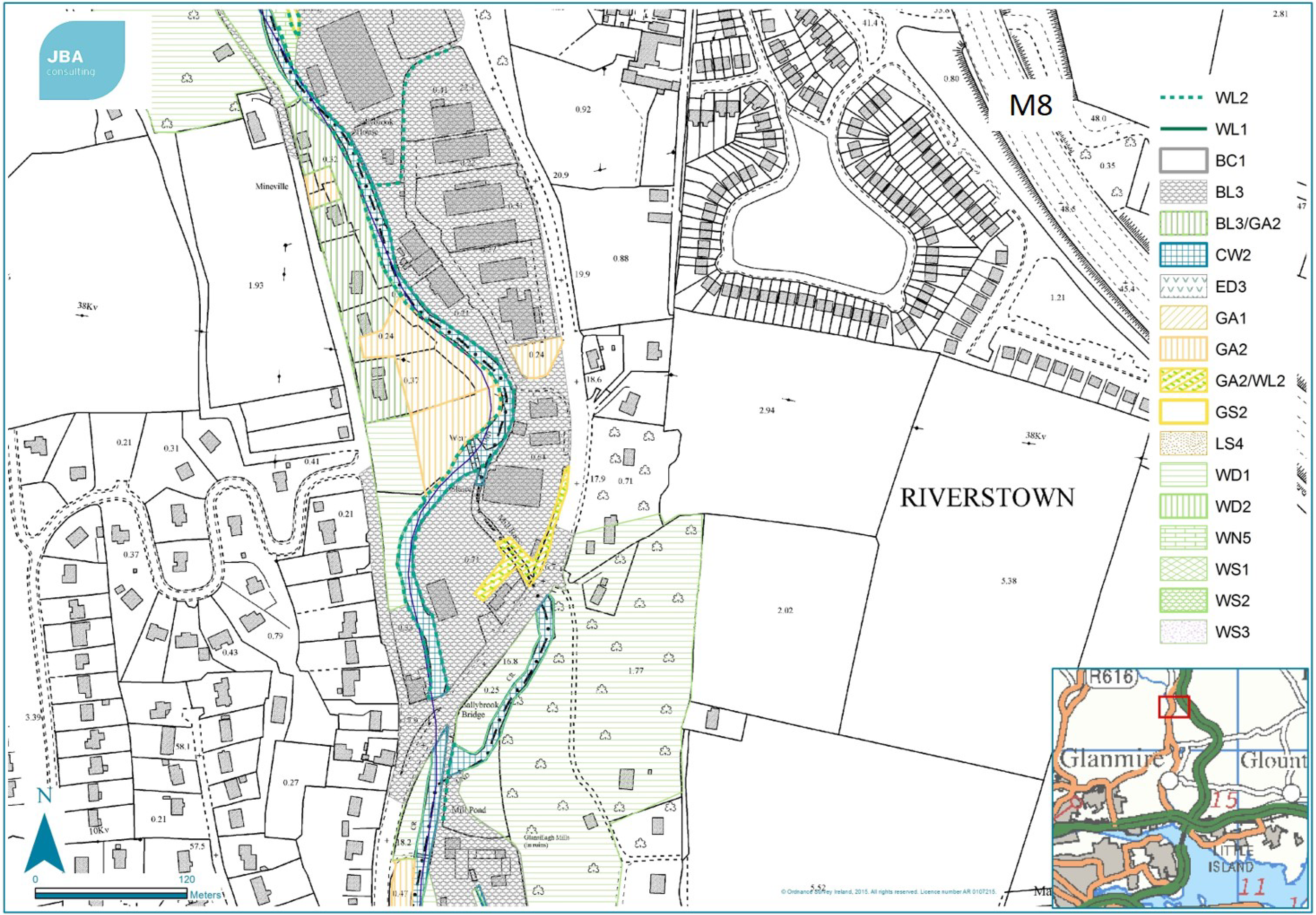
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Ballybrook
