Comhairle Contae
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South Dublin County Council

Clonburris

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Clonburris Strategic Development Zone (SDZ) Draft Planning Scheme

SURFACE WATER STRATEGY

September 2017

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Abbreviations

AEP	Annual Exceedance Probability
CAD	Computer Aided Design
CFRAM	Catchment Flood Risk Assessment and Management
DTM	Digital Terrain Model
FEH	Flood Estimation Handbook
FSU	Flood Studies Update
GDSDS	Greater Dublin Strategic Drainage Strategy
GIS	Geographical Information System
GSI	Geological Survey of Ireland
Ha	hectares
IW	Irish Water
JBA	JBA Consulting
LiDAR	Light Detection And Ranging
l/s	litres per second (flow rate or capacity)
m^3	cubic metres (volume)
m/s	meters per second (flow velocity)
m^3/s	cubic meters per second (flow rate or capacity)
mOD	Meters above Ordnance Datum
OPW	Office of Public Works
SAAR	Standard Annual Average Rainfall (mm)
SDCC	South Dublin County Council
SWMP	Stormwater (or surface water) Management Plan

TUFLOW .... Two-dimensional Unsteady FLOW (a hydraulic model)

WRAP .... Winter Rainfall Acceptance Potential

2D................................ Two Dimensional (modelling)

Definitions

Outfall .... The point where a water course or drain discharges.

1 Introduction

1.1 Terms of Reference

JBA have been engaged as consultants to provide a Surface Water Strategy for the Clonburris SDZ. This report was prepared to inform the proposed development strategy for the lands.

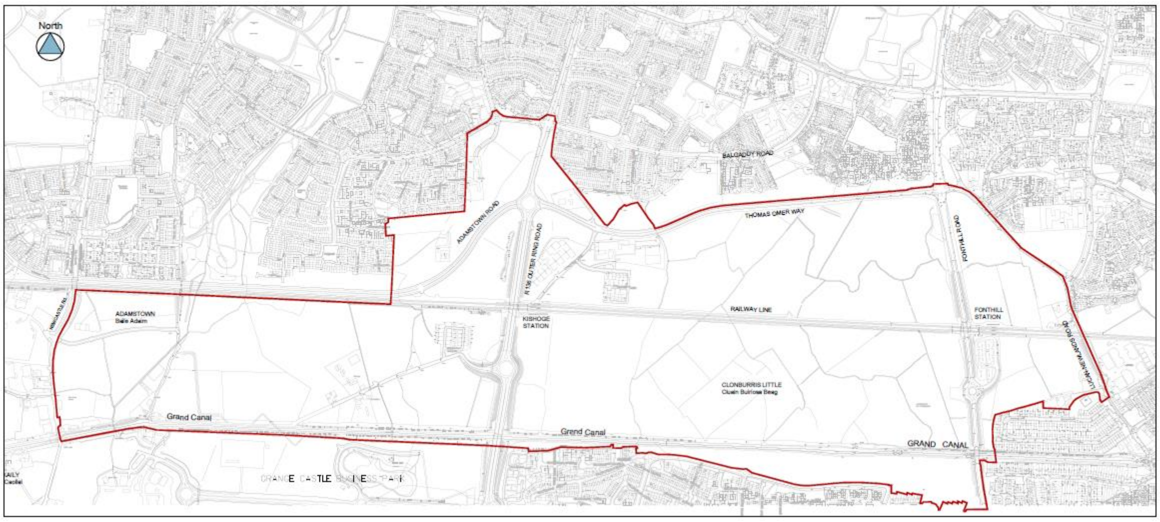
1.2 Background

On 15th December 2015, the Government approved the designation of the lands at Clonburris, as a site for the establishment of a Strategic Development Zone (SDZ). Order 2015 (S.I. No. 604 of 2015) established and extended the designated area for the Clonburris SDZ. A revised Planning Scheme must be made for the designated area not later than two years after the making of the Order. Under the Designation of Strategic Development Zone: Balgaddy – Clonburris, South Dublin County Order 2015, the lands which are deemed to be of economic and social importance to the state, are:

“designated as a site for the establishment of a strategic development zone in accordance with the provisions of Part IX of the Act for residential development and the provision of schools and other educational facilities, commercial activities, including employment office, hotel, leisure and retail facilities, rail infrastructure, emergency services and the provision of community facilities as referred to in Part III of the First Schedule to the Act, including health and childcare services.”

The Clonburris SDZ Draft Planning Scheme, refer Figure 1-1, is to be a comprehensive and multi-faceted spatial planning document which will be led by South Dublin County Council, as the Development Agency. The Planning Scheme will be prepared in collaboration with a range of stakeholders including: SDZ landowners, the public, government agencies and statutory bodies, staff and elected councillors of South Dublin County Council. The making of a Planning Scheme for these lands will revoke the existing Strategic Development Zone Planning Scheme and a Local Area Plan for adjoining lands, both of which were adopted in 2008. The Local Area Plan expired in 2014. The existing SDZ Planning Scheme will remain in place until superseded by the new Planning Scheme for the area.

Figure 1-1:- Clonburris SDZ Boundary



1.3 Aims and Objectives

The Clonburris SDZ requires a strategy to manage surface water in a sustainable way by:

- Minimising the residual risk of flooding to each site;
- Ensuring there is no increased flood risk up or downstream from each development; and
- Maintain the existing greenfield runoff rates or potentially reduce the amount of surface water entering the piped sewer system.

The strategy also requires adequate levels of treatment of the surface water prior to discharge, which will be into local watercourses, namely the Griffeen and Camac watercourses.

1.4 Report Structure

This report presents the surface water strategy for Clonburris SDZ.

Section 2 outlines existing infrastructure within and adjacent the subject site together with associated constraints to be considered.

Section 3 assesses the existing infrastructure together with preliminary hydraulic modelling of existing storm sewers external to the site.

Section 4 outlines the surface water management strategy to be adopted for the site inclusive of acceptable discharge rates and SuDS measures.

Section 5 outlines the surface water infrastructure requirements for each sub-catchment within the SDZ.

Section 6 outlines the design criteria and required storage provision for attenuation purposes.

1.5 Drawings

This report should be read in conjunction with the following drawings

Drawing No.	Title	Rev
2016s5230-001	Site Location Map	PL0
2016s5230-002	Stormwater Sub-catchments	PL0
2016s5230-003	Stormwater Management Strategy	PL0
2016s5230-004	Sub-catchment 1 Northwest Sector	PL0
2016s5230-005	Sub-catchment 2a North Sector	PL0
2016s5230-006	Sub-catchment 2b North Sector	PL0
2016s5230-007	Sub-catchment 3 North A and B Sector	PL0
2016s5230-008	Sub-catchment 4a Northeast Sector	PL0
2016s5230-009	Sub-catchment 4b South B Sector	PL0
2016s5230-010	Sub-catchment 4c Southeast Sector	PL0
2016s5230-011	Sub-catchment 5 Southwest Sector	PL0

2016s5230-012	Sub-catchment 6 Adamstown Extension	PL0
2016s5230-013	Sub-catchment 7 Canal Extension	PL0
2016s5230-014	Existing Stormwater Infrastructure	PL0
2016s5230-015	Proposed Drainage Catchments	PL0
2016s5230-016	Existing Drainage Catchment	PL0
2016s5230-017	Level Strategy (to facilitate the SWMP)	PL0

1.6 Technical Concepts

1.6.1 Presentation of Return Periods

The probability of a flood event is classified by its annual exceedance probability (AEP) or return period (in years). A 1% AEP flood will occur on average once every 100 years and has a 1 in 100 chance (or 1%) of occurring in any given year.

AEP can be a helpful concept as return period is often misunderstood to be the period between large flood events rather than an average recurrence interval. Annual exceedance probability is the inverse of return period as shown in Table 1-1.

Table 1-1: Return Periods & Annual Exceedance Probabilities

Return Period (Years)	Annual Exceedance Probability (%)
2	50
10	10
30	3.3
50	2
100	1
200	0.5

1.6.2 Climate Change

The Planning Guidelines (published in 2009) recommend that a precautionary approach to climate change is adopted due to the level of uncertainty involved in the potential effects. A significant amount of research into climate change has been undertaken on both a national and international front.

Specific advice on the expected impacts of climate change and the allowances to be provided for future flood risk management in Ireland is given in the OPW guidance . Two climate change scenarios are considered. These are the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS). The MRFS is intended to represent a "likely" future scenario based on the wide range of future predictions available. The HEFS represents a more "extreme" future scenario at the upper boundaries of future projections. Based on these two scenarios the OPW recommended allowances for climate change are given in Table 1 2 below.

Table 1-2: Climate Change Factors to be Applied to Drainage Design

	MRFS	HEFS
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%
Mean Sea Level Rise	+500mm	+1000mm
Land Movement	-0.5mm / year*	-0.5mm / year*
Urbanisation	No General Allowance - Review on Case by Case Basis	No General Allowance - Review on Case by Case Basis
Forestation	-1/6 Tp**	-1/3 Tp** +10% SPR***

Notes:
*   Applicable to the southern part of the country only (Dublin - Galway and south of this)
**   Reduce the time to peak (Tp) by a third; this allows for potential accelerated runoff that may arise as a result of drainage of afforested land
*** Add 10% to the Standard Percentage Runoff (SPR) rate; this allows for increased runoff rates that may arise following felling of forestry

2 Existing Infrastructure and Constraints

The subject site, circa 280 hectares, is a strategic parcel of land within the Balgaddy-Clonburris area that is for the most part, undeveloped with exception 2 schools, Fonthill train station, Kishoge train station and some housing.

There are some challenges as regards the development of the lands which are outlined as follows.

