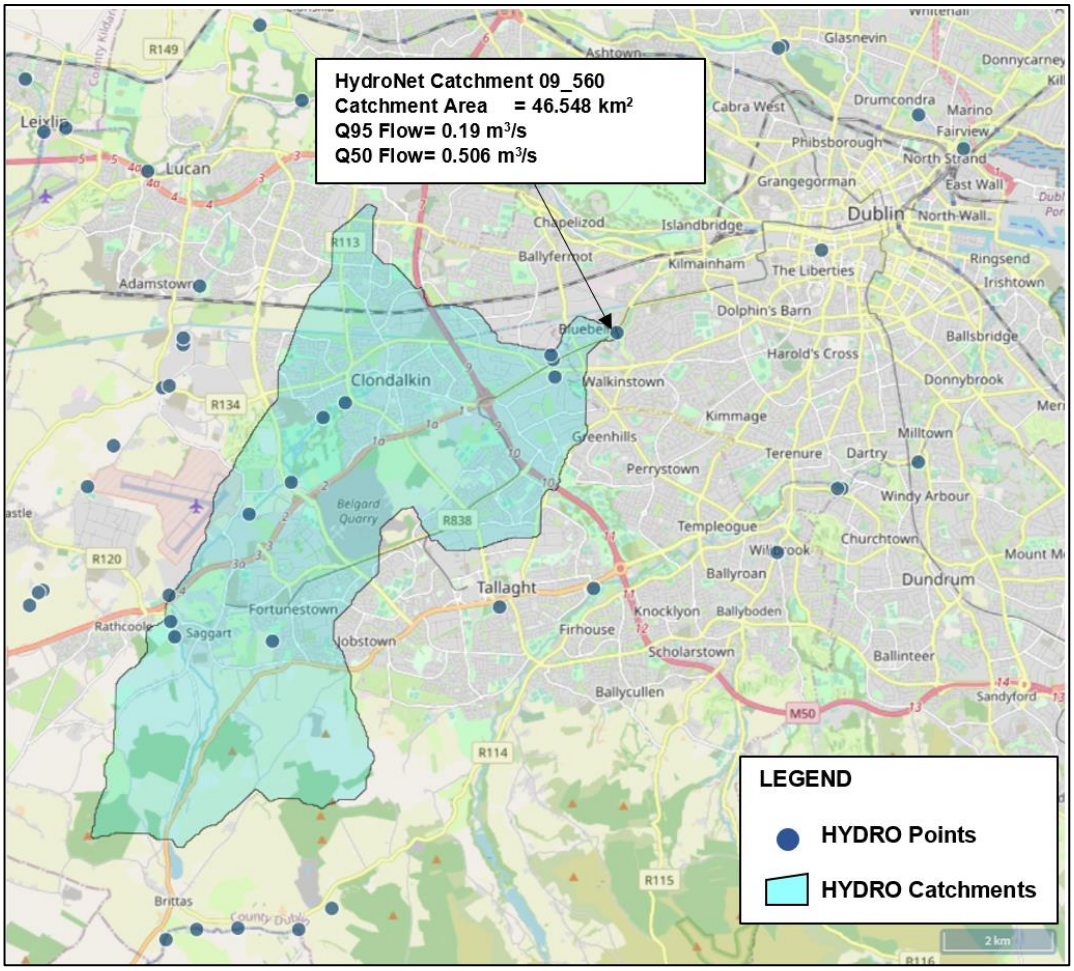


***Figure 2.2 Hydronet Flows estimated by the EPA (Source: EPA)***

There is an existing 450mm concrete public surface water sewer running along the northern boundary of the site within the Naas Road carriageway. A 225mm concrete public surface water sewer also runs along the northern boundary of the site within the Naas Road public footpath. Both stormwater pipes discharge to the culverted Camac River just north of the subject lands.

It should be noted that the Carriglea Residential Development (Phase 1 Planning Ref 2203/18 and Phase 2 TA29S.311606 schemes) discharges its site's stormwater run-off directly to the Camac River at the downstream end of the culverted watercourse. The associated development stormwater network design allows for collection, treatment, and attenuation of the stormwater prior to a controlled discharge to the Camac River in accordance with the requirements of the Greater Dublin Strategic Drainage Study (GDSDS).

A detailed study of the culvert Camac River was undertaken by O'Connor Sutton Cronin (OSCS) as part of the planning application for the adjacent Phase 1 Carriglea lands (Planning Ref 2203/18); it should also be noted that this planning application was complemented with its Phase 2 Strategic Housing Development (SHD) Application TA29S.311606. OSCS undertook a series of surveys and commissioned three separate surveying firms in order to definitively ascertain the alignment and depth of the culvert through the adjacent Carriglea site. The results of the survey show that the culvert follows an arc through the centre of the adjacent Carriglea site with the top of the culvert between 6.0 and 6.5 meters below ground level (mbgl). The culverted watercourse. consists of an approx. 4.5m x 5.0m arched tunnel with invert levels typically 10 mbgl.

According to the OPW flooding maps, the modelled water level at the outlet of the culverted Camac River into its open section at Landsdowne Park for the 0.1% AEP event (i.e., low probability event, associated to a 1-in-1,000-year return period) would be c. 30.92 mAOD. According to the OCSC surveys, the crown level of the culvert through the adjacent Carriglea site ranges from 34.21 to 33.72 mAOD (and invert levels from 29.39 to 29.30 mAOD). This indicates that the existing culvert would have sufficient hydraulic capacity for this extreme event. According to the Flood Risk Assessment carried out by Barret Mahony (BM, 2023), the Flood Zone C (i.e., where the probability of flooding from rivers is less than 0.1% or 1 in 1000 years) is below the projected basement slab level.

It should be noted that the planning condition in the granted Carriglea development proposals establishes a minimum distance of 3m between culvert and all structures on site which was addressed with the allowance of a 3m wayleave either side of the existing Camac River culvert. Additionally, the Inspector's Report ABP-311606-21 (related to the Phase 2 of the SHD Carriglea development, currently under construction), suggests that "*The phase 1 proposals provide for a water feature situated along the linear park, although this would not entail the uncovering of the Camac River. While the linear park and culverted river are within the applicant's landholding, I do not consider it practical or appropriate to attach a condition in the event of permission to uncover this watercourse, as works in this area are already permitted and at an advanced stage and the engineering works to uncover a watercourse at a substantive depth may have additional material implications for the well progressed phase 1 development"*. In conclusion, the planning granted by DCC for the adjacent development, which proposes to retain the culverted section of the Camac River throughout its extents, was accepted.

## 3.0 HISTORICAL OVERVIEW OF THE CAMAC RIVER

According to Walshe et al (2018[1]), "*the Camac River has a rich industrial history. Its historical significance in shaping the westerly growth of the city, and its importance to industry going back as far as the 1600's, is somewhat in contrast to its current condition, hidden underground in concrete culverts for long sections, squeezed into concrete channels between palisade fences, difficult for the public to access, inhospitable to wildlife, a history of flooding and with water of questionable cleanliness*".

Historically, the Camac River downstream Bluebell has about five contributing branch courses joining it, and five millraces took their waterpower from it. After crossing the Old Naas Road dual carriageway and then into a culvert, the Camac emerged in open channel upstream of the former Drimnagh Paper Mills. Further downstream, it was joined by a millrace which had begun near the point where the culvert on the main stream had started. This paper mills were powered by this race. This area is the south end of the Lansdowne Valley. The Camac was joined here by the second branch course, the Drimnagh Castle stream[2]. Refer to Figure 3.1 below.