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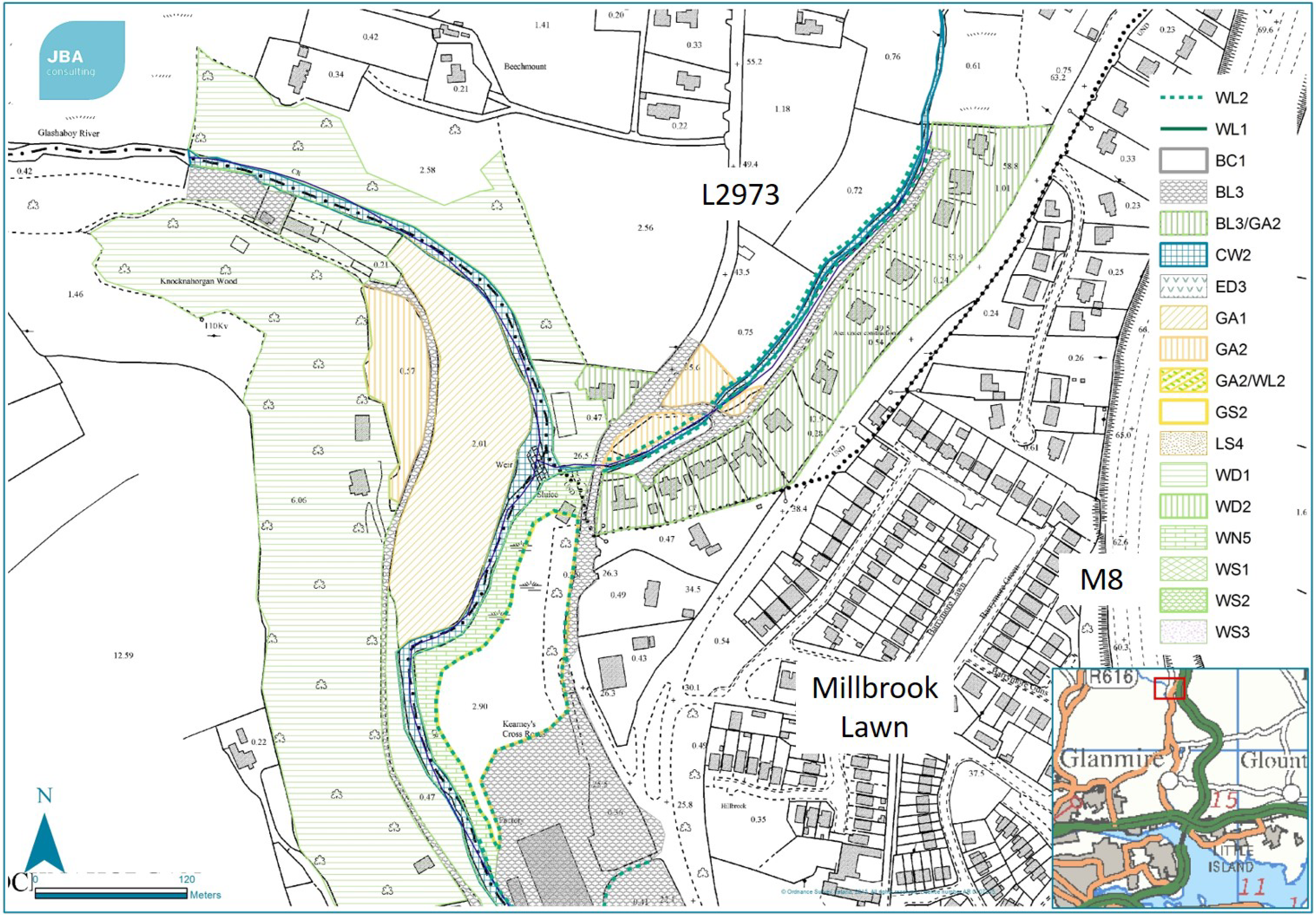
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