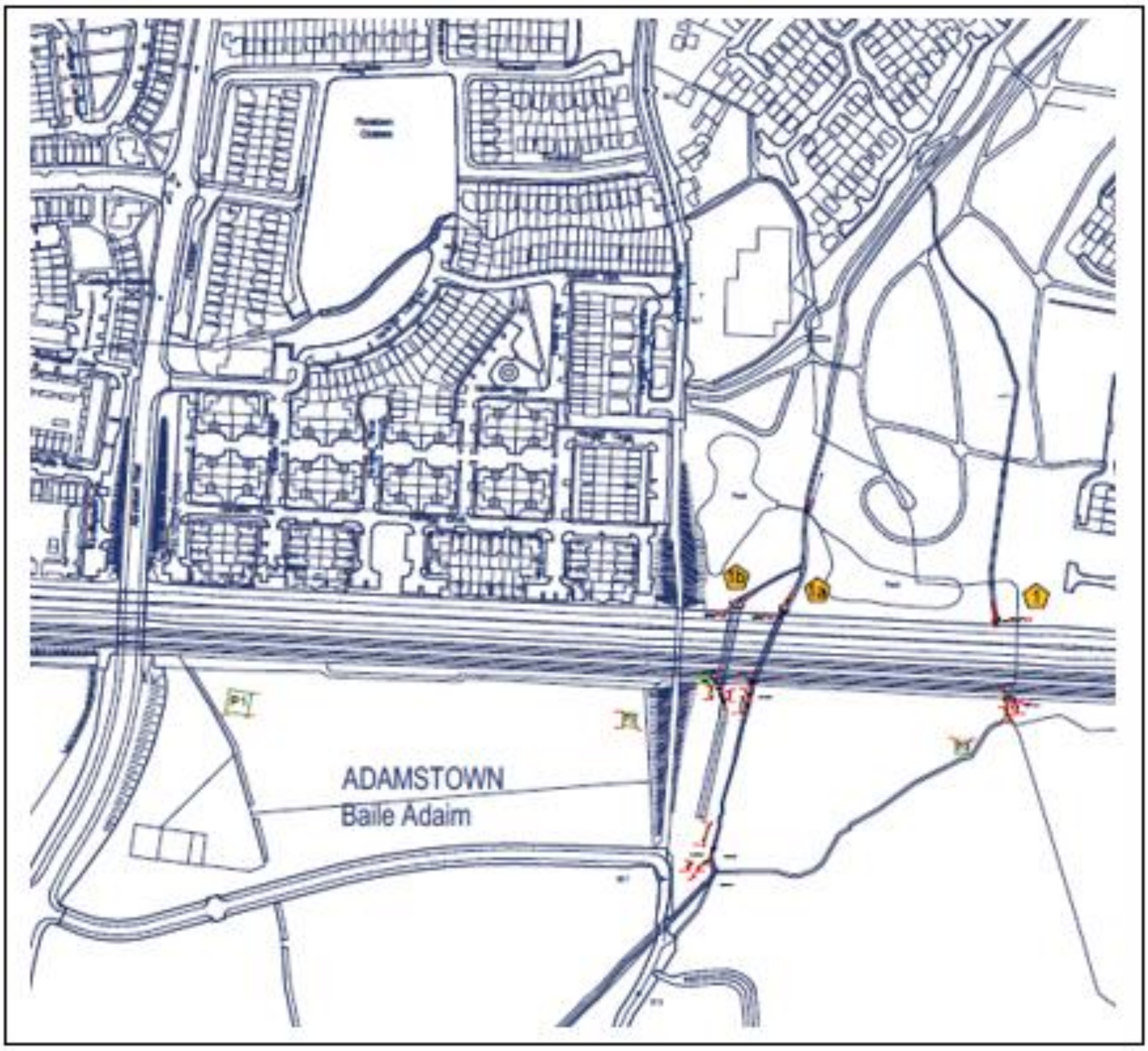
2.1 Existing Outfalls

There are multiple storm outfalls from the subject SDZ site which can be utilised for the purposes of conveying attenuated surface water flows to the receiving watercourses. These are outlined hereunder:

2.1.1 Griffeen River

There are 3no outfalls (reference 1, 1a and 1b in Figure 2-1) located to the underside of the existing railway tracks towards the western part of the site and south-east of Adamstown.

Figure 2-1: Griffeen River Outfalls



The lowest invert level is that of outfall 1 which has an invert level of 54.18m OD and will restrict the extent of the site which can be serviced by gravity. It is envisaged that outfalls 1a and/or 1b will be utilised for the Adamstown extension whereas outfall 1 will be utilised for the greater catchment area of the site which can be serviced by gravity.

2.1.2 **Thomas Omer Way**

There are 4 no outfalls (2, 3, 4 and 5) to the underside of the Thomas Omer Way and as outlined in Figure 2-2.

Outfalls 2, 3 and 4 are understood to connect into the primary surface water network on Balgaddy Road which in turn discharges into the Griffeen River via a 1500mm diameter culvert, refer Figure 2-3. Outfall 4 is understood to connect into the primary surface water network within Foxdene which in turns discharges into an existing open drain within Clondalkin Industrial Estate, refer Figure 2-3, which is a tributary of the Camac River.

The site survey information indicates that the outfalls are all 1050mm diameter, however, they will be of limited use as their invert levels are not of a sufficient depth to accommodate a gravity connection from the site as a whole. To maximise their use, they would need to be relayed at a lower depth. This is possible based on the invert levels of the primary surface water network on Balgaddy Road, however, this would require a crossing of the Thomas Omer Way.

Outfall 2 has the lowest invert level but is located within the confines of Kishoge Community School and maybe in private ownership.

Figure 2-2: Thomas Omer Way

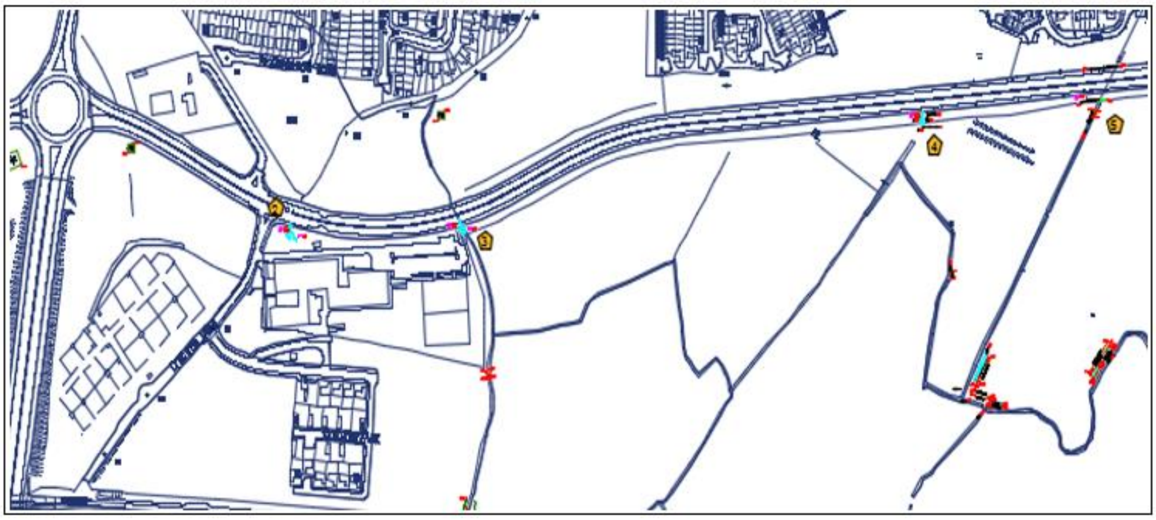
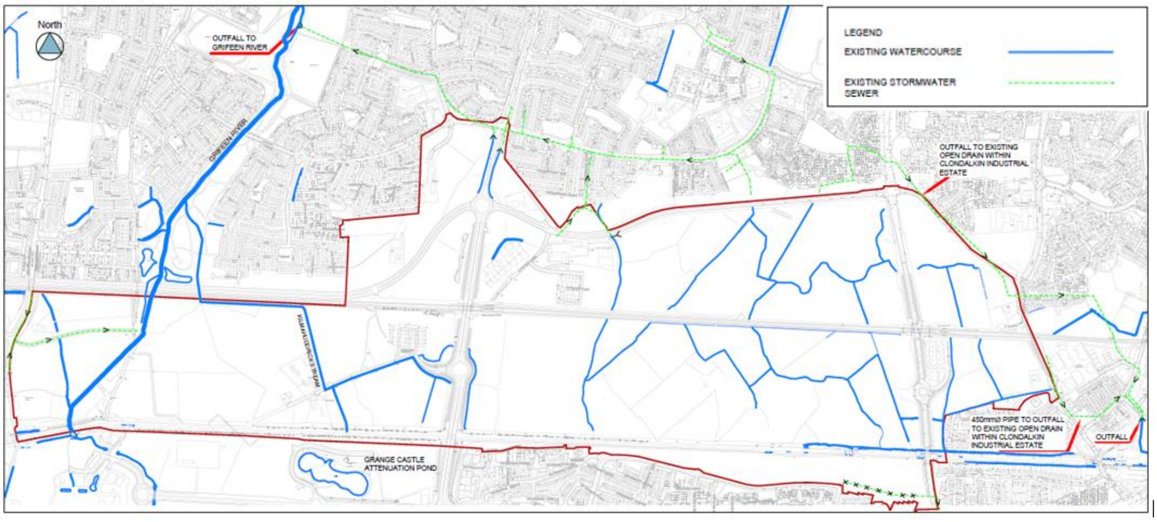


Figure 2-3: Existing Stormwater Infrastructure



2.1.3 **Lucan - Newlands Road**

There is an existing outfall towards the south-eastern corner of the subject site, immediately north of the Cappaghmore housing estate and as indicated in Figure 2-3. This outfall connects into an existing 450mm diameter storm sewer on the Lucan - Newlands Road which in turn discharges into an existing open drain within Clondalkin Industrial Estate which is a tributary of the Camac River. The alignment of the existing open drain upstream of this outfall will need to be incorporated into detailed design proposals.

2.1.4 **Canal Overflow**

Part of the subject site gravitates to the Grand Canal overflow east and west of Fonthill Road. West of Fonthill Road, the crest into the overflow ditch is higher than the surrounding land levels, resulting in some localised ponding on the site. This overflow ditch is effectively a bypass to the lock gate and returns into the canal in the next canal pond. Any flow entering these drains will pass onwards down the canal network and directly into the River Liffey. Discussions with Waterways Ireland have indicated that a drainage connection, attenuated or otherwise, from the developed site cannot be accommodated and will need to be directed towards the Camac directly.

2.1.5 **Outer Ring Road Drainage Outfalls**

There are 2 outfalls to the primary surface water network on Griffeen Avenue / Balgaddy Road which are understood to drain part of the Outer Ring Road (R136), refer Figure 2.4. It is not envisaged that these will be utilised for the purposes of any discharge from the subject SDZ lands and will be either maintained or incorporated into the future drainage of the site.

Other parts of the Outer Ring Road drain towards the Kilmahuddrick Stream where attenuation of flows is provided.

Figure 2-4: Existing Outfalls either side of the Outer Ring Road

2.2 Existing Stormwater Networks

As outlined in 2.1.2 and 2.1.3, a substantial part of the subject site is drained by a series of outfalls that are connected to primary surface water culverts external to the site, refer sections 2.1.2 and 2.1.3 in addition to Figure 2-5.

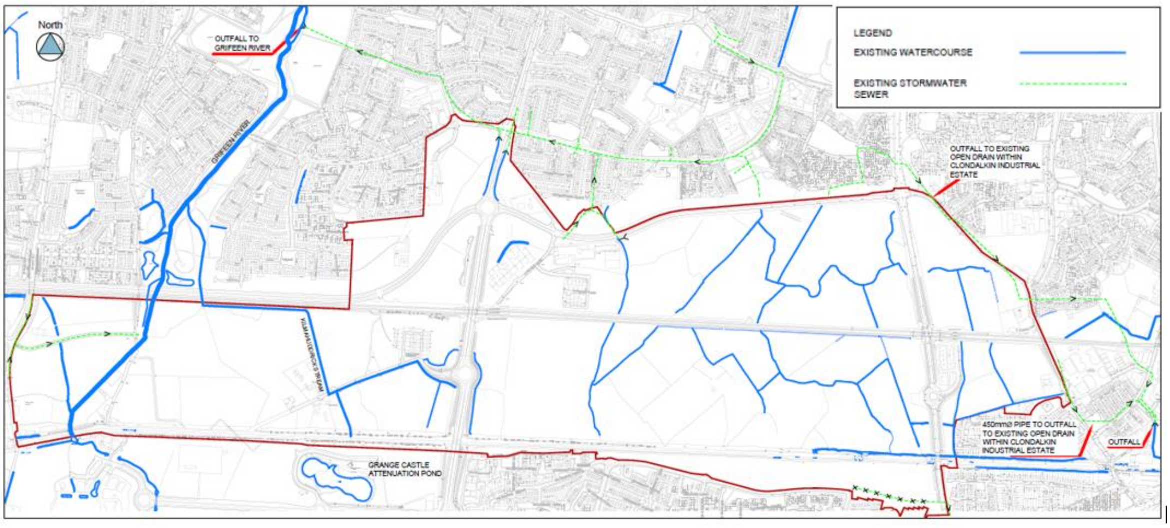
2.2.1 Primary Stormwater Network on Balgaddy Road

Preliminary hydraulic modelling of the existing culvert on Balgaddy Road has indicated that it is at risk of flooding in the 1 in 100-year storm event, refer Section 3.2, and cannot accommodate a continuous discharge from the site under these conditions.