[1] Rehabilitation of the Camac River under the water framework directive: New opportunities to engage local communities and to manage flood risk. Mary-Liz Walshe and Gerard O'Connell. Irish National Conference 2018.
[2] The Rivers of Dublin. Clair Sweeney. 2017.

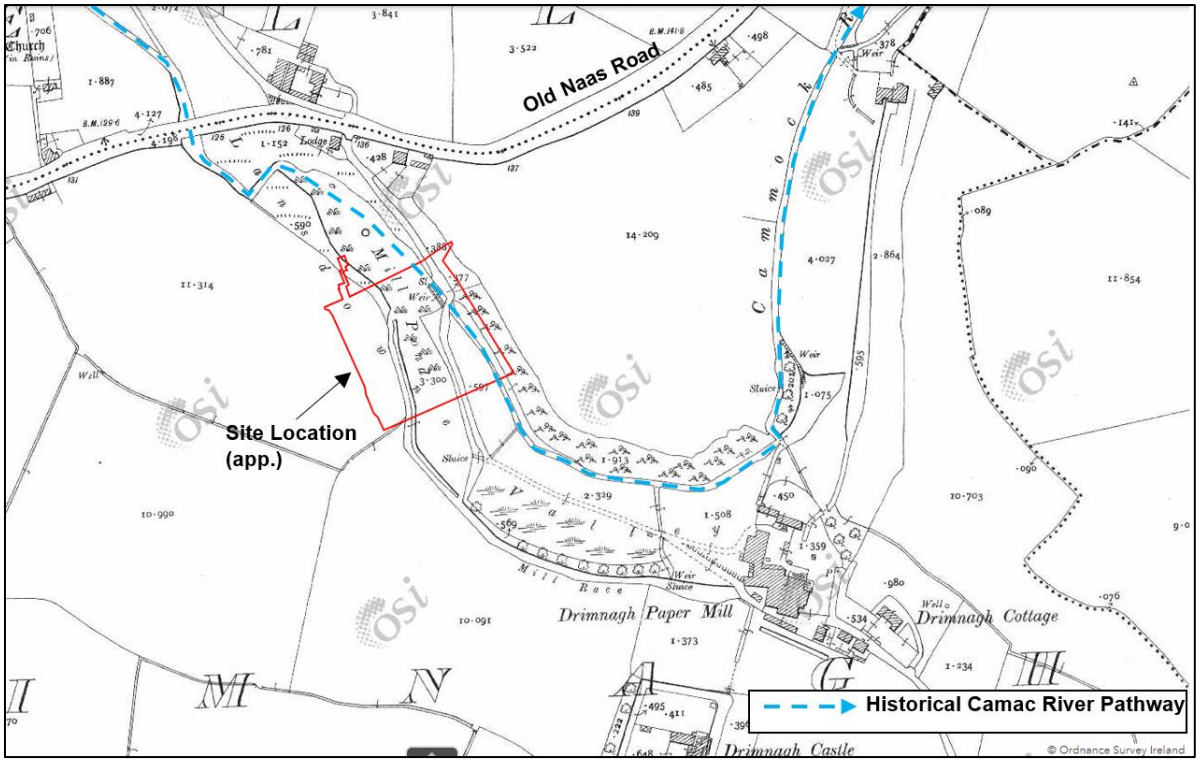


***Figure 3.1 Historical 25" Map (Source: OSi)***

As can be seen in the OSi historical maps, the Camac River in the study area has been intervened since ancient times. However, the meander belt presented in the Section 2.0 above can be related to its historical and natural course. Likewise, at the local scale, across the development site, even when the river was flowing open, no local meanders can be identified from the historical maps (refer to Figure 3.1 above).

## 4.0 CHARACTERISTICS OF THE PROPOSED DAYLIGHTING OF THE CAMAC RIVER

The development proposes the reopening of the culverted section of the Camac River in association with the Camac Flood Alleviation Scheme. The River Camac is a culverted river lying from c. 7.5 to 10 metres below the ground floor level through the development site, and flows at an angle through the middle of the subject site from northwest to southeast. The proposed development includes for daylighting approximately 76 no. metres of the River Camac. The intention is that this would create 1,261 sq m (13% of the site area) of space allocated for the Riparian Zone.

To establish softer, more natural riverbanks that will aim to improve the quality of the River Camac and enhance biodiversity at the river level, a combination of grey and green bioengineering solutions are proposed such as vegetated rip-rap and willow staking, spiling and mattressing.

The existing Camac River culvert bed will be maintained up to 1.0 m in height, this being the base of the proposed new riverbed. The riverbed, riverbanks and riparian zone will comprise the following:

- Tree planting: Variation of tall, large canopy native trees (Alder, Birch, Aspen) and small shrubby native species (Willow, Hazel, Hawthorn) will help to further stabilize the embankments and add higher layers of habitats in the Riparian Zone River Corridor for birds and insects and enhance the biodiversity.

- Riparian Planting: Live willow mattress and marginal shade tolerant plants such as Ivy, Iris, ferns will be planted to stabilize the embankments with their root structure and to create a new riparian habitat.
- Rip Rap: Crushed Rock Armour. It stabilizes embankments and protects them from mechanical erosion.
- Granite Boulders: Large Granite Boulders will act as anchor/ballast to keep the gabion mattress on the river bed in place and protect the bioengineered embankments from washing away during high water conditions (floods).
- Weir: Varies the depths of water within the culvert bed to create different dynamics throughout the day-lit section of the river. Aerates and agitates the water to improve the quality of the water.
- 300mm Thick Gabion Mattress: These will keep loose rocks in place as water passes through as the river re-enters the culvert on the riverbed. They encourage the deposition of silt, creates the opportunity for spawning and improves the condition and quality of the river.
- Wildlife Pond: Composed of a bentonite lined area and planted with Iris. It creates a still water habitat, attracts an array of invertebrates, potential breeding environment for amphibians.
- Topsoil Varies 300mm-600mm.
- Subsoil will comprise clean imported and approved material.
- Riparian Bank will be placed over Existing Camac River Culvert Bed

Refer to Figure 4.1 and Figure 4.2 below for further details.