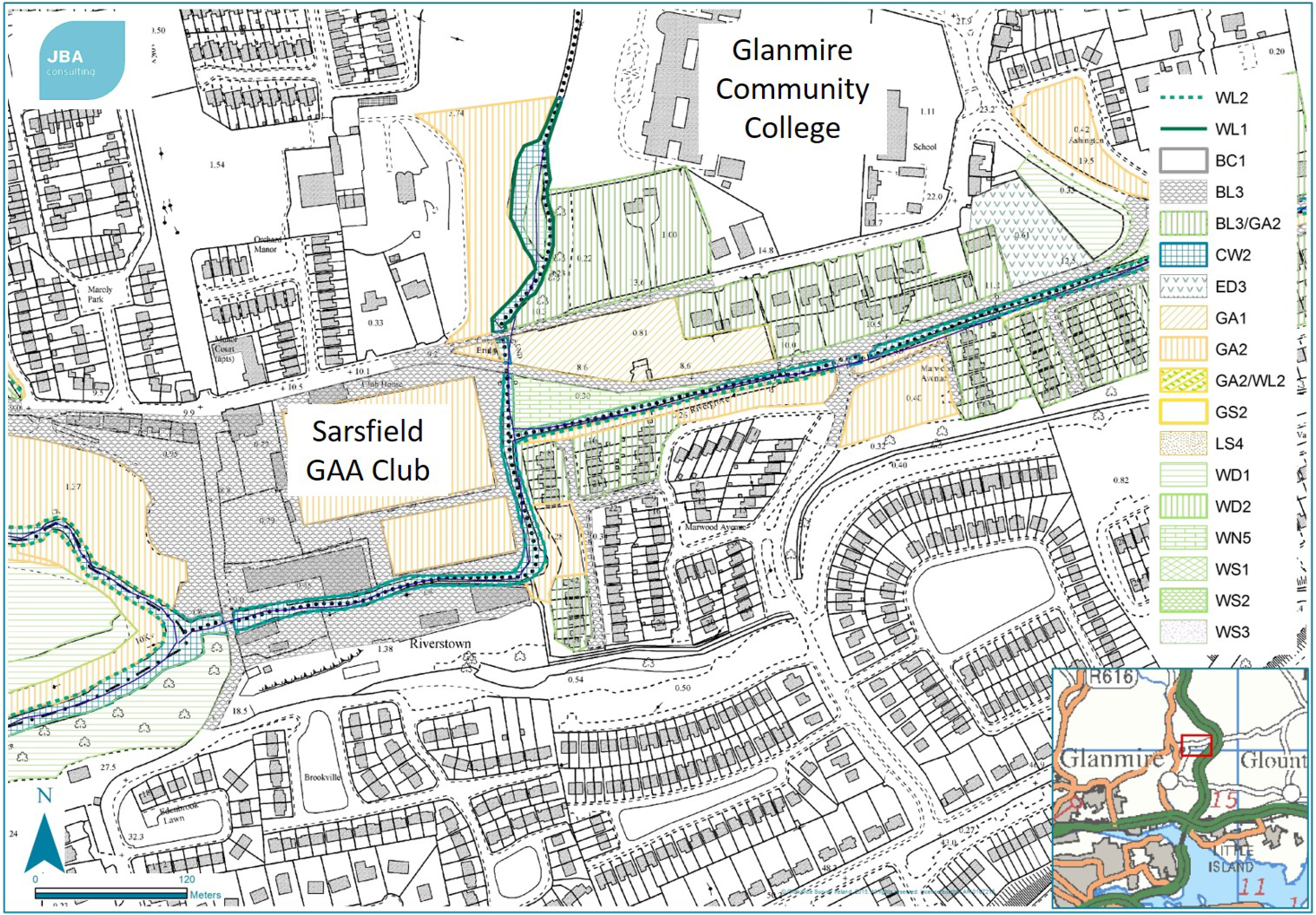
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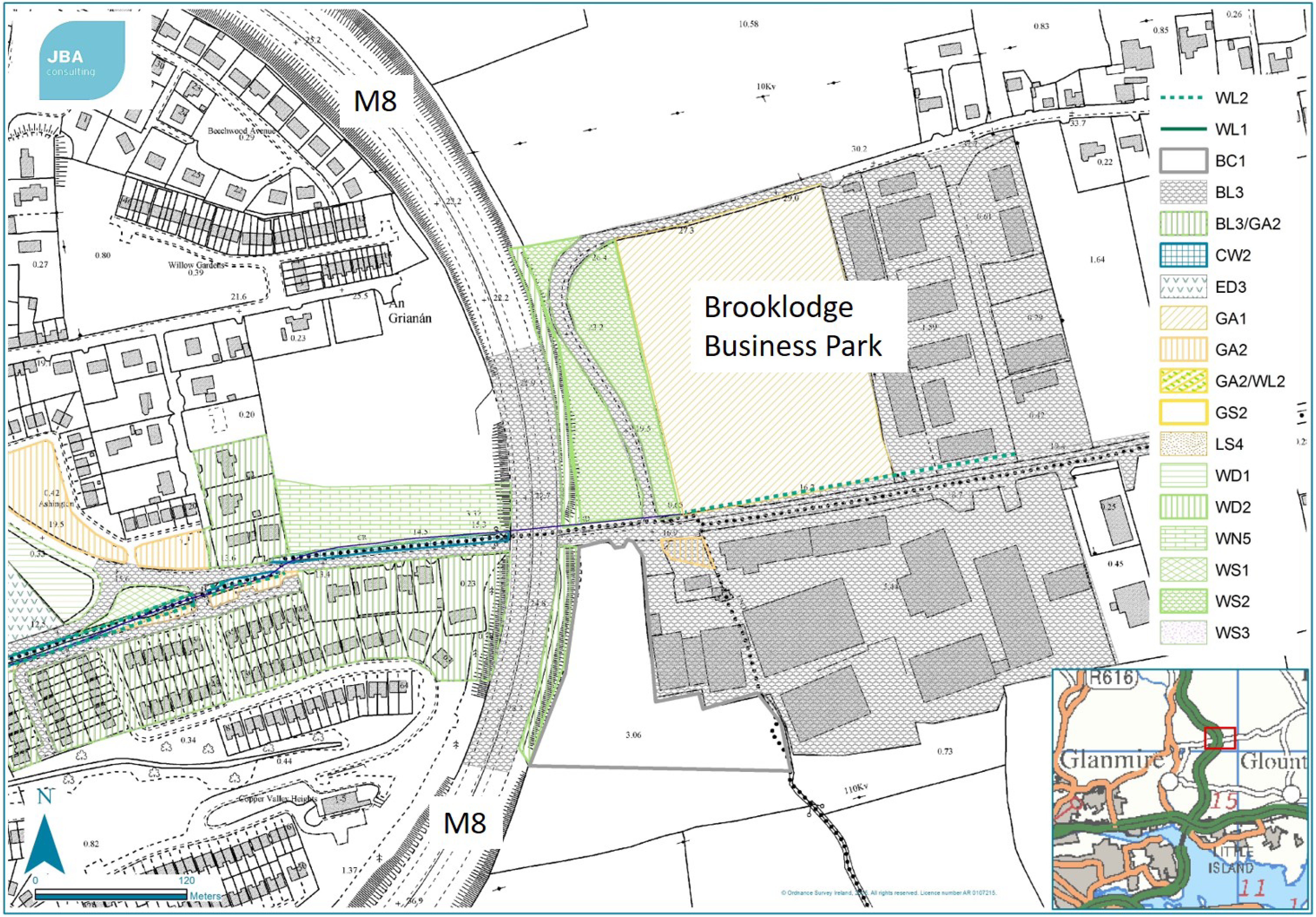