2.2.2 Primary Stormwater Network on Lucan - Newlands Road

Preliminary hydraulic modelling of the 450mm diameter culvert to the existing open drain has been undertaken, the results of which indicate that it has sufficient capacity to receive attenuated flows from part of the subject site, refer Section 3.2. It is anticipated that detailed modelling will be completed at detailed design stage when the final drainage arrangements for the site are known.

Figure 2-5: Existing Stormwater Culvert Systems



2.3 Topography

The subject lands are generally flat throughout and substantially below the level of the primary road network bounding the site. It is envisaged that some level of filling will be required to accommodate access to/from the site irrespective of any drainage requirements.

2.3.1 East of Fonthill Road

The lands east of the Fonthill Road have a topographical fall (typically 1 in 160) in a southern direction towards Cappaghmore Estate. The levels range from c. 61m in the north to c. 56m in the south-east corner adjacent the Lucan-Newlands Road. It is not possible to drain this part of the site to the Griffeen River without substantial filling and/or pumping.

The lands are substantially below the level of the Fonthill Road and local filling may be required to tie into existing road infrastructure.

2.3.2 North of the Railway Line

The lands north of the railway line are generally flat. Levels vary from c. 60m adjacent Fonthill Road to c. 55.5m at Griffeen Avenue. Part of the site in the north-west area (north of the railway and west of the Outer Ring Road) has a natural fall towards Tullyhall and Oldbridge residential estates.

There is little by way of a longitudinal fall in the existing open drains within the site.

2.3.3 South of the Railway Line

The lands between the Fonthill Road and the Outer Ring Road have a fall in both a western and eastern direction. The lands fall from an elevation of c.61m to c.59m in the south west corner and c. 57.5 in the south-east corner of the site.

The lands are substantially below the level of both the Fonthill and Outer Ring Roads and local filling may be required to tie into existing road infrastructure.

2.4 Railway Line

The railway line traverses the site in an east-west direction and forms a natural constraint to any proposed drainage linking development both north and south of the line. Although there are a number of existing culverts along its length, they are unlikely to be at an invert level that will be suitable for overall development and it is envisaged that discussions will be required with Irish Rail at detailed design stage should new culverting be required.

2.5 Kilmahuddrick Stream

The Kilmahuddrick Stream, refer Figure 2-6, runs in a north-west direction through the western part of the subject site (west of the Outer Ring Road) and is culverted underneath the railway line via outfall no 1, refer Figure 2-1, and discharges into the Griffeen River. Downstream of Lynch's Lane, the Kilmahuddrick Stream will be regraded for the reasons outlined hereunder:

2.5.1 Level Difference with Culvert to Underside of Railway Line

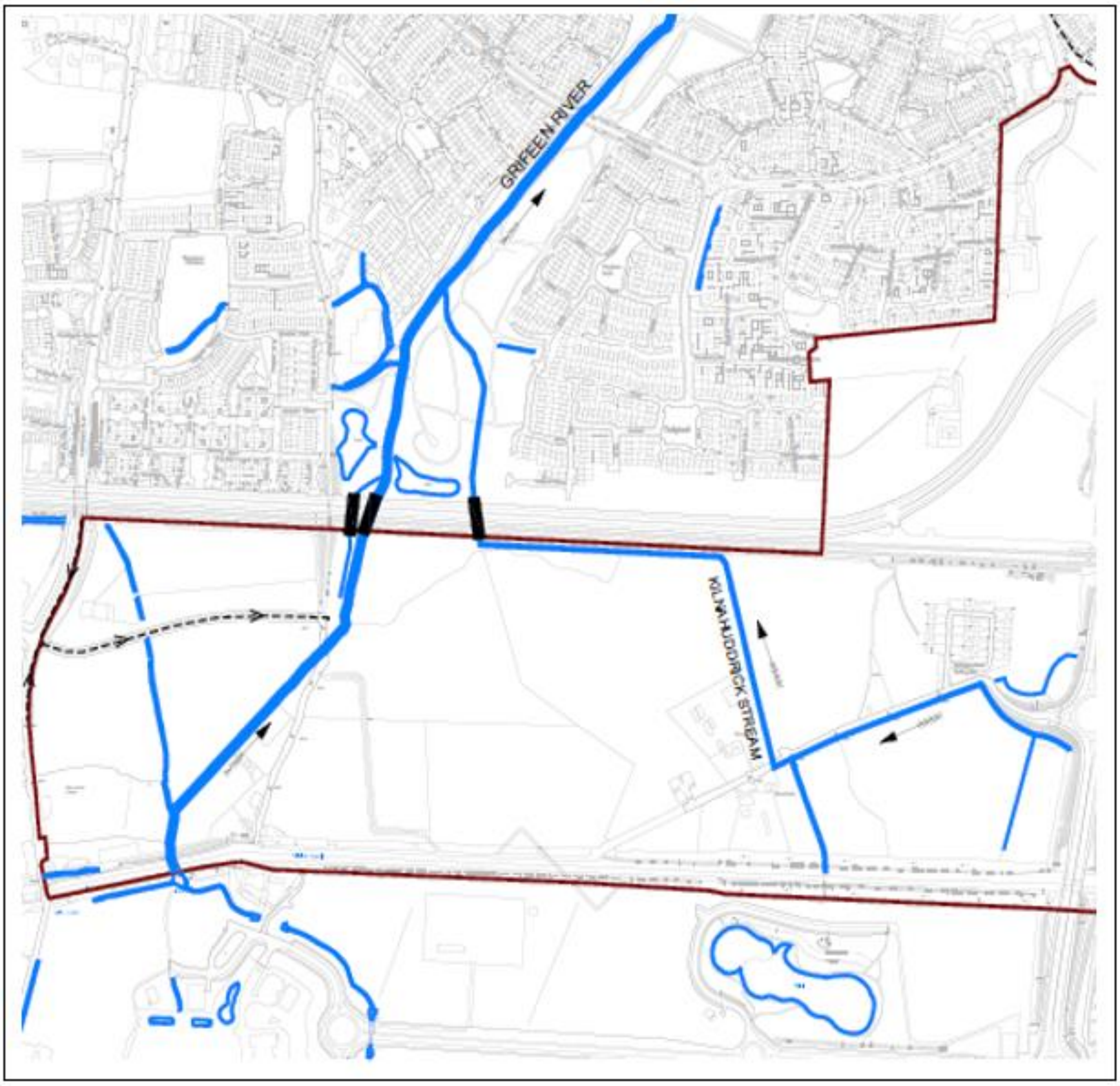
The invert level of the Kilmahuddrick Stream immediately upstream of the culvert to the underside of the railway line is approximately 300mm lower than the culvert itself which results in a permanent pool of water upstream of the railway line. Part of site infrastructure works will be to regrade the bed of the Kilmahuddrick Stream to ensure a continuity of flow downstream.

2.5.2 Future Site Drainage

The provision of an attenuated / integrated construction wetland pond within Griffeen Park to service the greater catchment will require a crossing of the Kilmahuddrick Stream.

Given the invert levels of existing culverts to the underside of the railway line, the likely top water level within the future Griffeen Park pond and the current invert levels of the Kilmahuddrick Stream, it will be necessary to regrade the bed of the Kilmahuddrick Stream to provide minimum cover to future drainage crossings.

Figure 2-6: Kilmahuddrick Stream



2.6 Soil Infiltration Characteristics

The soils in the Clonburris area are classified as SOIL Type 2 within the Flood Studies Report (NERC, 1975) with an associated SPR (Standard Percentage Runoff) value of 0.3. This would suggest that some level of infiltration can be expected throughout the site which will reduce overall attenuation volumes.

However, the GSI website suggests that there are areas of rock outcrop within the site, refer Figure 2-7, which is likely to impact on soil permeability rates.

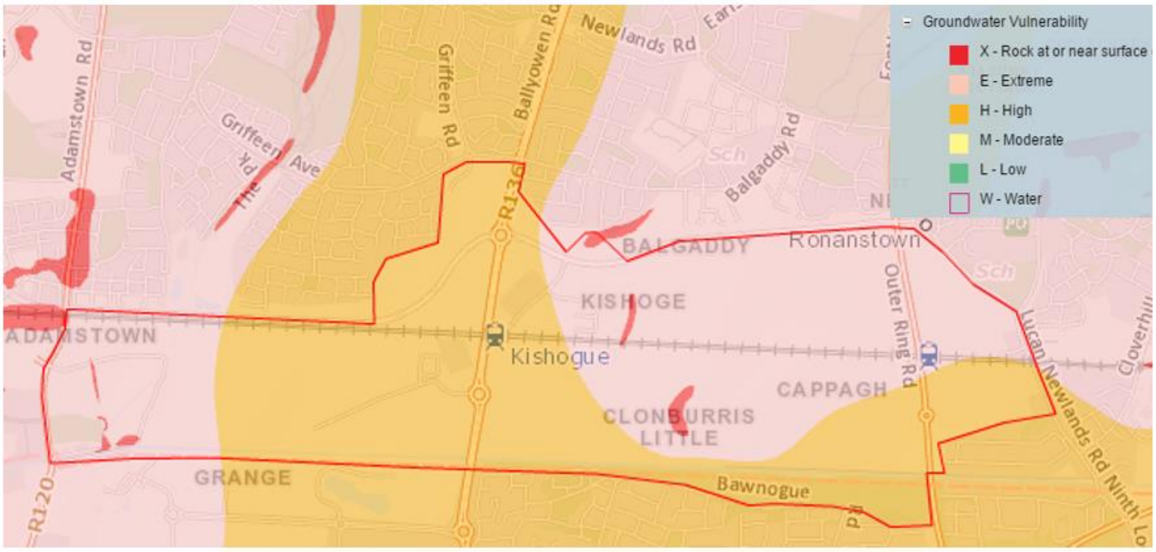
At detailed design stage, infiltration testing in accordance with BRE365 will be required to ascertain the co-efficient of permeability of the soils throughout the site. Pending the results, it is envisaged that the attenuation ponds as proposed may be reduced in size as storm volumes as generated will be dissipated into the ground via SuDS measures, for example, infiltration trenches, tree pits, permeable paving.

2.7 Groundwater Vulnerability

The Geological Survey Ireland (GSI) actively maintain and develop national and project based spatial datasets derived from internal programmes relating to Land Mapping, Groundwater, Geotechnical, Landslides, Quaternary, Geological Heritage, Minerals, INFOMAR and Tellus.

An extract from the GSI website relating to groundwater vulnerability is as shown in Figure 2-7. As indicated, the SDZ site is within a catchment where the groundwater vulnerability is considered Extreme and/or High. The impact from any development of the subject site will need to consider the groundwater impacts at detailed design stage which may or may not allow infiltration. This would not alter the strategy put forward in this report, but any restriction in terms of infiltration will limit any capacity to reduce storage volumes throughout the site. Should groundwater need to be protected, it is possible that a lined pond system may be needed.