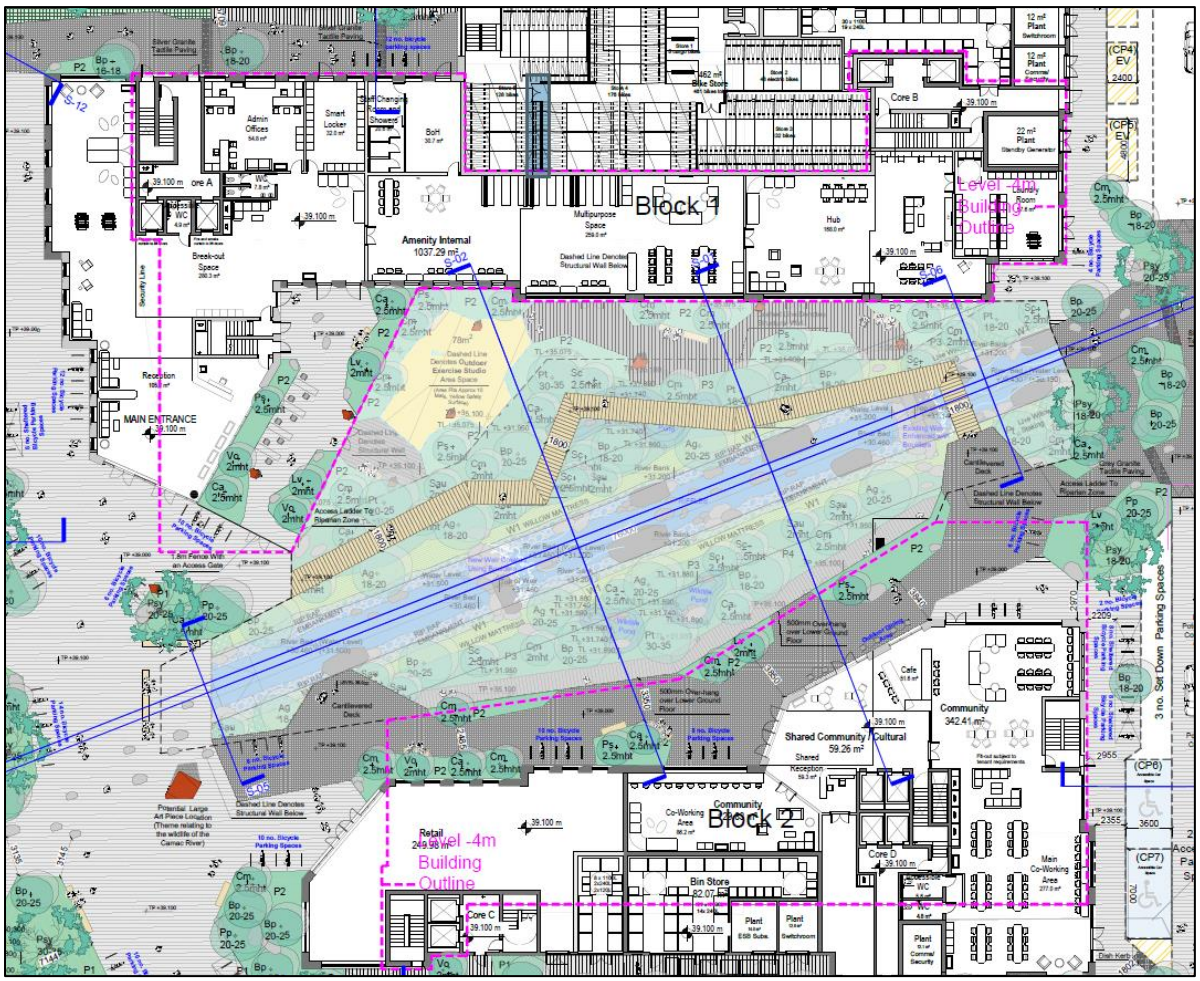


***Figure 4.1 Proposed Development – Lower Ground Level***

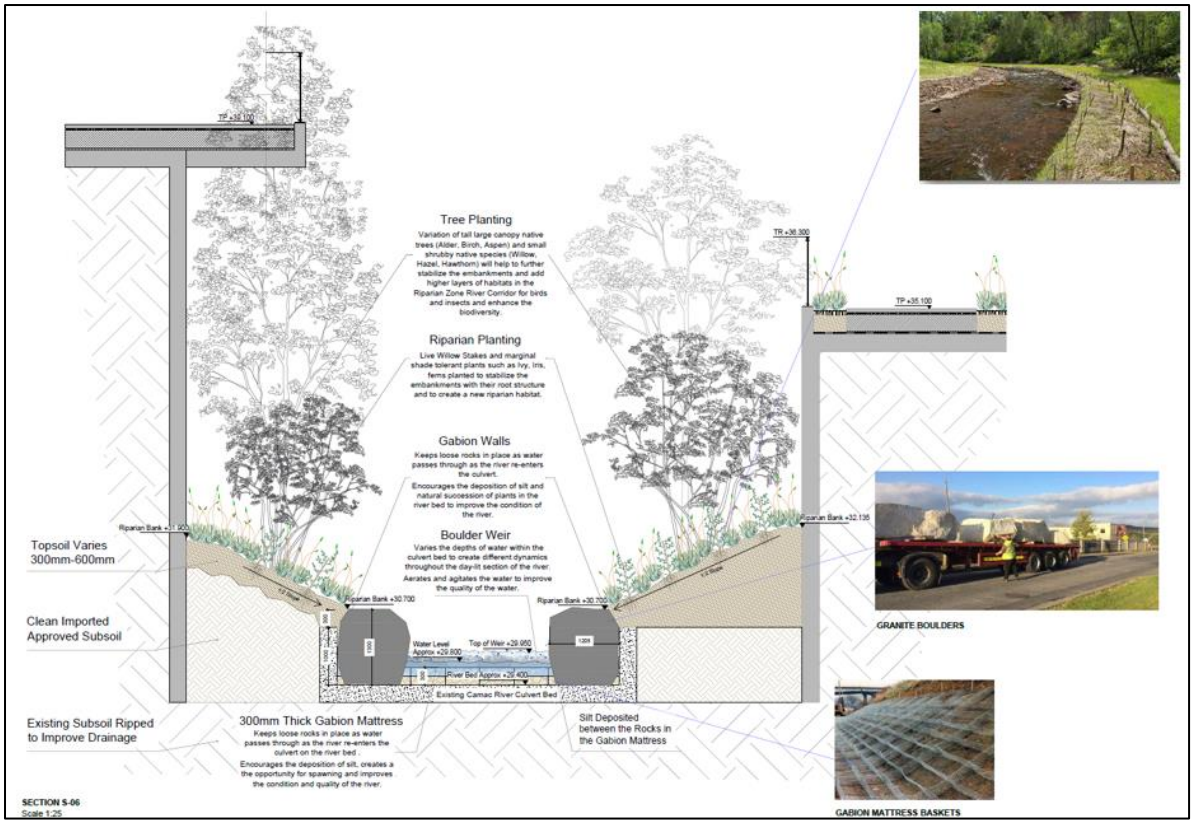


***Figure 4.2 Proposed Development – Cross Section of the Development***

## 5.0 RIVER HYDROMORPHOLOGY ASSESSMENT TECHNIQUE

The European Water Framework Directive (WFD) 2000/60/EC requires the assessment of the ecological status of water bodies, which is comprised of biological, physico-chemical and hydromorphological quality elements. Hydromorphology is a term used in the WFD to describe the processes operating within, and the physical form of a waterbody. The term encompasses both hydrological and geomorphological characteristics that, in combination, help support a healthy ecology. Hydromorphological elements contribute towards WFD status classification.

Likewise, the WFD requires Member States to classify rivers in terms of hydromorphology to support high ecological status (fish, macrophytes, invertebrates and diatoms) and to put into place mitigation measures necessary to achieve at least good ecological status. Member States should also prevent further deterioration of the water body status.

The Environmental Protection Agency (EPA) in the Republic of Ireland and the Northern Ireland Environment Agency (NIEA), through the North South Shared Aquatic Resource (NS SHARE) project, agreed a field assessment technique for WFD classification called the River Hydromorphology Assessment Technique (RHAT) which newest version was published in 2014.