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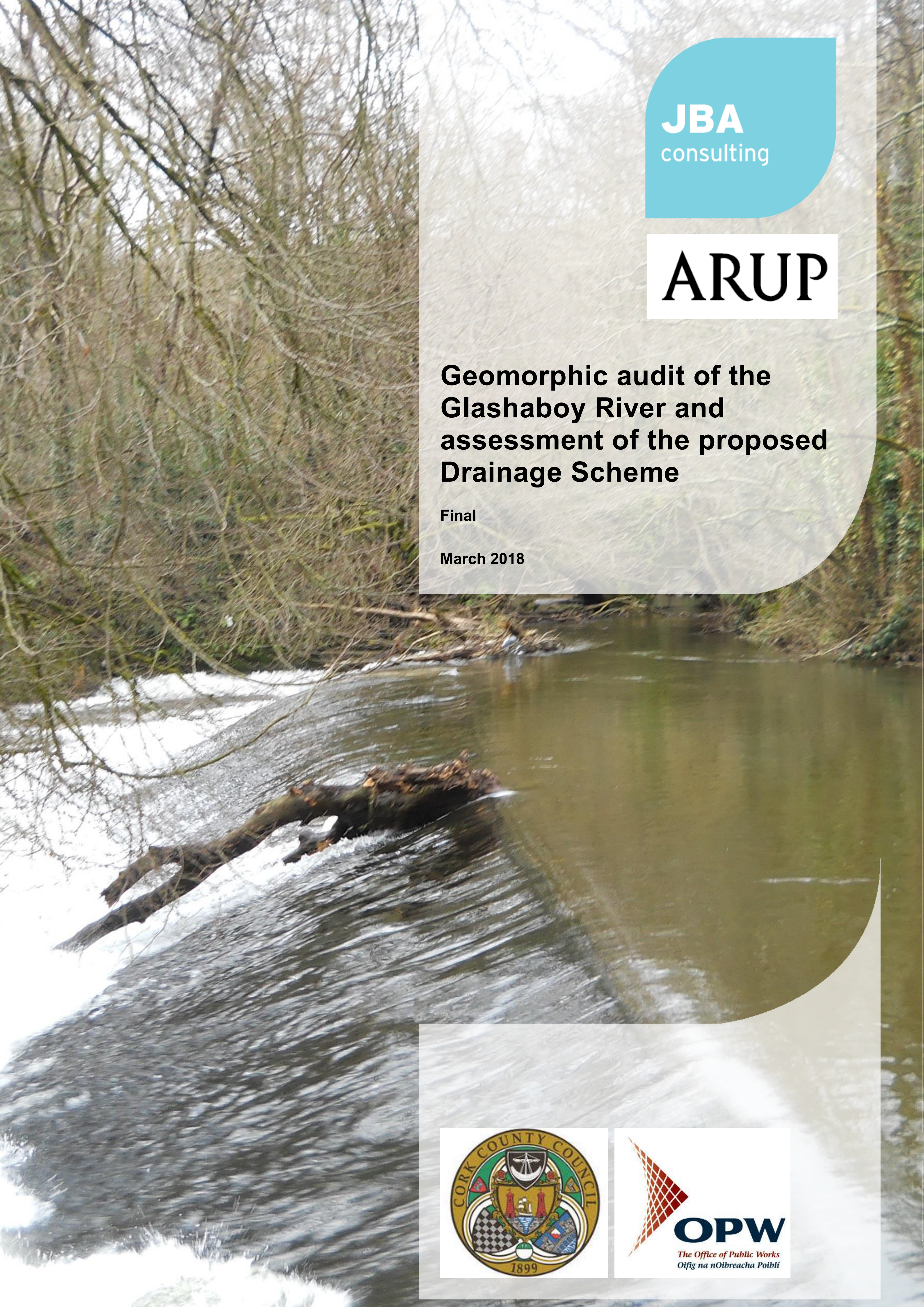
Appendix 6.2