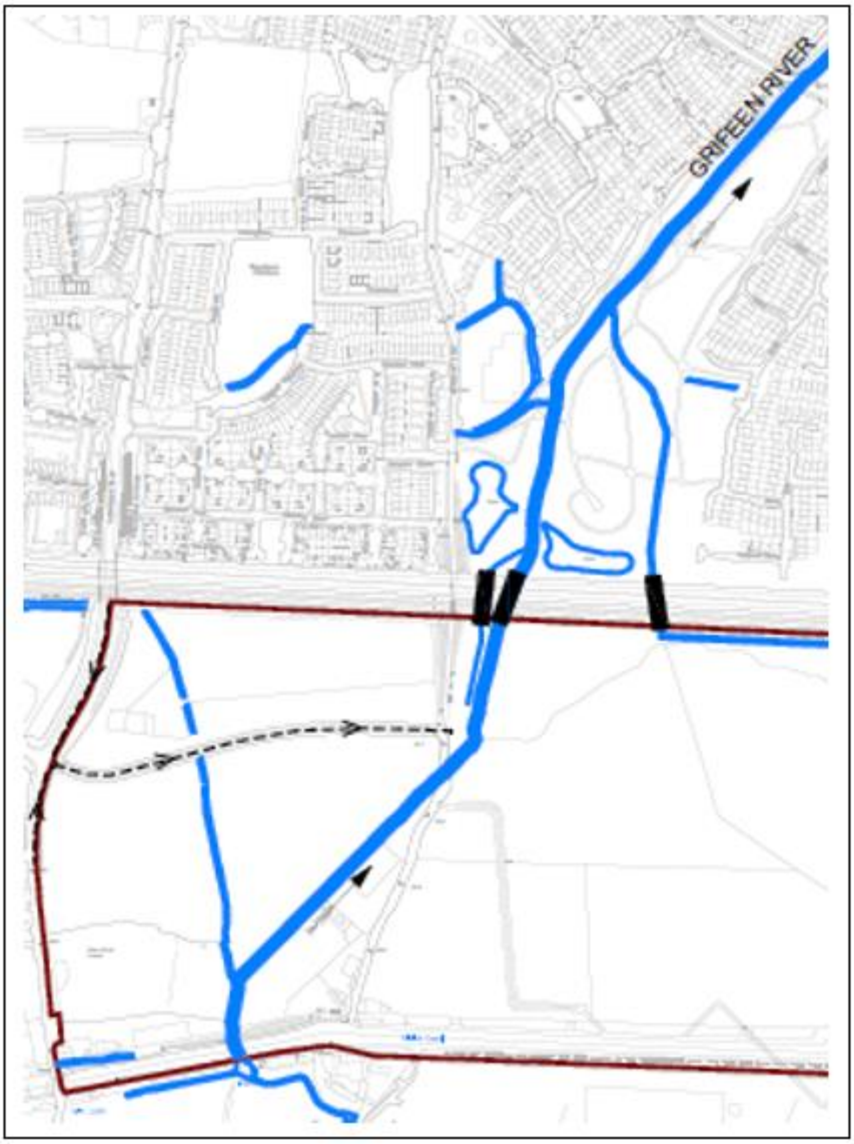
Figure 2-7: Groundwater Vulnerability Extract Map from GSI Website



2.8 Newcastle Road (R120) Drainage

Part of the Newcastle Road (R120) is drained to the Griffeen River via Haydens Lane, refer Figure 2-8. Development of the SDZ lands will require the existing drainage to be either maintained or incorporated into future site infrastructure works.

Figure 2-8: Existing Newcastle Road (R120) Drainage



2.9 Existing Open Drains

As indicated on Figure 2-5, there are multiple open drains throughout the site, most notably between the Outer Ring and Fonthill Roads. Whereas, it is envisaged that all open drains within the SDZ site will be filled in as part of site development works, it should be noted that developers will need to provide temporary diversions of same to maintain continuity of the existing surface water drainage throughout the site.

2.10 Foul Sewer Wayleaves

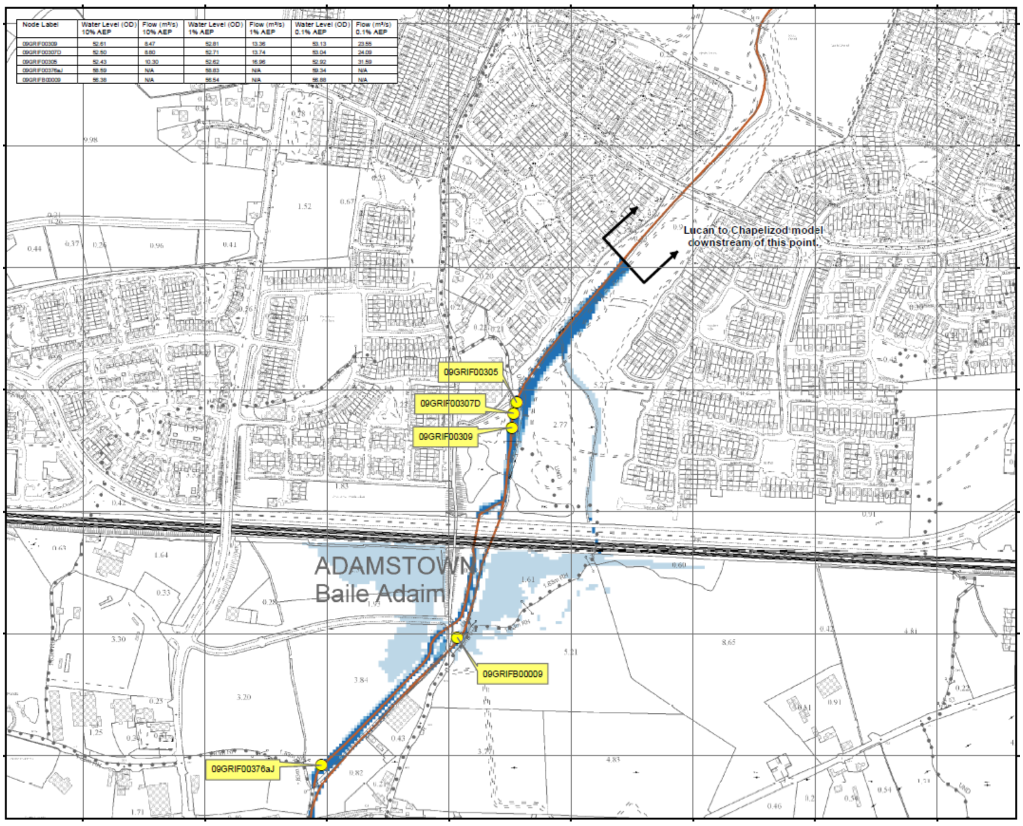
Two (2) no foul sewers, understood to be 600mm diameter and servicing Grange Castle Park, are located south of the Grand Canal, refer Figure 2-9. The associated wayleave is 25m wide and hatched red.

Figure 2-9: Existing Foul Sewers from Grange Castle Business Park

2.11 Flood Zone

An extract from the Eastern CFRAM and RPS drawing No. E09BAL_EXFCD_F0_11 is as shown in Figure 2-10. As indicated, part of the subject site is located within Flood Zone B, i.e. the 0.1% AEP Fluvial Flood Event.

Figure 2-10: Extract from CFRAM Flood Mapping



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09GRIF00309	52.61	8.47	52.81	13.36	53.13	23.55
09GRIF00307D	52.50	8.80	52.71	13.74	53.04	24.09
09GRIF00305	52.43	10.30	52.62	16.96	52.92	31.59
09GRIF00376aJ	58.59	N/A	58.83	N/A	59.34	N/A
09GRIFB00009	56.38	N/A	56.54	N/A	56.88	N/A

The affected area should be maintained for water compatible uses and any residential development should be designed such that it does not conflict with the flood extents as outlined.

2.11.1 **Strategic Flood Risk Assessment (SFRA)**

As part of the Clonburris SDZ, South Dublin Co Council have also completed a SFRA for the development and development of the subject lands shall be in strict compliance with its findings and recommendations.

Under the Planning System and Flood Risk Management Guidelines (OPW/DoEHLG, 2009) referred to as The Guidelines, the purpose for the SFRA is detailed as being "to provide a broad (wide area) assessment of all types of flood risk to inform strategic land-use planning decisions. The SFRA enables South Dublin Co Council to:

1. Undertake the sequential approach including the Justification Test,
2. Allocate appropriate sites for development and
3. Identify how flood risk can be reduced as part of the development plan process".

As the Clonburris SDZ is the key document for setting out a vision for the development of Clonburris during the plan period, it is important that the SDZ also fulfils the requirements of 'The Guidelines' which states that flood risk management should be integrated into spatial planning policies at all levels to enhance certainty and clarity in the overall planning process.

In order to ensure that flood risk is integrated into the SDZ, the main requirements of the SFRA document are to:

- Produce Flood Mapping;
- Prepare a Stage 2 - Flood Risk Assessment of Clonburris in relation to the location and type of zoning and land-use proposals;
- Prepare a Flood Risk Management Plan in compliance with OPW/DoEHLG – "The Planning System and Flood Risk Management –Guidelines for Planning Authorities (OPW/DoEHLG, 2009)" and Circular PL02/2014 (August 2014);
- Advise on zonings/land use-proposals, assess and report on any submissions received as part of both the preparation and the public consultation stage of the plan, as they relate to flood risk.

2.12 **Tullyhall & Oldbridge Residential Estates**

Part of the SDZ site north of the railway line and west of the Outer Ring Road has a topographical fall in a north-west direction towards Tullyhall and Oldbridge, both of which are taken-in-charge by South Dublin County Council.

We understand that there have been historical flooding incidents within part of this development and a connection to their existing surface water infrastructure has not been considered thus.

Should the known flooding issues be resolved to these estates, an outlet for part of the north-west sub-catchment into Tullyhall and / or Oldbridge would be advantageous for developers.

2.13 Camac River

There are known flooding issues along the Camac River, the catchment of which was prioritised within the Eastern CFRAM Study. As no flood relief works have been carried out to date to resolve same, development of the subject development and the management of surface water will be such that there will be no increase in flood risk downstream.

2.14 Legislative Requirements

The following legislative requirements guide the approach to sustainable drainage systems (SuDS) proposed at Clonburris strategic development area.

2.14.1 Water Framework Directive (WFD) (2000/60/EC)

This is a European Parliament Directive and of the Council establishing a framework for Community action in the field of water policy. This directive is concerned with the protection of the aquatic ecosystem by preventing any further deterioration in status of waters, groundwater and water dependent ecosystems and where necessary the restoration of the water body, to achieve a 'good' condition. The status is based on both the ecological status as well as the natural chemical and physical characteristics. In addition to qualitive targets, the Directive also promotes the sustainable use of water resources and most notably, the elimination of the discharge of specific hazardous substances.

The legislation places onus upon stakeholders, including both the polluters and regulators, to ensure all appropriate measures are taken to protect the environment from risk.

2.14.2 The Planning and Development Act 2000 (S.I. 600,2001) and associated regulations

This gives local government power of sanction regarding acceptance, or otherwise, of developer proposals.