These guidelines assume that natural systems support ecology better than modified systems. Hence the RHAT method classifies river hydromorphology based on a departure from naturalness. It assigns a morphological classification directly related to that of the WFD: *High*, *Good*, *Moderate*, *Poor* and *Bad*, based on semi-qualitative and quantitative criteria.

The eight criteria that are scored by the RHAT are:

1. Channel morphology and flow types: This attribute evaluates the form of the river and its deviation from natural including the planform, cross-section, natural bed forms, flow types and obstructions.

2. Channel vegetation: This attribute relates to the presence, diversity and habitat potential of any vegetation, including woody habitat (WH), leaf litter and tree roots occurring within the channel. The river type and riparian land cover affect the type and quantity of vegetation present in terms of the amount of leaf litter provided as a source of food and the number of refuges such as underwater roots for habitat.

3. Substrate diversity and condition: This attribute evaluates the type, quantity and diversity of substrate present in the river. The dominant substrate depends on the river type and geology. It will reflect the heterogeneity of the substrate present.

4. Barriers to continuity: This attribute relates to in stream barriers which affect both the variation in velocity across the channel and the longitudinal continuity of the river. It will indicate the impacts of widening, over deepening, straightening, impoundments, weirs and dams on downstream transport of water, sediment and organic matter, and up and downstream migration of fish (salmon, trout, eel and lamprey).

5. Bank structure and stability: This attribute assesses the shape and stability of the banks of the river. Rivers are naturally dynamic entities whose pathways constantly change. The degree of expected lateral movement will depend on typology, geology, soil type and hydrology. It relates to both the degree of bank engineering, e.g. steepening, and the effect of riparian or channel use on the stability of the banks.

6. Bank and bank top vegetation: This attribute assesses the types, continuity and canopy layers of the bank vegetation. Bank top should be taken as the first obvious break in slope to 1m back. The river type, altitude, geology and riparian land use will affect the type and extent of bank vegetation present. Bank vegetation contributes to river habitat and bank stability. It will reflect the amount and extent of vegetation cover.

7. Riparian land use: This attribute relates to land cover within the zone adjacent to the river from 1m to 21m back from the bank top. It will reflect the amount and type of vegetation (i.e. whether native or not) within this zone and the intrusion of human activities. Weight should be given to the nature of the activity, proximity to the river channel, and the importance of the floodplain area to the river ecosystem (most important for lowland rivers that interact regularly with the floodplain zone).

8. Floodplain interaction: This attribute concerns the degree of lateral connectivity between the channel and floodplain. The natural connectivity depends on the river type and valley confinement. For rivers that would naturally flood over bank at high discharges, the score will reflect the degree to which channel and bank work have altered flow regimes.

A scoring system is established in the RHAT Guidelines and is presented in Table 5.1 below.

***Table 5.1 RHAT Score for each Attribute***

| Attribute | WFD Classification / Score | | Comment |
|---|---|---|---|
| 1. Channel morphology and flow types | High | 4 | If it is not possible to assess the attribute, a score of 2 should apply. |
| | Good | 3 | |
| | Moderate | 2 | |
| | Poor | 1 | |
| | Bad | 0 | |
| 2. Channel vegetation | High | 4 | If it is not possible to assess the attribute, a score of 2 should apply. |
| | Good | 3 | |
| | Moderate | 2 | |
| | Poor | 1 | |
| | Bad | 0 | |
| 3. Substrate diversity and condition | High | 4 | If it is not possible to assess the attribute, a score of 2 should apply. |
| | Good | 3 | |
| | Moderate | 2 | |
| | Poor | 1 | |
| | Bad | 0 | |
| 4. Barriers to continuity | High | 4 | If it is not possible to assess the attribute, a score of 2 should apply. |
| | Good | 3 | |
| | Moderate | 2 | |
| | Poor | 1 | |
| | Bad | 0 | |
| 5. Bank structure and stability (LB: Left Bank; RB: Right Bank) | High | LB: 2 RB: 2 | If it is not possible to assess the attribute, a score of 1 should apply. |
| | Good | LB: 1.5 RB: 1.5 | |
| | Moderate | LB: 1 RB: 1 | |
| | Poor | LB: 0.5 RB: 0.5 | |
| | Bad | LB: 2 RB: 2 | |
| 6. Bank and bank top vegetation (LB: Left Bank; RB: Right Bank) | High | LB: 2 RB: 2 | If it is not possible to assess the attribute, a score of 1 should apply. |
| | Good | LB: 1.5 RB: 1.5 | |
| | Moderate | LB: 1 RB: 1 | |
| | Poor | LB: 0.5 RB: 0.5 | |
| | Bad | LB: 2 RB: 2 | |
| 7. Riparian land use (LB: Left Bank; RB: Right Bank) | High | LB: 2 RB: 2 | If it is not possible to assess the attribute, a score of 1 should apply. |
| | Good | LB: 1.5 RB: 1.5 | |
| | Moderate | LB: 1 RB: 1 | |
| | Poor | LB: 0.5 RB: 0.5 | |
| | Bad | LB: 2 RB: 2 | |
| 8. Floodplain interaction (LB: Left Bank; RB: Right Bank) | High | LB: 2 RB: 2 | If it is not possible to assess the attribute, a score of 1 should apply. |
| | Good | LB: 1.5 RB: 1.5 | |
| | Moderate | LB: 1 RB: 1 | |
| | Poor | LB: 0.5 RB: 0.5 | |
| | Bad | LB: 2 RB: 2 | |

The sum of attributes scores (∑Assessment scores) and the Hydromorph Score (HM=∑Assessment scores / 32) will determine the WFD hydromorphological status as presented in Table 5.2 below.

***Table 5.2 WFD Classification for Morphological Condition***

| WFD Classification | HM Score | ∑Assessment Scores |
|---|---|---|
| High | ≥0.8 | ≥26 |
| Good | 0.6 – <0.8 | ≥19.5 – <26.0 |
| Moderate | 0.4 – <0.6 | ≥13.0 – <19.5 |
| Poor | 0.2 – <0.4 | ≥6.5 – <13.0 |
| Bad | <0.2 | <6.5 |

RHAT is designed to be a holistic visual assessment based on information from desktop studies using GIS data, aerial photography, historical data and field surveys.

## 6.0 RIVER CORRIDOR RESTORATION

According to the Sustainable Environmental Infrastructure and Flood Risk included in the DCC Development Plan 2022-2028, the River Camac Flood Alleviation Scheme, which is under preparation, will review and improve flood protection on the Camac River catchment, with opportunities for river corridor restoration being explored as part of this initiative.

This river corridor restoration seeks to support the restoration of natural processes and historical functioning of a river as far as possible, thereby improving its water quality and ecology in line with the requirements of the WFD, RBMP and climate change adaptation. Providing more 'room for the river' is central to the concept. Forthcoming national guidance on nature-based sustainable urban drainage and WFD assessment of plans and projects will provide a strong policy basis for nature-based water management and will support the advancement of the Council's River Restoration Strategies. According to the EPA[3], the main impacts associated to hydromorphological pressure due to culverted rivers is the impediment of the movement of water, sediment and aquatic species (notably fish) along the river.