Geomorphological Audit



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ARUP

Geomorphic audit of the Glashaboy River and assessment of the proposed Drainage Scheme

Final

March 2018

Cork County Council 1899

OPW The Office of Public Works Oifig na nOibreacha Poiblí

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Revision History

Revision Ref / Date Issued	Amendments	Issued to
Rev 1 - May 2014	Initial Issue	Steering Group
Rev 2 - August 2016	Addendum including extended FRS works in Appendix 1	Arup
Rev 5 - October 2016	Report update	Exhibition
Rev6 - November 2016	Update for reduced works at in tidal area	Exhibition
Rev7 - March 2016	Minor updates following scheme amendments	Arup for EIAR

Contract

This report describes work commissioned by Cork County Council, by a contract signed in December 2013 by Arup, with JBA Consulting operating as sub-contractors.

Matthew Hemsworth and Sebastian Bentley of JBA Consulting carried out this work.

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Purpose

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Executive Summary

The geomorphological audit has shown that the Glashaboy is presently not actively transporting much gravel sized material. The river in its upper reaches has good floodplain connectivity, but in its lower reaches, as the urban influences encroach into the channel and floodplain and confine the river corridor, instabilities in the channel occur and erosional processes increase.

Sediment deposition is generally at a low level. The main supply of sediment into the system is from bank erosion, steep tributaries and glacial sediment re-working (in the very upper reaches). Run off from agricultural areas also inputs fine sediment in to the system with limited buffer strips due to a poor quality riparian zone in many locations. Where sediment accumulation issues exist within the system these tend to be as a result of modifications to the channel which has acted to disrupt the natural river system processes. This includes impoundment disrupting the downstream transport of sediment, over widening which reduces channels velocity (increasing sedimentation), channel narrowing increasing velocities (decreasing sedimentation and increasing bank erosion) and poor placement of in channel features and structures.

Opportunities are noted where it is possible to improve floodplain connectivity in several areas upstream of urban locations. This could help reduce flow energy causing erosion in key areas such as adjacent to the shopping centre. However, the opportunities available as a result of the proposed measures is limited and therefore channel erosion mitigation measures will be necessary at vulnerable areas. The steepness of the banks adjacent to the shopping centre though and the limited easement between the top of bank and buildings means careful consideration should be given to bank stability, as the current ad-hoc method of bank protection could lead to long term issues.

Contents

List of Figures

1 Project background and objectives

1.1 Introduction

It is important to understand the geomorphic processes and subsequent response to any flood relief scheme arising to the direct impact that they can have on altering flood capacity and changing flood risk levels. It is also important in terms of maintaining or improving biotic and hydromorphological health through the creation and development of ecological habitats impacting on water body hydro-geomorphological status which is a fundamental component of the European Water Framework Directive (WFD).

The Glashaboy River FRS study aims to assess and develop a viable, cost-effective and sustainable flood alleviation scheme. This scheme must consider potential system dynamics and associated issues linked to changing patterns of erosion and deposition, ensuring that any depositional sites are minimised and that where sediment is predicted to accumulate that it does not compromise the flood capacity of the scheme. Geomorphological issues linked to erosion and deposition can be efficiently investigated through a desk and site based fluvial audit. The process based knowledge gained from the exercise will inform the development of a conceptual model of system dynamics predicting likely patterns of channel change.

1.2 Assessment Methodology

1.2.1 Overview

The existing geomorphological processes have been assessed through a high level hydromorphic audit involving a catchment baseline survey and local fluvial audit to determine the historic, current and likely future dynamics of the river, paying particular attention to the sediment transport regime (coarse and fine) and associated patterns of erosion and deposition. The audit has concentrated on the Glashaboy River but has also considered wider system response to disrupted / altered flow and transport processes.

The findings of the audit have been used to develop a conceptual model of the form and dynamics of the interacting watercourses allowing predictions of system response to be made regarding potential flood works throughout the catchment. This model will be key in ensuring a sustainable, Water Framework Directive (WFD) compliant solution to the flooding problems is found that minimises hydromorphic impact elsewhere.

1.2.2 Sub-catchment baseline survey

This is a process based audit of the Glashaboy River catchment and tributary channels, providing a clear and simple qualitative understanding of how the river system functions. The audit required a walkover survey associated with a review of online archival sources (aerial photographic evidence, historic flow data, archive planform change information from OS maps and previous studies of the regional geomorphology where available) together with any information provided by the client.

1.2.3 Fluvial audit

The fluvial audit includes a field based survey reviewing the present state of the watercourse morphology and active processes. It identifies key locations where erosion and deposition are impacting on the river and links this to the wider sediment delivery, transport and storage regime to assist in sustainable scheme design and minimise future maintenance requirements.

1.2.4 Development of regional channel change models

The baseline and audit information have been utilised to construct a larger scale cascading model of sediment flux through the catchment and drainage network based on local channel character with channel segments responding to adjacent and upstream sediment inputs. The model also predicts potential channel evolution to altered flow and catchment conditions in the catchment and locally, potentially allowing targeted action at sediment source areas which will reduce erosion and deposition problems through the scheme.

2 Existing Catchment Conditions

2.1 Overview

The Glashaboy River rises in the Nagles Mountains to the North of Cork and flows in a southerly direction entering the Upper Cork Harbour downstream of Glenmire. The upper reaches are predominantly rural, however, the catchment becomes more urbanised in its lower reaches.

The geology of the catchment is predominantly sandstone till overlain by a cover of acid brown earth soils offering free drainage. The lower reaches are underlain by limestone. Low hills dominate the catchment with steeper sloping valleys located to the north.

The Glashaboy catchment is drained by a number of watercourses, the main one being the River Glashaboy which drains land to the west of the catchment. The Butlerstown River and Glenmore River join the Glashaboy at Genmore and drain land to the east.