2.14.3 The Local Government (Water Pollution) Acts, 1977/1990 (various S.I.)

This sets out a general prohibition on the entry of polluting matter to open water bodies and gives the Local Authority the power to require measures to be taken to prevent such water pollution. The legislation also sets out the roles and responsibilities of the Local Authority with respect to monitoring of water bodies and reposting of results to the Environmental Protection Agency (EPA).

2.14.4 Water Quality (Dangerous Substances) Regulations, 2001, S.I. 12 of 2001.

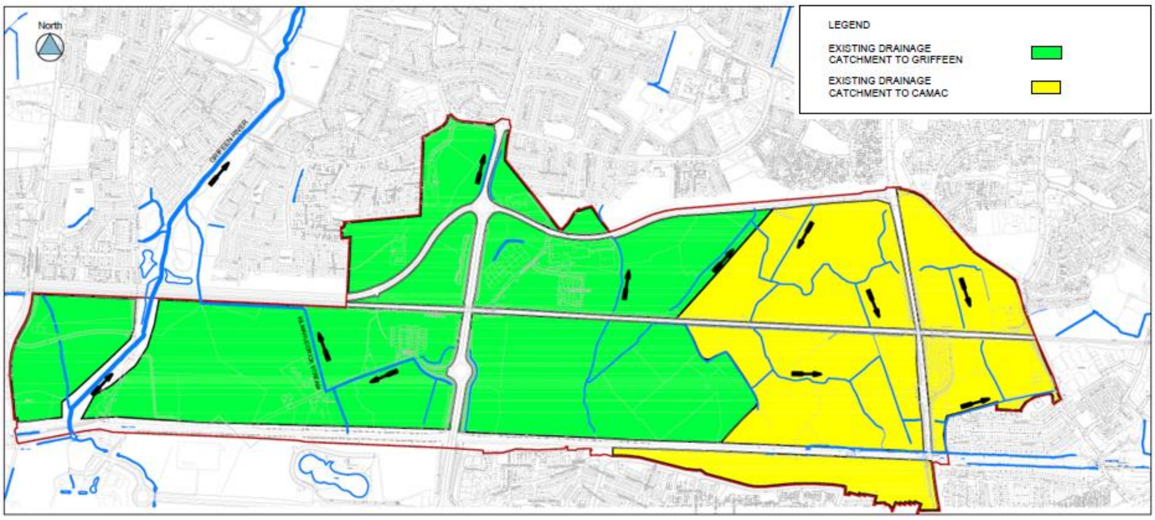
Guides the water quality monitoring programme in the region.

3 Assessment of Existing Drainage

3.1 Overview of existing drainage catchments

The Clonburris development area is currently drained by a series of open drains which ultimately discharge to the Griffeen River and the Canal overflow / Camac River, refer Figure 3-1 for illustration.

Figure 3-1: Existing Drainage Regime



3.2 Surface Water modelling

As outlined in Section 2.2, current outfalls from the site discharge into a number of primary surface water networks adjacent to the site.

Existing records of these culverts were received from South Dublin County Council, together with the details of their respective drainage catchments.

Preliminary hydraulic modelling was undertaken of all 3 surface water systems, results of which are summarised as follows:

Table 3-1: Summary of Hydraulic Modelling Results

Stormwater System	**1 in 30 Year Storm Event**	**1 in 100 Year Storm Event**
Primary Stormwater Culvert on Balgaddy Road to Griffeen River	Surcharging	Flooding
Primary Stormwater Culvert from Foxdene and down the Lucan-Newlands Road to an Open Channel within Clondalkin Industrial Estate	Surcharging	Flooding
450mm diameter culvert on Lucan - Newlands Road to Open Channel within Clondalkin Industrial Estate	Surcharging	Surcharging

Results of preliminary hydraulic modelling indicate that there is insufficient capacity within the two (2) primary surface water culverts (on Balgaddy Road and from Foxdene) to accept any additional flows from the SDZ site.

Furthermore, as the culverts are predicted to cause flooding in the 1 in 100-year storm event, a continuous discharge from the proposed ponds within the SDZ site will not be facilitated, resulting in the backing up of flows within the SDZ site.

As the existing 450mm diameter culvert on the Lucan - Newlands road has sufficient capacity during the 1 in 100-year storm event, it is envisaged that this culvert, following detailed hydraulic modelling, will be the point of connection for discharge to the existing open drain within Clondalkin Industrial Estate.

3.2.1 Remediation options to surface water network on Balgaddy Road

Potential options to address the deficiencies within the existing surface water network on Balgaddy Road would include the following:

1. Provision of SuDS retro-fitting upstream of the surface water system to alleviate flooding;
2. Provision of a new surface water culvert to the Griffeen, an overflow from the existing surface water culvert on Balgaddy Road could be provided to alleviate capacity issues within;
3. Increase the size of relevant ponds within the SDZ site to account for reduced and/or no discharge during times of flooding within the primary surface water network.

3.3 Baseline greenfield runoff rate

Calculations were undertaken to assess the existing greenfield run-off rates from the SDZ site, results are as follows:

Table 3-2: Greenfield Runoff Rates

Greenfield Runoff Rates	
Qbar	2.23 l/sec/ha
Q1yr	1.90 l/sec/ha
Q30yr	4.75 l/sec/ha
Q100yr	5.82 l/sec/ha

Based on the requirements of the GDSDS, it is proposed to control discharge rates from the site to 2 litres/second/hectare for all return periods including the 1 in 100-year return period. Such an approach will represent a significant reduction in the estimated greenfield runoff rate for the 1 in 30 and 1 in 100-year storm events.

3.3.1 Eastern CFRAM hydrology

An allowable discharge rate of 2 l/sec/ha to both the Griffeen and Camac is further supported by the Eastern CFRAM Hydrology report.

The impacts of attenuated flows on the Griffeen and Camac watercourses have also been assessed, refer Section 4.2.1 for further reading.

4 Surface Water Strategy

The focus of the strategy is to manage surface water in a sustainable way, ensuring there is no unacceptable residual risk of flooding to each site; ensuring no increased flood risk up or downstream from each development. A fundamental part of the strategy is the provision of adequate levels of treatment of the surface water as it is proposed to discharge directly to existing watercourses.

This can be achieved through a detailed surface water management strategy that incorporates new and existing drainage features to control and treat surface water runoff. The guiding principles for this strategy are shown in Table 4-1. The following surface water strategy provides a basis for sustainable development of the subject SDZ lands in terms of the management and control of surface water discharge from the site.

In terms of site development works, it is accepted that this strategy document will be developed as part of a detailed design process whereby all objectives will be realised within.

Table 4-1: Surface water strategy principles

	Principle	Purpose
1	Manage surface runoff at source	Prevention or reduction of surface water flows. The GDSDS states that there should be no discharge to a surface water body or sewer from the first 5-10mm of any rainfall event.
2	Manage water on the surface	The ability to intercept flows and direct them to areas designed to treat, store and discharge flows away from homes, businesses and transportation networks where disruption and flooding can occur.
3	Integrate public space and drainage design	SuDS can provide intrinsically attractive features and focal points within the landscape and have added ecological value; by incorporating these features into open public spaces local communities can enjoy a variety of diverse ecological features. The design of SuDS features within the open public spaces is required to be of high quality to achieve a multi-functional space for amenity, biodiversity and surface water management. In this context, design should have regard to The SuDS Manual (C753).
4	Effective operation and maintenance	A robust operation and maintenance schedule of SuDS measures should be produced and adhered to, to ensure SuDS measures are operating to their full capacity, and that life cycles can be extended as much as possible. SuDS designs and maintenance schedules should be agreed with those adopting them early in the planning process. It can be beneficial to make maintenance contracts mandatory

		in advance of SuDS construction. The lifespan of SuDS measure should also be considered in design.
5	Account for climate change and changes in impermeable area	20% allowance for climate change.

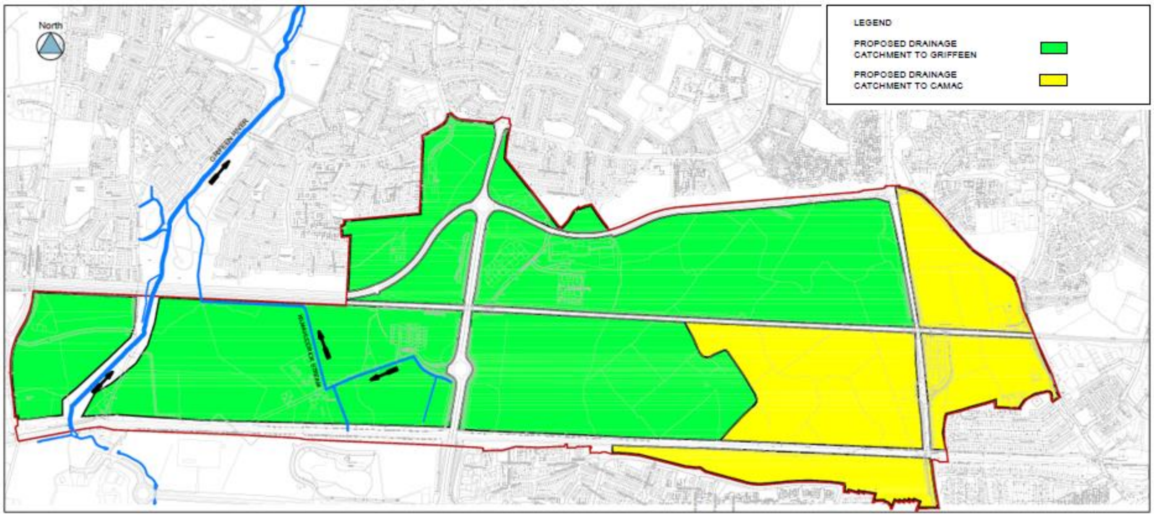
Such a strategy seeks to address both quality and quantity related aspects of the surface water. Given the current flooding related issues downstream of the Camac catchment, it will also seek to reduce the rate and volume of discharge from the site by:

- Provision of appropriate SuDS measures, and;
- Alteration of the current drainage characteristics of the site with a reduced catchment draining to the Camac River.

4.1 Proposed Drainage Outfall Regime

To reduce the overall catchment that drains to the Camac River, the natural drainage characteristics of the site will be modified whereby, the extent of the site north of the railway and west of Fonthill Road (c. 25 hectares) will now be drained to the Griffeen River, refer Figure 4-1. For comparison with the existing drainage regime, refer Figure 3-1.

Figure 4-1: Proposed Drainage Outfall Regime



Such an approach will reduce the overall rate and volume of discharge to the Canal Overflow / Camac River. In addition, the c.25 hectares which will now be drained to the Griffeen River will have a much longer travel distance whereby increased detention times will also encourage infiltration and overall volume reduction.