In the interim, progressive restoration within river corridors is to be achieved by managing the nature and extent of development adjoining the City's rivers by applying a recommended minimum setback distance from all rivers in line with Planning for Watercourses in the Urban Environment Guidance (2020) produced by Inland Fisheries Ireland and the River Hydromorphology Assessment Technique (RHAT) under the Water Framework Directive.

A more extensive set-back distance based on a hydromorphological assessment may be required for larger scale sites along the Camac River, to safeguard the restoration integrity of specific river reaches.

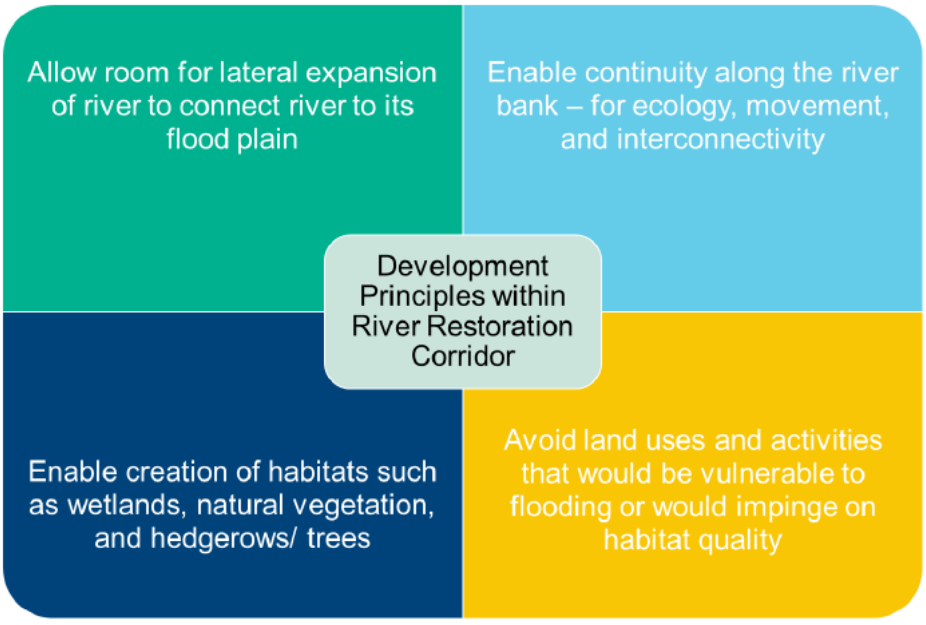


***Figure 6.1 Development Principles with River Restoration Corridor***

In this regard, DCC has established the following policy for *Managing Development Within and Adjacent to Camac River Corridor* (SI11):

[3] https://www.catchments.ie/significant-pressures-hydromorphology/

- *SI11: To manage all development within and adjacent to the Camac River Corridor in a way that enhances the ecological functioning and water quality of the river and aligns with the principles for river restoration. All development shall provide for a minimum set-back distance of 10-25m from the top of the river bank depending on site characteristics. Large development sites in excess of 0.5ha should provide a minimum set-back of 25m from the top of the river bank where informed by a hydromorphological study*.

## 7.0 HYDRAULIC ANALYSIS

A hydraulic assessment of the flows in the culvert was prepared by BMCE (refer to Civil Infrastructure & Surface Water Management Report) to assess the risk from the daylighting of the Camac River. The analysis was carried out using the HEC RAS water flow modelling software.

In terms of the storm water flows through the culvert, the following flow information has been taken from the CFRAMS study map for this location:

- For 10 % AEP Rainfall event, flow = 24.03 $m^3$/s.
- For 1 % AEP Rainfall event, flow = 36.1 $m^3$/s.
- For 0.1 % AEP Rainfall event, flow = 47.69 $m^3$/s

Conservatively, it has been assumed that a 20% increase in the storm flows needs to be allowed for, which results in the following design flows in the channel:

- For 10 % AEP Rainfall event, increased flow = 24.03 * 1.2 = 28.84$m^3$/s.
- For 1 % AEP Rainfall event, increased flow = 36.1 m3/s * 1.2 = 43.32$m^3$/s.
- For 0.1 % AEP Rainfall event, increased flow = 47.69 m3/s * 1.2 = 57.3$m^3$/s.

Based on the HEC RAS analysis, which was carried out, for the extreme 0.1% AEP storm event, the flood flows will rise to a level approximately 700 – 800mm above the riparian planting zone showing extract from the channel design. The approximate flood level will be +32.700 mOD. the basement level for the new development is set at +35.100 mOD. Hence the 0.1% AEP flood event water level will still be 2.40m below the basement slab level.

Consideration was also given to a potential partial blockage of the downstream culvert, to determine if this would have a significant impact on the flood levels through the open channel. A further iteration of the channel flow design for the 0.1% AEP storm event was carried out, but with the width of the downstream culvert reduced by 1m to simulate a potential blockage of the culvert. This is effectively considering a 20% reduction in the cross section of the remaining culvert through the Carriglea residential development. It is considered that such a blockage would be highly unlikely given the size of the culvert.

In such a case, it was found that the water level in the channel rises to approximately 2m above the riparian zone, but critically the flood water is still contained within the channel. A freeboard of just under 1m remains between the basement floor level and the flood water level in such an event. The complete HEC RAS flow design is detailed in the 'Civil Infrastructure & Surface Water Management' report. Based on the results, which are extracted and discussed above, it is considered that the daylighting of the Camac culvert does not create a significant fluvial flood risk to the development.

The model also determined the flow velocity and Froude number[4] along the daylighted section for the three scenarios described above (i.e., 10% AEP, 1% AEP, 0.1 % AEP).

***Table 7.1 WFD Classification for Existing Condition of Camac River***

| Hydrological Condition | Flow [m3/s] | Flow Velocity [m/s] | Froude Number [-] |
|---|---|---|---|
| 0.1% AEP | 57.3 | 4.27 | 0.86 |
| 1% AEP | 43.32 | 3.92 | 0.85 |
| 10% AEP | 28.84 | 3.54 | 0.87 |
| Q50 (Mean condition) | 0.506 | 0.36 | 0.21 |
| Q95 (Dry weather condition) | 0.19 | 0.25 | 0.20 |

In terms of potential erosion, the granite boulder size defined was defined as 1m x 1m x 1m. According to the model, the drag force from moving water will be 9.7 kN for the 0.1% AEP event. The resistance, which is the friction force between the boulder and the concrete riverbed is 10 kN. Hence, there would be sufficient resistance to avoid the rock moving even for the 0.1% AEP event.

According to the literature consulted[5], under normal turbulence conditions, a 300mm Reno mattress will be stable up to mean flow velocities of 4.8 to 5.6 m/s. Therefore, the proposed 300mm thick gabion mattress would resist the extreme velocity projected for a 0.1% AEP event. It should be noted that the model obtained Froude number < 1.0 for all the analysed events. A Froude number <1.0 would mean that the flow is subcritical and therefore has lower velocity and is less susceptible to turbulence.

With regard to sedimentation, according to the Hjulstrom-Sundborg diagram, the flow for the mean and dry weather condition (Q50 and Q95, respectively) would allow transport and deposition of different size of sediments for the mean and dry weather condition (refer to Figure 7.1 below).