The lower reaches of the Glashaboy are tidally influenced (up to Glanmire). The fine sediment dynamics of the Cork estuary result in deposition of extensive mud flats through Lough Mahon. However, there is no significant deposition of tidally derived silts along the Glashaboy, suggesting that depositional processes are largely controlled by fluvial processes.

2.2 Water Framework Directive status

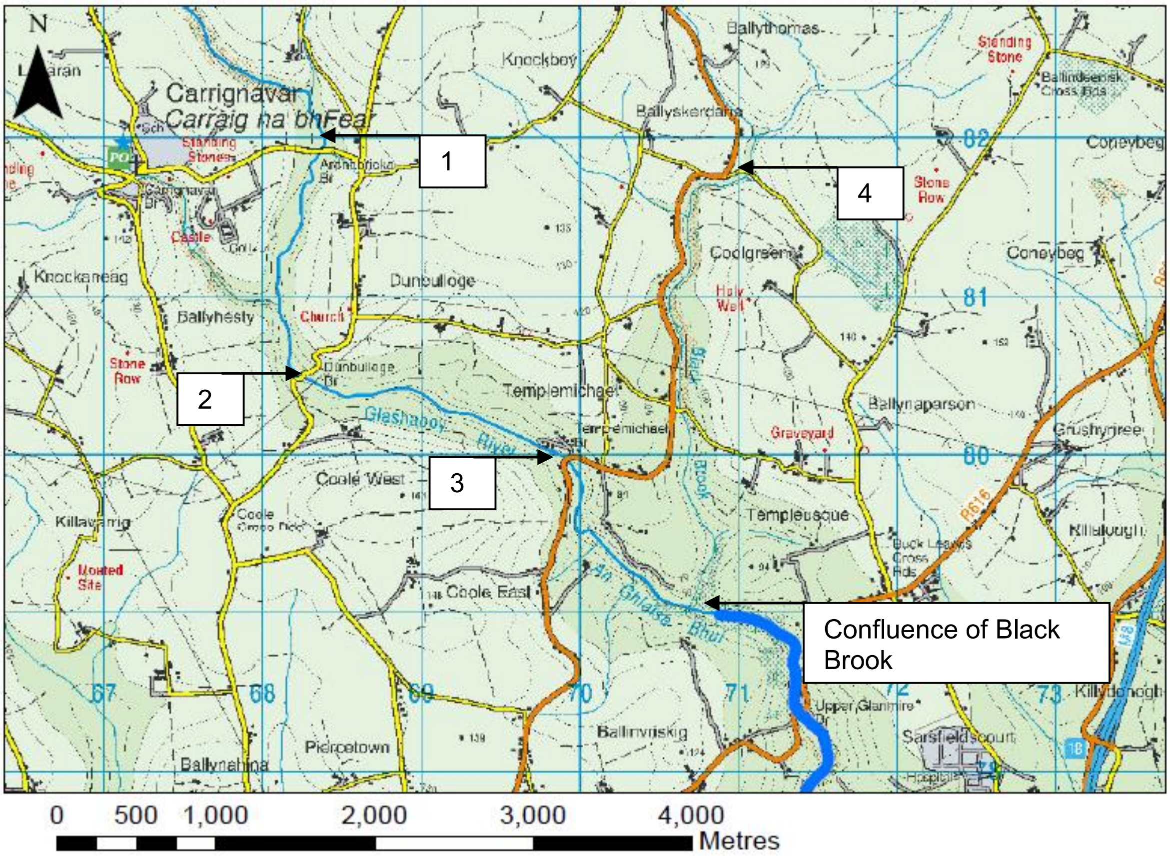
The Glashaboy River is currently classed as being at a Moderate status, whilst its tributaries the Glenmore River and Butlerstown River are classed as being at Good status (with the upper reaches of the Butlerstown river classed as moderate status). All reaches need to achieve 'Good Ecological Status' by 2027.

3 Fluvial Audit

This section of the report summarises the qualitative findings of the geomorphological / fluvial audit conducted on the Glashaboy River and the lower sections of the Butlerstown River and Glenmore River during April 2014 and August 2016, following the large flood events of 2015. Tidal reaches were visited at low tide to maximise the opportunity to view the bed conditions within the watercourse / estuary.

3.1 Carringnavar to Upper Glanmire Bridge

Figure 3-1 Survey Reach Overview



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The upper sections of the Glashaboy between Carringnavar to Upper Glanmire Bridge (1 to 2 on Figure 3-1) are predominantly rural. The floodplain in most locations is narrow and dominated by farmland and woodland. The channel exhibits a pool-riffle morphology which is dominated by a cobble and gravel bed, with little evidence of significant transport of cobble and gravel sized material given the amount of bed algae present across this sediment (Figure 3-2). Limited large accumulations of gravel as bar features were noted even in areas where the gradient was reduced. This suggests a limited upstream supply of gravels and/or the ability of the channel to flush sediment downstream during higher flow events.