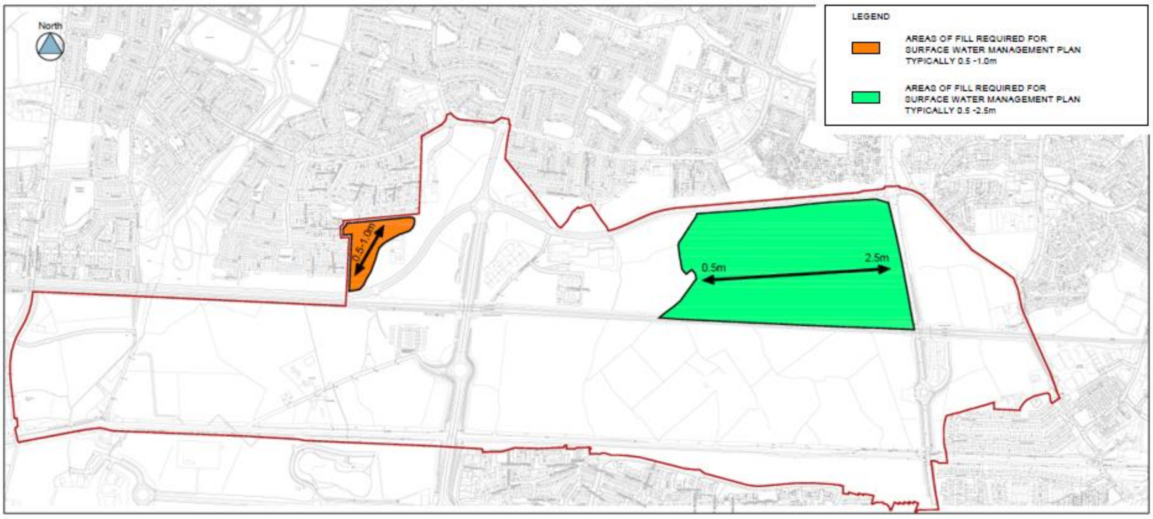
The requirement to provide a culvert to the underside of the railway line will also be removed as all lands north of the railway line and west of Fonthill Road will have the option to discharge in a north-western direction to the Griffeen River.

However, pending phasing and resolution of the flooding issues within the primary surface water culvert on Balgaddy Road, refer section 3.2.1, the developer will also have the option to discharge this part of the site to the proposed attenuation pond within Griffeen Park subject to agreement with Irish Rail about a new culvert crossing.

The modified drainage regime will induce site filling to the c.25 hectares with approximate fill depths as indicated in Figure 4-2.

In addition to the filling requirements to the c.25 hectares which will now be drained to the Griffeen, some nominal filling will be required to the north-west sector of the site where the natural topography is towards the existing Tullyhall and Oldbridge residential estates, refer Figure 4-2 and section 0.

Figure 4-2: Required Fill Depths



4.2 Discharge Rate

It is probable that soil infiltration rates coupled with the extent of hardstanding areas proposed will be such that the overall volume of surface water may increase because of development on site. Stormwater volume will also be dependent on the extent and type of SuDS measures that will be adopted at detailed design and planning stage.

To counter the potential increase in volumes and in accordance with the GDSDS, the allowable discharge rate will be 2 l/sec/ha to both the Griffeen and Camac Rivers for all storm events.

As can be seen from the existing greenfield runoff rates as provided in Table 3-2, the rate of discharge from the site will be substantially reduced during times of heavy rainfall, most notably the 1 in 30-year and 1 in 100-year storm events.

4.2.1 Hydraulic Modelling Assessment

The impact of development and associated discharge on both the Griffeen and Camac have been assessed by RPS (Consulting Engineers for the Eastern CFRAM), whereby, associated hydrographs for this strategy were inputted into the hydraulic models for both watercourses.

The peak water levels for both the existing model and post-development model are as summarised in Table 4-2 together with the easting and northing for the 8 model nodes for reference.

Table 4-2: Results of Hydraulic Modelling Pre & Post Development

Location No.	Watercourse Name	Easting	Northing	Current 1% AEP Water Level (mAOD)	Post-development 1% AEP Water Level (mAOD)
1	Camac	310432	232378	37.599	37.628
2	Camac	310574	232421	37.019	37.055
3	Camac	311138	232006	28.555	28.555
4	Griffeen	303175	232311	59.3	59.3
5	Griffeen	303274	232445	58.014	58.013
6	Griffeen	303989	233707	48.75	48.764
7	Griffeen	304044	234174	44.135	44.137
8	Griffeen	303299	232491	57.856	57.856

As indicated, the results indicate that the Camac is more sensitive to discharge than the Griffeen, however, the increase in water levels in the 1 in 100-year event can be considered negligible given the scale of the overall catchments involved.

We believe there is no substantial benefit in a reduced discharge rate from the subject site which would result in enlarged attenuation ponds within the SDZ boundary which will:

- Reduce the overall net developable area;
- Increase infrastructure costs (additional excavation etc); and
- Reduce the amenity value and function of open spaces in the Planning Scheme.

What is clear is that the Griffeen and Camac would both benefit from the recommendations set out in the Eastern CFRAM Report. The Camac, in particular, would benefit from selected screen upgrades and/or the removal of identified restrictions. Such works would improve flow conditions with a likely reduction in flood level. South Dublin Co Council may wish to engage with Dublin City Council in this regard.

4.2.2 **Objective**

It is a requirement of this strategy that SuDS measures shall be fully implemented on all individual sites/plots to limit the rate of runoff to 2 l/sec/ha. The grouping of individual sites/plots may be required to achieve minimum flow rates through individual flow control devices.

As the rate of discharge will be limited to 2 l/sec/ha, there will be a requirement to provide attenuation storage at strategic locations throughout the site. For the purposes of this strategy, regional ponds will be constructed.

It is an objective of this strategy, unless otherwise agreed with South Dublin County Council, that all surface water generated within the development will discharge downstream via a regional pond which in addition to providing the necessary attenuation requirements, also provide the final level of treatment prior to discharge downstream.

4.3 Surface Water Drainage

4.3.1 Development Stormwater Management

Urbanisation disrupts natural soil profiles, increases impervious surfaces and decreases vegetation cover. These disruptions increase surface water runoff resulting in downstream flooding. Furthermore, the disruptions impair groundwater recharge, degrade water quality and impair aquatic habitat.

Figure 4-3 illustrates the proposed surface water strategy for the SDZ. The outline network design proposed in this section incorporates the recommendations of the Greater Dublin Strategic Drainage Study 2005 (GDSDS), Regional Drainage Policies – Volume 2 New Development.

For the purposes of establishing the outline layout of the surface water network to serve the Planning Scheme, the area is sub-divided into a number of sub-catchments based generally on existing land topography, with exception of localised site filling as discussed in section 4.1.

4.3.2 Specific Objective

It is an objective of the SDZ to promote Sustainable Urban Drainage Systems (SuDS) to manage surface and groundwater regimes sustainably.

The following measures are the key strategic elements and principles of the SuDS solution proposed for the Clonburris SDZ to manage the surface water and enable development of the lands.

Section 4.3.2.1 summarises the acceptable measures within the public realm areas while Section 4.3.2.2 summarises the acceptable measures within individual plots/sites.

4.3.2.1 Measures in Public Realm Areas

- **Ponds and/or Integrated Catchment Wetlands** located at several major outfall locations. These will provide storage to meet attenuation requirements for the 1 in 100-year criterion. Such ponds/ wetlands will provide the final stage of treatment for surface water runoff prior to discharge to the watercourses. The ponds, which are located in open space areas will also provide amenity and biodiversity benefits in accordance with best design practice.
- **Detention basins** adjacent to existing and proposed roads. These are vegetated surface storage basins that provide flow control through attenuation of surface water runoff. They also facilitate some settling of particulate pollutants. They are normally dry and in most cases, can accommodate soft landscaping and contribute to local amenity.
- **Infiltration basins** located at carefully selected locations in the detention basins. These are vegetated depressions designed to store run off and infiltrate it gradually into the ground. These are very effective at pollutant removal and contribute to groundwater recharge.

- **Underground Modular systems** with a high void ratio (e.g. Stormtech system or similar) will be used subject to agreement with the Local Authority in any suitable locations of open spaces subject to level and ready access to provide below ground storage and infiltration. Prior to the inclusion of underground modular systems, at detailed design stage, the developer shall demonstrate that alternative SuDS methods are not feasible with the required volume of water to be attenuated at the location and the achievement of a multi-functional open space for amenity, biodiversity and surface water management.
- **Filter Strips** can be used as treatment for road or car park runoff where space allows. Filter strips can provide treatment for road runoff, upstream of swales or trench components. They can reduce the need for kerbing and runoff collection systems.
- **Infiltration trenches** are linear soakaways. The advantages of trenches over soakaways is that they can often be kept shallower and, in variable soils, can help distribute the infiltration area so that the impact of less permeable areas of soil is less pronounced. A perforated pipe may also be utilised to convey water along the trench.
- **Tree Root Structural Cell Systems** (e.g. Silva Cell) are subsurface tree and surface water systems that hold large soil volumes while supporting traffic loads beneath paving and hardscapes. It is proposed that these will be used throughout the Planning Scheme area to assist with attenuation and groundwater recharge.

4.3.2.2 Measures within Individual Development Site Boundaries:

- **Blue Roofs** - a roof design that is explicitly intended to store water, typically rainfall. Blue roofs that are used for temporary rooftop storage can be classified as "active" or "passive" depending on the types of control devices used to regulate drainage of water from the roof.
- **Green Roofs** - can be designed to give a wide range of benefits. These include; reducing the amount of storm water running off the roof reducing the risk of flooding - it is suggested that they result in reduced annual run-off of at least 40% and more usually 60-70%, providing habitat, water quality improvement, keeping buildings cool, help reduce the amount of dust and pollutants in the air, creating new open space for relaxation and creating green useable spaces.
- **Pervious Paving**, namely:
    - Modular permeable paving;
    - Porous asphalt;
    - Grass reinforcement;
    - Resin bound gravel;
    - Porous Concrete;
    - Macro pervious paving;
    - Sports surfaces;
    - Block porous paving.
- **Infiltration Trenches**;

- **Detention Basins**;
- **Swales** - shallow, flat bottomed, vegetated open channels, designed to convey, treat and attenuate surface water flows;
- **Tree Root Structural Cell Systems** - enhance surface water management by transpiration, interception, increased infiltration, phytoremediation;
- **Rainwater Harvesting -** the collection of rainwater runoff for re-use;
- **Water Butts -** limited form of rainwater harvesting.

Petrol inceptors, SurfSeps, Downstream Defenders or other such proprietary devices are not considered primary SuDS measures and shall not be provided in lieu of acceptable SuDS measures outlined in Section 4.3.2.1 and 4.3.2.2.

4.3.3 Key Principles of Surface Water Management within Development Sites

Runoff from all sites must pass through at least one level of treatment using a SuDS component prior to the final level of treatment within the Regional Ponds.

A second level of treatment may be required upstream of the regional ponds as per the GDSDS or as otherwise recommended by The SuDS Manual (C753).

The increasing frequency and intensity of significant rainfall events will require that all developments allow for 'exceedance' in their internal surface water drainage design. In particular, the design of all drainage systems shall allow for surface flood pathways, on-site low level storage in less vulnerable areas (car parks, planted areas, driveways etc), over and above the SuDS volumes required.

4.3.3.1 Other Objectives

1. It is an objective to ensure that surface water management, flood attenuation and Sustainable (Urban) Drainage Measures (SuDS), including a requirement to undertake Stormwater Audits, shall form part of the pre-planning, planning and post construction stages of any application.
2. It is an objective to ensure that SuDS measures shall be fully implemented on all sites to 2 litres per second per hectare runoff rates, unless otherwise agreed with South Dublin County Council. In this regard, solutions other than tanking systems shall be required for all developments. For larger applications, Blue and / or Green Roofs shall be used.

   The South Dublin County Council Development Plan 2016 -2022 outlines that the Planning Authority will seek to avoid the use of underground attenuation and storage tanks apart from in exceptional circumstances where it is demonstrated that SuDS measures are not feasible. As such, underground tanking systems are not generally permitted within the SDZ Planning Scheme.