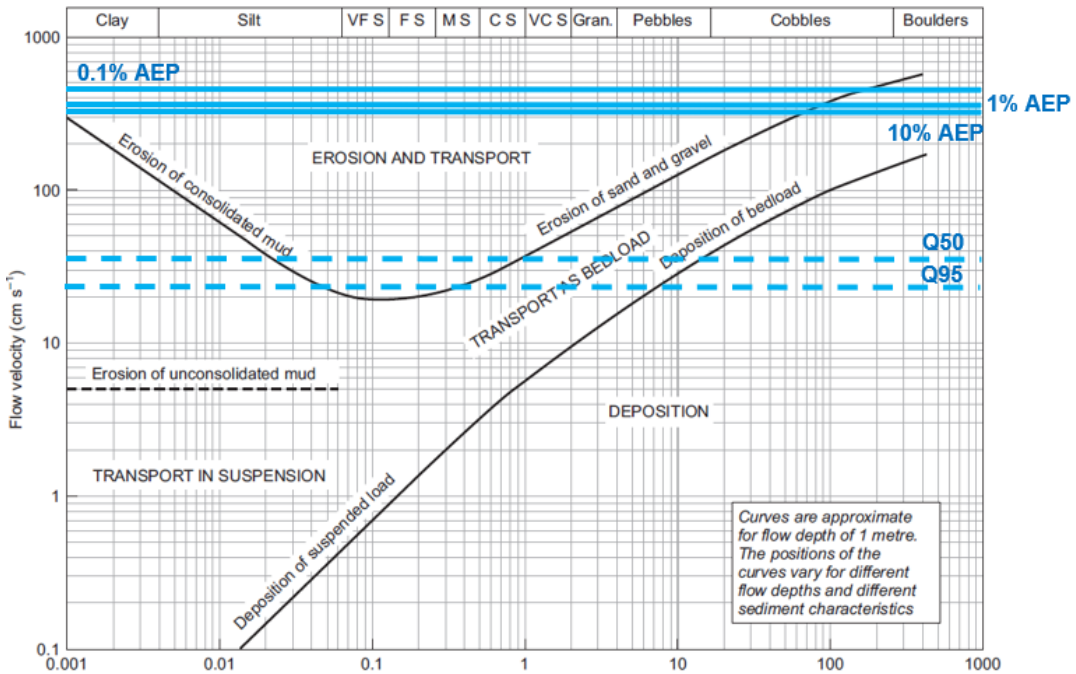


***Figure 7.1 Hjulstrom-Sundborg diagram with modelled flow velocities***

[4] The Froude Number is a dimensionless parameter measuring the ratio of the inertia force on an element of fluid to the weight of the fluid element.

[5] Channel Protection. Gabion Mattresses and Concrete Blocks. Escarameia. HR Wallingford. 1995

# 8.0 HYDROMORPHOLOGICAL ASSESSMENT

In this section, the hydromorphology of the Camac River is classified using the RHAT criteria for the existing culverted section, as well as for the proposed daylighting section through the development site.

## 8.1 RHAT for Existing Culverted Section

The following subsections assess all the attributes defined in the RHAT Guidance for the existing culverted section of the Camac River:

### 8.1.1 Channel morphology and flow types

The Camac River in the section through the proposed development is culverted as such the river is not in its natural course. There is an absence of natural features. Excessive interference (section totally realigned) applies to this section.

As such, a condition category of *Bad* (<25% natural) is considered adequate and therefore a score of 0 is considered for this attribute.

### 8.1.2 Channel vegetation

As the Camac River is culverted, no natural vegetation within its channel has been identified. As such, as if it is not possible to assess this attribute, a score of 2 has been considered.

### 8.1.3 Substrate diversity and condition

As the Camac River is culverted, a homogeneous concrete channel bed is present through its pathway.

As such, a condition category of *Bad* (<25% natural) is considered adequate and therefore a score of 0 is considered for this attribute.

### 8.1.4 Barriers to continuity

As the Camac River is culverted in this area, there are no barriers to the longitudinal flow of water. Downstream sediment transport is not interfered by the culverted section. However, a culverted section acts as a barrier to lateral flow, organic matter and fish. No fish resting places are located within the culvert section.

As such, a condition category of *Poor* (>25-65% natural) is considered adequate and therefore a score of 1 is considered for this attribute, due to the existence of a major feature such as a culvert.

### 8.1.5 Bank structure and stability

As the Camac River is culverted in this area, there are no banks associated with this section of the watercourse. As such, as if it is not possible to assess this attribute, a score of 1 has been considered.

### 8.1.6 Bank and bank top vegetation

As the Camac River is culverted in this area, there are no banks associated with this section of the watercourse. As such, as if it is not possible to assess this attribute, a score of 1 has been considered.

### 8.1.7 Riparian land use

As the Camac River is culverted in this area, there are no riparian lands adjacent to this watercourse. As such, as if it is not possible to assess this attribute, a score of 1 has been considered.

### 8.1.8 Floodplain interaction

According to the Naas Road LAP, flood zones A and B are developed immediately upstream and downstream of the local culverted section of the Camac River. Therefore, water is artificially prevented from reaching the natural floodplain in these areas (refer to Figure 8.1 below).

As more than 75% of the reach would be affected by the River Camac Flood Alleviation Scheme, a condition category of *Bad* (<25% natural) is considered adequate and therefore a score of 0 is considered for this attribute.