Stable vegetated bars were common throughout the reach (Figure 3-5) along with small pockets of fine sediment deposition along the lateral edges of the channel, mainly from localised bank erosion. Small areas of deposition like this are often an indication of the channel naturally attempting to narrow as a result of historic intervention, such as over widening. Several low weirs exist (see example in Figure 3-2), which cause limited upstream impoundment, but act to cause increased fine sediment deposition within their impoundment zones. Limited evidence was noted of weirs restricting movement of gravels.

Evidence within the reach of historic channel management exists, including old dredging embankments (Figure 3-3) and channel straightening. Channel straightening and dredging has led to some disconnection of the channel from its floodplain in certain areas (although this is not excessive in the upper reaches). Modifications to the channel such as dredging and straightening concentrates in-channel energy, due to reduced stream length. This may also explain the lack of gravel deposition seen in some areas.

Opportunities exist to improve connection through embankment removal and re-grading (Figure 3-5). This should act to improve floodplain storage in these upper reaches and act to reduce downstream flood risk.

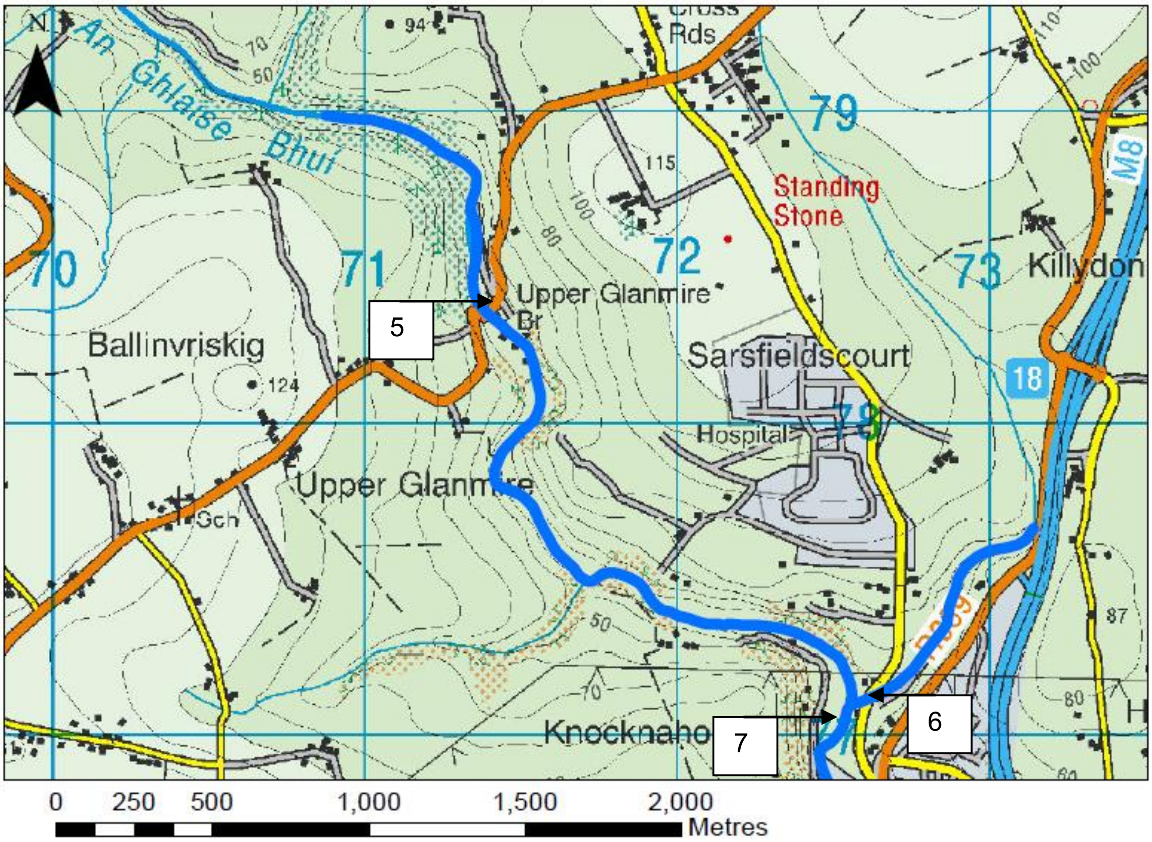
Figure 3-2 Ardnabricka Bridge (Point 1)

Figure 3-3 Dunbulloge Bridge (Point 2)

Figure 3-4 Templemichael Bridge (Point 3)

Figure 3-5 Upstream of Ballyskerdane Bridge (Point 4)

3.2 Upper Glanmire Bridge to Knocknahorgan



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In the reach between Upper Glanmire Bridge and Knocknahorgan the river valley narrows which results in a confined floodplain. At Upper Glanmire Bridge a weir is leading to local bank erosion (Figure 3-6), due to the direction of flows passing under the bridge. Banks have been reinforced using gabion baskets, however, in the long term the river may undercut these baskets.

Downstream of Upper Glanmire Bridge, flow energy in the channel reduces and areas of gravel and small cobble deposition occur (sizes of gravels range from 4cm to 40cm). Gravel splays occur at tributary confluence points (Figure 3-6) along this section, suggesting an active supply of gravels is present from the steep tributaries joining the river (Figure 3-7).