3. Underground concrete tanks are not permitted within the SDZ.

   In locations, such as the Town Centre Sites where the design level of site storage may not be practicable to achieve either above or at ground level, then on an exceptional basis an underground tanking system will be considered in conjunction with other soft SuDS measures and also where an intensive green roof covering a minimum of 80% of the roof is utilised.

4. It is an objective to ensure urban areas are designed to accommodate surface water flood flow at times of extreme events through the dual use of roads and pathways as flood conveyance channels and low value areas (parkland, car parks, large paved areas etc) used as temporary flood ponding areas.
5. It is an objective to ensure that all trees planted in/adjacent to hard paved areas (footpaths, parking areas etc) incorporate tree root structural cell systems.
6. It is an objective that each planning application shall address the vulnerability of the groundwater and ensure that appropriate SuDS measures are provided which will protect the underlying aquifer.
7. It is an objective to ensure that the drainage design is integrated into the public open space and public realm to achieve high quality multi-functional spaces.

4.4 **Benefits of proper surface water management**

Sustainable surface water management will:

- Reduce the volume of surface water by managing surface water runoff at source and reducing areas of impermeable surfaces;
- Manage or reduce surface water flooding by maximising the potential for flood storage through ponds, infiltration trenches, tree pits, swales etc;
- Manage water on the surface during exceedance events by designing multi-functional open spaces to safely route and manage temporary surface water;
- Enhance local biodiversity and water quality by protecting, enhancing and providing high quality blue and green infrastructure;
- Improve local access to natural, shady outdoor spaces;
- Manage urban cooling;
- Protect or create carbon sinks and other climate change mitigation or adaptation benefits
- Provide an attractive setting for development, with better public access, particularly around the riverside;
- Achieve a number of core strategy strategic objectives and planning policies.

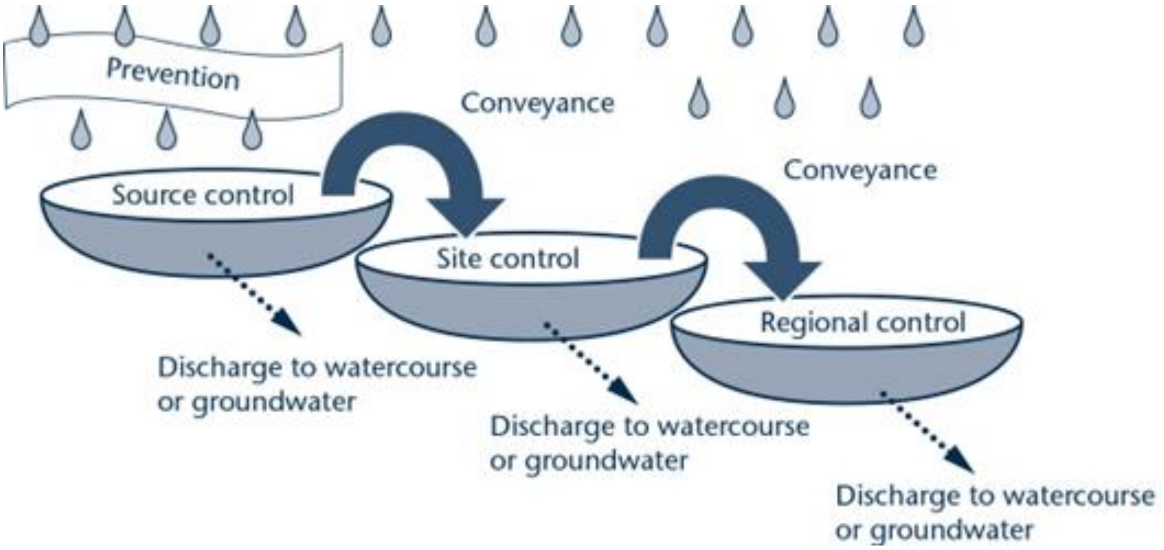
This high level strategy is required to achieve a coordinated and cohesive approach to surface water management and provide for the consistent designing of SuDS and traditional systems to achieve the benefits identified above. It is a requirement that a detailed surface water drainage system is designed at planning stage based on the strategy document.

4.5 Prevention, Source, Site and Regional Controls

Each site should adopt the SuDS Management Train approach, illustrated in Figure 4-3. Preventative, source, site and regional controls can be used to mimic the catchments natural processes as closely as possible. Whilst there are many different SuDS techniques that could be successfully implemented across the site, there is no one correct drainage solution for a site and in most cases a combination of techniques will be required, which could include:

- **Preventio**n - good site design to prevent runoff and pollution i.e. rainwater reuse / harvesting;
- **Source Control** - control runoff as close to the source as possible through soakaways, infiltration trenches, green roofs, pervious pavements and rainwater gardens;
- **Site Control** - management of runoff in a local area or site by routing runoff to swales, detention basins, ponds or wetlands;
- **Regional Control** - management of runoff from site or several sites to a balancing pond or wetland.

Figure 4-3: SuDS management train



4.5.1 Prevention

The first step in the surface water management train for each site should be the prevention or reduction of surface water flows during the first flush of rain generated runoff. The GDSDS states that there should be no discharge to a surface water body or sewer from the first 5mm of any rainfall event. This can be achieved using a combination of methods including rainwater harvesting, porous / permeable paving and soakaways, diverting small roof areas to grassed areas.

4.5.2 Source control using SuDS within Individual Sites

Where possible, the first two stages (where 2 stages are required) should be in-curtilage, privately owned systems that are maintained by the owner.

Roof water runoff should be captured and treated within the curtilage of each individual site. This could be typically achieved by using SuDS measures such as green roofs, rain water gardens, filter trenches or bio-retention units. All other areas such as residential driveways, or car parking areas and access roads in commercial sites will require two stages of SuDS treatment. This could be typically achieved using SuDS measures such as improved swales, porous paving and bio-retention. Where two stages of SuDS treatment cannot be achieved at source, site control SuDS should be considered.

4.5.3 Source Control using SuDS in Public Realm Areas

Where possible the first two stages of SuDS treatment from public realm areas, such as footpaths, roads and public open spaces should be achieved at source. It is accepted this may not be feasible in every case and can be addressed with alternative approaches demonstrated at detail design stage.

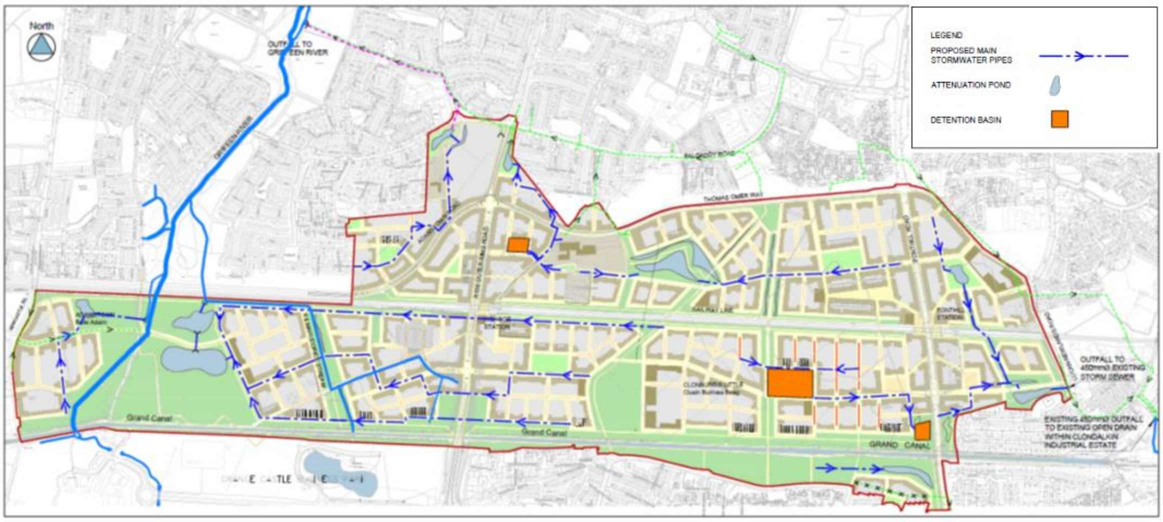
This could be typically achieved by using SuDS measures such as infiltration trenches; bio-retention units, or possibly porous paving.

These SuDS will generally be taken-in-charge / maintained by the local authority and constructed in easily maintained, open public spaces having the multi-functional use of surface water treatment, biodiversity habitats as well as being a focal point for amenity.

4.5.4 Regional Controls

Regional controls by way of Integrated Construction Wetlands (ICW's) or as otherwise approved by South Dublin Co Council will provide the surplus attenuation requirements for the 1 in 100-year event plus 20% climate change to cater for roads, specific areas in the public realm and attenuated discharge from individual plots. They will also act as the final level of treatment prior to discharge to the Griffeen and Camac. Proposed regional control ponds are as illustrated in Figure 4-4.

Figure 4-4: Proposed Drainage Strategy



Note: A larger version of the above Figure is available within the Appendices.

4.6 Strategic Actions

The key strategic measures and actions required to implement the surface water management strategy are as follows:

1. Subject to assessment of environmental impacts at detailed design stage:
    a. Divert and/or integrate existing road drainage into the detailed drainage of the lands, incorporating treatment within the regional ponds;
    b. Regrade Kilmahuddrick Stream downstream of Lynch's Lane;
    c. Raise the site development platform, where required at specified locations, to meet the drainage plan strategy.
2. Discharge will be restricted to 2 l/sec/ha:
    a. From Individual sites;
    b. From intermediate attenuation measures;
    c. To both the Griffeen and Camac.
3. Attenuation up to the 1 in 100-year event plus 20% climate change will be provided as follows:
    a. Within individual sites;
    b. Within regional ponds for all public realm areas.
4. Provide first 1 or 2 stages of treatment (as required) on the development site (Roof Runoff receiving 1 stage of SuDS treatment and all other impermeable areas receiving 2 stages) or as otherwise required by 'The SuDS Manual (C753)'.
5. Enhance biodiversity and treatment potential of the drainage and within site based SuDS.
6. Integrate and enhance the Green Infrastructure network, using linked blue and green corridors
7. Connect site level drainage to main trunk systems and regional attenuation ponds.

8. Maintain a buffer zone as required from the Canal, onsite drainage and the railway line.
9. Provision of high quality design solutions to integrate public spaces and SuDS measures to achieve a multi-functional space.
10. Preparation of a detailed drainage design for the lands to encompass all requirements of the Surface Water Management Strategy. The detailed design shall include for revised attenuation volumes, design solutions and include SuDS measures as appropriate.