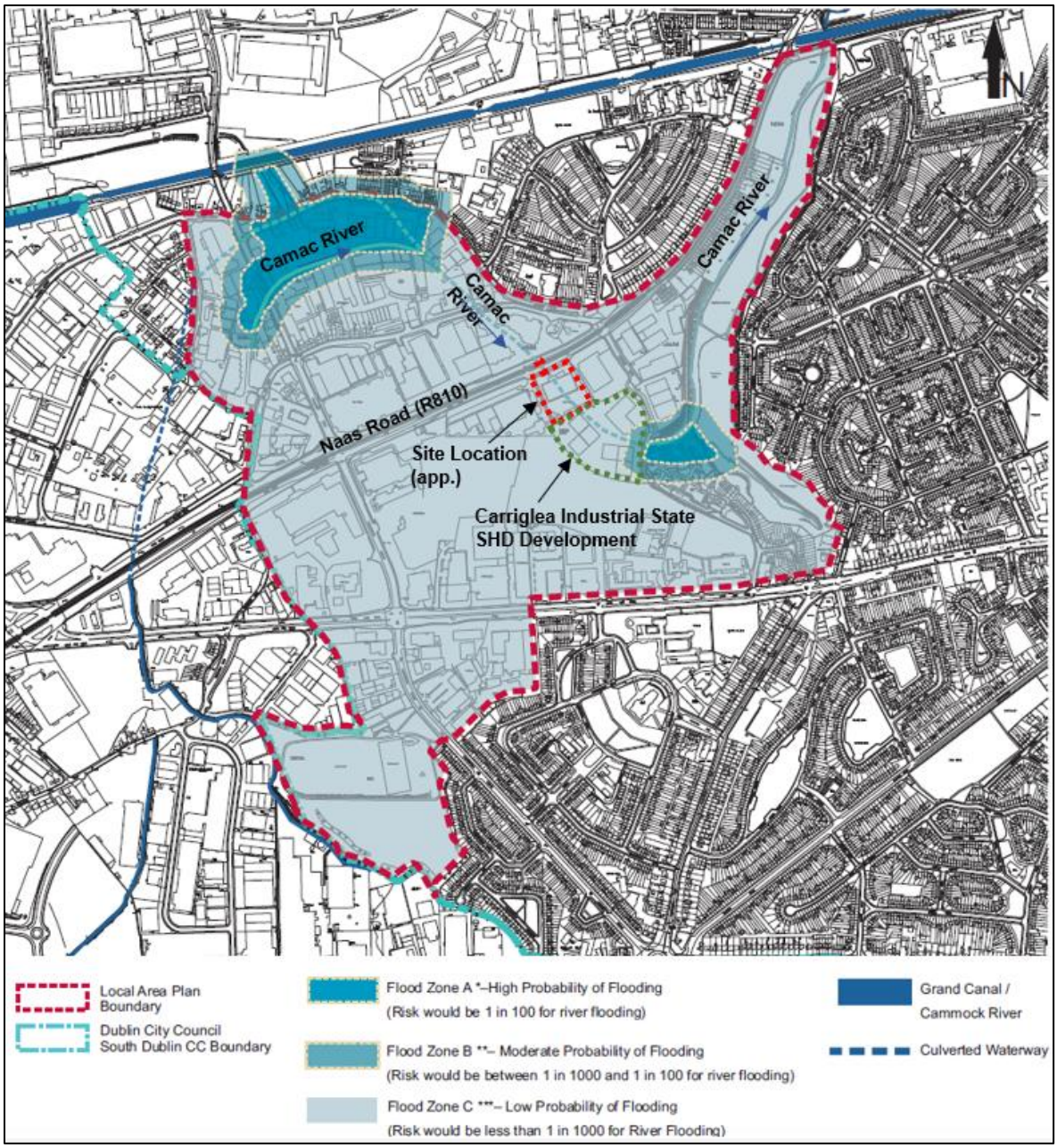


***Figure 8.1 Hydrological Environment (Source: Naas Road LAP)***

The obtained result for the WFD hydromorphological status is presented in Table 8.1 below.

***Table 8.1 WFD Classification for Existing Condition of Camac River***

| Attribute | Score | HM Score | ∑ Scores | WFD Classification |
|---|---|---|---|---|
| 1. Channel morphology and flow types | 0 | 7 | 0.22 | Poor |
| 2. Channel vegetation | 2 | | | |
| 3. Substrate diversity and condition | 0 | | | |
| 4. Barriers to continuity | 1 | | | |
| 5. Bank structure and stability | 1 | | | |
| 6. Bank and bank top vegetation | 1 | | | |
| 7. Riparian land use | 1 | | | |
| 8. Floodplain interaction | 0 | | | |

As can be seen above, the WFD Classification for the hydromorphological status for the Camac River is '*Poor*' which is consistent with the current status of this catchment assessed by the EPA.

## 8.2 RHAT for the Proposed Daylighting of the Camac River

The following subsections assess all the attributes defined in the RHAT Guidance for the proposed daylighting of the Camac River detailed in Section 4.0 above.

### 8.2.1 Channel morphology and flow types

The proposed daylighting of the Camac River will include natural riverbanks that will aim to improve the quality of the River Camac and enhance biodiversity at the river level, a combination of grey and green bioengineering solutions are proposed such as vegetated rip-rap and willow staking, spiling and mattressing.

The combination of these improvements is expected to give the appearance of a natural channel in the reopened section of the river. Elements such as granite boulders and gabion mattress in the riverbed will contribute to this objective. No significant variations in velocity/depth along the open section are expected as presented in the hydraulic model carried out by BMCE (refer to Civil Engineering Infrastructure Report). It should be noted that the natural pathway of the river did not include any meanders in the specific development area (although, as presented in Section 2.0 above, a meander can be observed at the regional scale that will not be altered by the proposed development).

However, as the river will follow a course which is altered by man, a condition category of *Good* (<85% natural) is considered adequate and therefore a score of 3 is considered for this attribute.

### 8.2.2 Channel vegetation

The proposed daylighting of the Camac River will introduce gabion mattress and granite boulders in order to encourage the deposition of silt and create opportunity for spawning and protecting the projected bioengineered embankments.

The proposed tree planting is expected to give a woody habitat as it will include variations of tall, large canopy native trees (Alder, Birch, Aspen) and small shrubby native species (Willow, Hazel, Hawthorn). This tree planting will help to further stabilize the embankments and add higher layers of habitats in the Riparian Zone River Corridor for birds and insects and enhance the biodiversity.

The proposed weir will help to create different dynamics throughout the day-lit section of the river. It is not expected that the river channel will be choked with vegetation.

As it is possible that the proposed development will require some vegetation management during its early stages, a condition category of *Good* (<85% natural) is

considered adequate (instead of *High*) and therefore a score of 3 is considered for this attribute.

### 8.2.3 Substrate diversity and condition

The proposed daylighting of the Camac River will introduce gabion mattress, rip rap and granite boulders in order to encourages the deposition of silt and protection from mechanical erosion. Therefore, it is expected that a good diversity of substrate will be achieved after the daylighting will be operating. No deposits of oil are expected in the projected riverbed.

The expected hydraulic conditions presented in Section 7.0 above would guarantee the heterogeneity and cleanliness of the substrate as the median hydrologic condition would allow to transport and deposit of different size of sediments. The projected weir will ease the deposition of sediments.

As such, a condition category of *Good* (<85% natural) is considered adequate and therefore a score of 3 is considered for this attribute.

### 8.2.4 Barriers to continuity

The proposed daylighting of the Camac River will not include any barrier to the longitudinal flow of water. Sediment and flow will not be impeded. A minor artificial structure (the projected minor weir) may act as a small barrier. Excessive in-channel vegetation is not expected and therefore, no excess of dissolved oxygen level is anticipated. The projected weir and the heterogeneity of the substrate will facilitate to improve the water quality in the channel.

As such, a condition category of *Good* (>85-95% natural) is considered adequate and therefore a score of 3 is considered for this attribute. This score is considered adequate (instead of *High*), due to the proposed minor weir.

### 8.2.5 Bank structure and stability

The proposed daylighting of the Camac River includes riparian planting to stabilize the embankments with their root structure and to create a new riparian habitat, rip rap that will also stabilize embankments and protects them from mechanical erosion. Topsoil and clean subsoil will be placed in the riparian areas.

Although a complete re-naturalised section is proposed, it is considered that the soft/permeable proposed reinforcement reach at least 75% of the de-culverted section. As such, a condition category of *Moderate* (>65-85% natural) is considered adequate and therefore a score of 2 (1 for each bank) is considered for this attribute.

### 8.2.6 Bank and bank top vegetation

The proposed bank vegetation will contribute to river habitat and bank stability. A variety of vegetation and canopy layers is also proposed (small shrubby native species such as Willow, Hazel, Hawthorn and marginal shade tolerant plants such as Ivy, Iris, ferns, etc.).

It is considered that a score associated with a *Good* category is adequate as it is expected that disruption and vegetation management would be minimal, >85% of the banks will be covered by native vegetation with a range of canopy layers, there will not be one dominant type of vegetation. No alien species are expected to be present in the banks after the daylighting is finished. Therefore, a score of 3 (1.5 for each bank) is considered for this attribute.