Figure 3-6 Upper Glanmire Bridge (Point 5)

Like the upper sections above Glanmire, bankside vegetation remains dense in many places which acts to improve bank stability through cohesive root networks. In areas where vegetation was less dense small pockets of erosion were noted, but this was certainly not widespread.

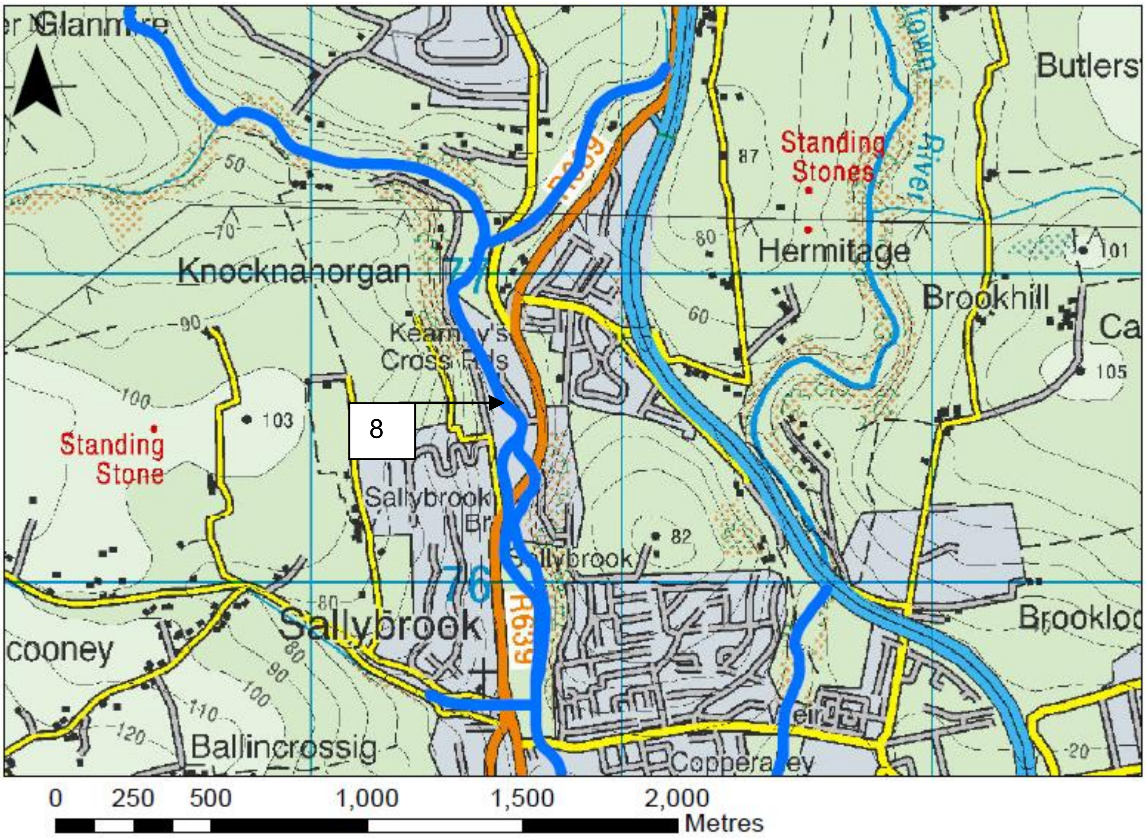
Figure 3-7 Knocknahorgan tributary (Point 6)

Figure 3-8 Knocknahorgan (Point 7)

The channel bed throughout this reach is again dominated by gravels and cobbles, in a plane bed and pool riffle morphology. Less algae was seen on the more gravelly sections on the bed which suggests a more active supply and movement of gravels through this reach (Figure 3-8).

3.3 Knocknahorgan to Sallybrook

Figure 3-9 Reach overview



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As the river approaches Sallybrook the channel and its floodplain become subject to greater urban influences including embankments, weirs and limited floodplain connectivity due to the presence of flood embankments.

Figure 3-10 Channel upstream of Sallybrook (Point 8)

As the channel approaches Sallybrook the valley widens and becomes less confined. The wider floodplain along this reach has been developed / built upon which acts to constrict the channel. In some areas informal flood embankments have been constructed. In other areas active bank erosion is occurring as the channel attempts to naturally adjust within is confined channel. This is exacerbated by the higher energies during flood conditions as a result of the channel constriction. Hard measures, such as walls have been constructed to reduce the erosional impact of the river (particularly on the outside of bends) and some of these are now failing (such as adjacent to the petrol station). The erosion of banks acts as a strong sediment supply of gravels and fine materials. Deposition is also common through this reach, with several gravel bars (which are unvegetated, signalling frequent movement) being present. However, in the lower portions of the reach the channel becomes incised as a result of the influence of old mill leats and weirs (some existing and some now removed). As a result of these structures the channel is disconnected by over 1m from the floodplain (due to the channel eroding downwards in an attempt to adjust its bed gradient) and deposition is minimal, due to floodplain disconnection and high in channel energy levels. The channel in this lower section is dominated by coarser cobbles.