### 8.2.7 Riparian land use

The proposed bank vegetation will contribute to river habitat and bank stability. A variety of vegetation and canopy layers is also proposed (large canopy native trees such as Alder, Birch, Aspen and small shrubby native species such as Willow, Hazel, Hawthorn).

A public elevated walkway through the riparian zone is proposed. It is considered that the vegetation cover within the riparian zone is >85% natural but some areas close to the bank top may be affected by human activities. As such, a condition category of *Moderate* (>65-85% natural) is considered adequate and therefore a score of 2 (1 for each bank) is considered for this attribute.

### 8.2.8 Floodplain interaction

As mentioned above, a hydraulic model was developed by BMCE to assess the flooding risk within the section of the proposed daylighting of the Camac River. Based on this, for the extreme 0.1% AEP storm event, the flood flows will rise to a level approximately 2.40m below the basement slab level and will be confined to the projected riparian zones.

No artificial barrier to over bank flooding is proposed. The proposed public elevated walkway will not interfere with the expected flooding zone. Water will not be artificially prevented from reaching the floodplain in the riparian zones. It is expected that the riparian zone form will result in a natural valley confinement.

As such, a condition category of *High* (>95-100% natural) is considered adequate and therefore a score of 4 is considered for this attribute (for each bank).

The obtained result for the WFD hydromorphological status is presented in Table 8.2 below.

***Table 8.2 WFD Classification for Proposed Daylighting of Camac River***

| Attribute | Score | HM Score | ∑ Scores | WFD Classification |
|---|---|---|---|---|
| 1. Channel morphology and flow types | 3 | 23 | 0.72 | Good |
| 2. Channel vegetation | 3 | | | |
| 3. Substrate diversity and condition | 3 | | | |
| 4. Barriers to continuity | 3 | | | |
| 5. Bank structure and stability | 2 | | | |
| 6. Bank and bank top vegetation | 3 | | | |
| 7. Riparian land use | 2 | | | |
| 8. Floodplain interaction | 4 | | | |

As can be seen above, as a result of the proposed new development the hydromorphological condition would be improved to '*Good*' at the site.

The proposed development has not considered to reach a '*High*' status primarily because the riverbed is projected over the existing culvert section (which means a less natural section in theory), and the riparian zones and riverbed will require management and maintenance at least during its early stages. However, retaining the existing culvert section as a base of the riverbed is considered adequate in order to give more stability to the projected gabion mattress.

The proposed development includes for daylighting approximately 76 no. metres of the River Camac. The intention is that this would create 1,261 $m^2$ of for the Riparian Zone. This area equates an average setback distance of c. 8.3 m from the proposed top of the bank of the open river on each bank. With regard to the minimum set-back distance from the top of the Camac River bank established by the DCC SI11 policy (25 m) it is not achievable due to the limited space of the proposed riparian zone

development. However, this will be addressed with a design that proposes a substantial improvement of the WFD hydromorphological status from '*Poor*' to '*Good*' due to the proposed daylighting of the Camac River.

The development of these riparian areas represents a lateral expansion of the river which will be connected to the flood plain area of the Camac River. It should be noted that the River Camac Flood Alleviation Scheme results are not available at the date of this report.

The proposed developments will not deteriorate the existing river profile, and no disruption in lateral connectivity is proposed. Therefore, the hydrological regime of the river will not be affected.

## 8.3 Development Principles within River Restoration Corridor

Table 8.3 below presents a summary of the development principles developed by DCC under the WFD and how these will be met in the proposed development.

***Table 8.3 Analysis of Development Principles within River Restoration Corridor***

| **Development Principles within River Restoration Corridor** | **Proposed Development** |
|---|---|
| Allow room for lateral expansion of river to connect river to its flood plan. | It is proposed to provide a new open channel section of the river that will represent a lateral expansion of the river which will be connected to the flood plain area of the Camac River, as can be seen in the hydraulic model carried out by BMCE. |
| Enable continuity along the riverbank – for ecology, movement and interconnectivity. | The proposed scheme will allow the morphological and hydraulic continuity of the Camac River for movement and connectivity, including flow and transport of sediments. No disruption in lateral connectivity is proposed. The development of the natural riparian zones will improve the existing ecological conditions (as it is now culverted) and will incorporate new habitats such as native riverbank and riparian planting, wildlife pond, etc.<br><br>The proposed developments will not deteriorate the existing river profile and will bring significant improvement to its hydromorphological status (from '*Poor*' to '*Good*' as estimated by the RHAT).<br><br>The flow for different hydrological conditions would allow transport and deposition of sediments. No significant erosion has been estimated even for the 0.1%AEP flow.<br><br>The hydrological regime of the river will not be affected. This continuity will ensure no deterioration of the ecological status downstream. |
| Enable creation of habitats such as wetlands, natural vegetation, and hedgerows/ trees. | The development proposes open natural riparian zones that will improve the existing ecological conditions of the Camac River. To establish softer, more natural riverbanks that will aim to improve the quality of the River Camac and enhance biodiversity at the river level, a combination of grey and green bioengineering solutions are proposed such as vegetated rip-rap and willow staking, spiling and mattressing. |
| Avoid land use and activities that would be vulnerable to flooding or would impinge on habitat quality. | Open spaces and amenities areas will not involve any activities that would pose a risk to the habitat quality downstream, given the residential nature of the development. |

## 9.0 CONCLUSIONS

As a result of the proposed new development the hydromorphological condition will be significantly improved from '*Poor*' to '*Good*' at the site, as established in the River Hydromorphology Assessment Technique (RHAT) guidelines. As such, it is concluded that the 25 metres set-back distance is not essential as the ecological functioning and water quality of the river are expected to be improved at a local scale due to the proposed daylighting of the Camac River.

The development of these riparian areas represents a lateral expansion of the river which will be connected to the flood plain area of the Camac River. It should be noted that the River Camac Flood Alleviation Scheme results are not available at the date of this report.

The proposed developments will not deteriorate the existing river profile, and no disruption in lateral connectivity is proposed. Therefore, the hydrological regime of the river will not be affected.

The development stormwater network will be designed for collection, treatment and attenuation of the stormwater prior to a controlled discharge to the Camac River in accordance with the requirements of the Greater Dublin Strategic Drainage Study (GDSDS). Any SuDS proposed to drain the open areas adjacent to the river should include natural interception of run-off such as bio-retention, trees, etc. to comply the restoration corridor principles.

## 10.0 REFERENCES

WFD (2006). WFD and Hydromorphological Pressures. Technical Report.

DCC Development Plan 2022-2028.

DCC (2013). Naas Road Local Area Plan (LAP) (expired since January 2023).

EPA-NIEA (2014) River Hydromorphology Assessment Technique (RHAT) Training Manual – Version 2.

Walshe et al (2018). Rehabilitation of the Camac River under the water framework directive: New opportunities to engage local communities and to manage flood risk.

The Rivers of Dublin. Clair Sweeney. 2017

Escarameia (1995). Channel Protection. Gabion Mattresses and Concrete Blocks. HR Wallingford.

Nichols (2009). Sedimentology and Stratigraphy. Second Edition. Wiley-Blackwell.

BM (2023). Civil Engineering Infrastructure and Surface Water Management Report. Development at Gowan House, Carriglea Business Park, Naas Road, Dublin 12.

BM (2023). Flood Risk Assessment Report. Development at Gowan House, Carriglea Business Park, Naas Road, Dublin 12.