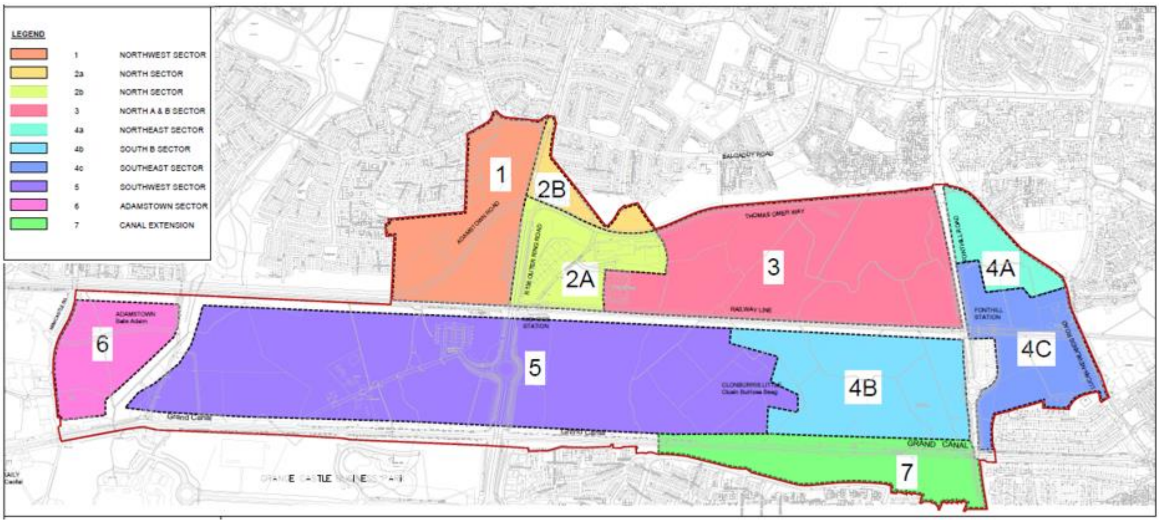
To help describe the strategic vision of the wider surface water management train, sites have been clustered together to represent sub-catchments. Each cluster or sub-catchment is geographically and hydraulically linked to the existing surface water network and has its own recommended surface water management train.

5 Sub-Catchment Stormwater Planning

For the purpose of the SDZ and ease of reference, the subject site has been divided into a series of sub-catchments to simplify assessment and provide a basis for outlining drainage requirements for each sector of development, refer Figure 5-1.

Each sub-catchment will need to assess how it will provide the stages of treatment for each runoff surface. In addition, the connection to the Regional ponds and surface water network linking individual sites to regional ponds will need to be engineered, preferably through a SuDS train device.

Figure 5-1: Illustration of sub-catchments



It is envisaged that the soil infiltration capacity of the underlying subgrade will be investigated at detailed design stage such that the ground may be recharged, notwithstanding any limitations due to the groundwater vulnerability, via suitable infiltration measures. Pending the extent of infiltration, the associated regional ponds may be reduced in volume and associated area extent.

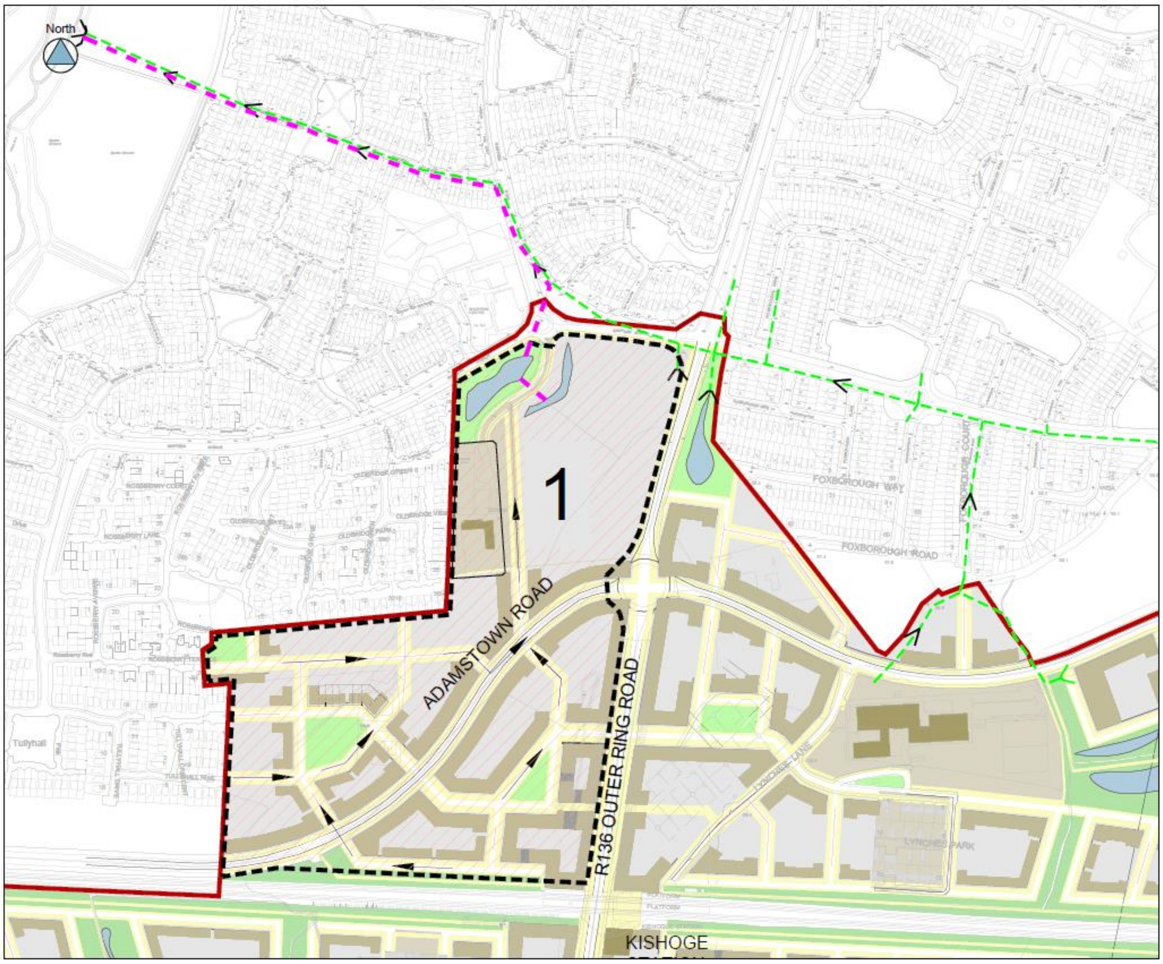
As outlined in Section 3.2, detailed hydraulic modelling of the existing surface water networks will be required at detailed design stage should a connection into same be preferred.

Each sub-catchment has varying challenges and the drainage requirements and options are discussed hereunder.

5.1 Stormwater Infrastructure Requirements Sub-catchment 1

Sub-catchment 1 comprises lands north of the railway line and west of the Outer Ring Road, refer Figure 5-2.

Figure 5-2: Strategic Drainage Approach to Sub-catchment 1



5.1.1 Stormwater Requirements:

- Provision of a regional pond (ICW) adjacent Griffeen Avenue;
- Discharge from regional pond at 2 l/sec/ha to:
    - Existing 1500mm diameter surface water culvert on Griffeen Avenue subject to upstream retro-fitting of SuDS to alleviate flooding for the 1 in 100-year storm event;
    - New surface water culvert to the Griffeen River;
- Existing road drainage of Outer Ring Road (refer section 2.1.5) to be maintained or diverted into future site drainage at detailed design stage;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Localised filling adjacent Tullyhall and Oldbridge Estates.

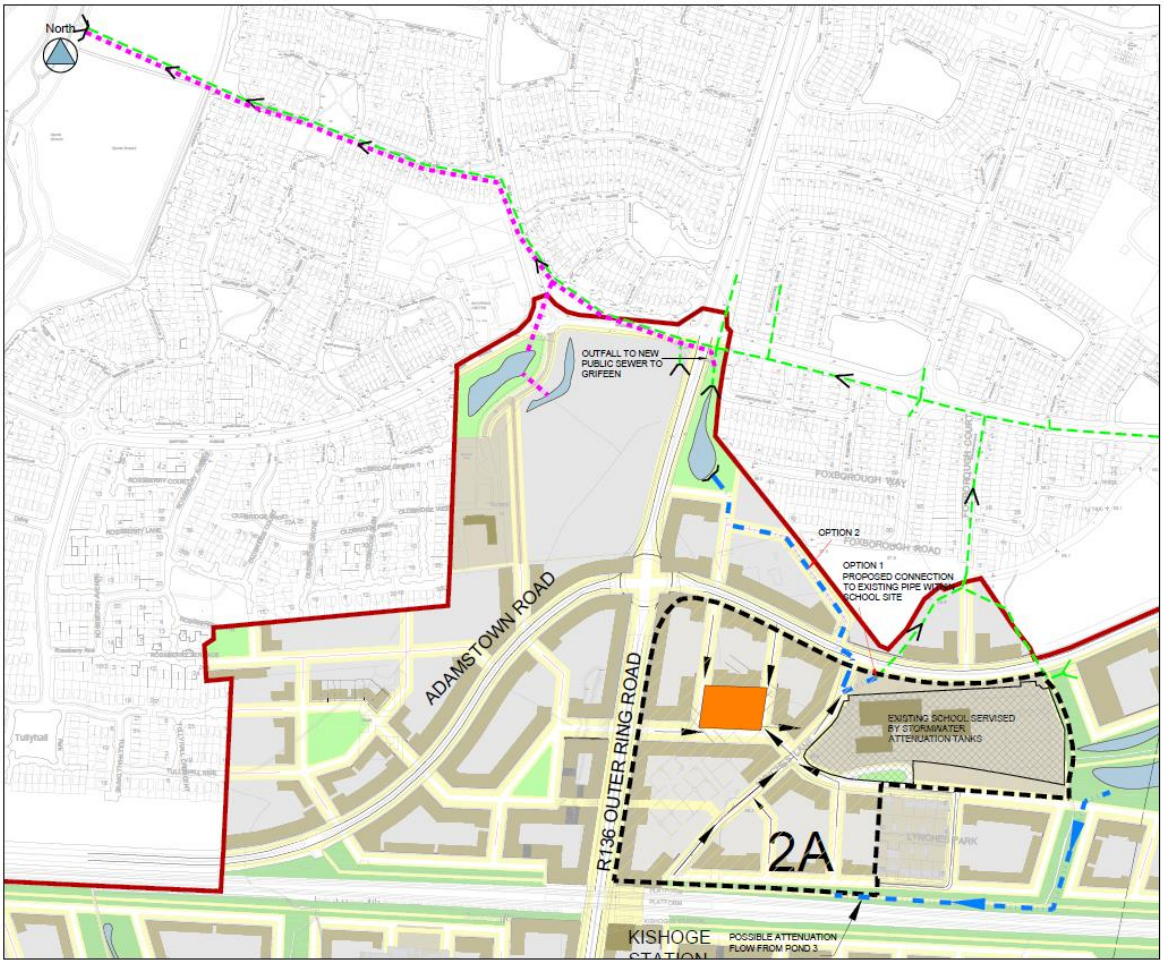
5.2 Stormwater Infrastructure Requirements Sub-catchment 2

Area 2 comprises two separate sub-catchments as outlined hereunder.

5.2.1 Sub-Catchment 2a

Sub-catchment 2a comprises lands south of the Thomas Omer Way and east of the Outer Ring Road, refer Figure 5-3.

Figure 5-3: Strategic Drainage Approach to Sub-catchment 2a



5.2.1.1 Stormwater Requirements

- Provision of detention basin within the proposed pubic open space;
- Discharge from the detention basin at 2 l/sec/ha:
    - To existing 1050mm diameter storm culvert within Kishoge Community School (Option 1), subject to:
        - Upstream retro-fitting of SuDS to the 1500mm diameter culvert on Balgaddy Road to alleviate flooding for the 1 in 100-year storm event, or;
        - Provision of new surface water culvert to the Griffeen River with overflow from existing 1500mm diameter culvert on Balgaddy Road;

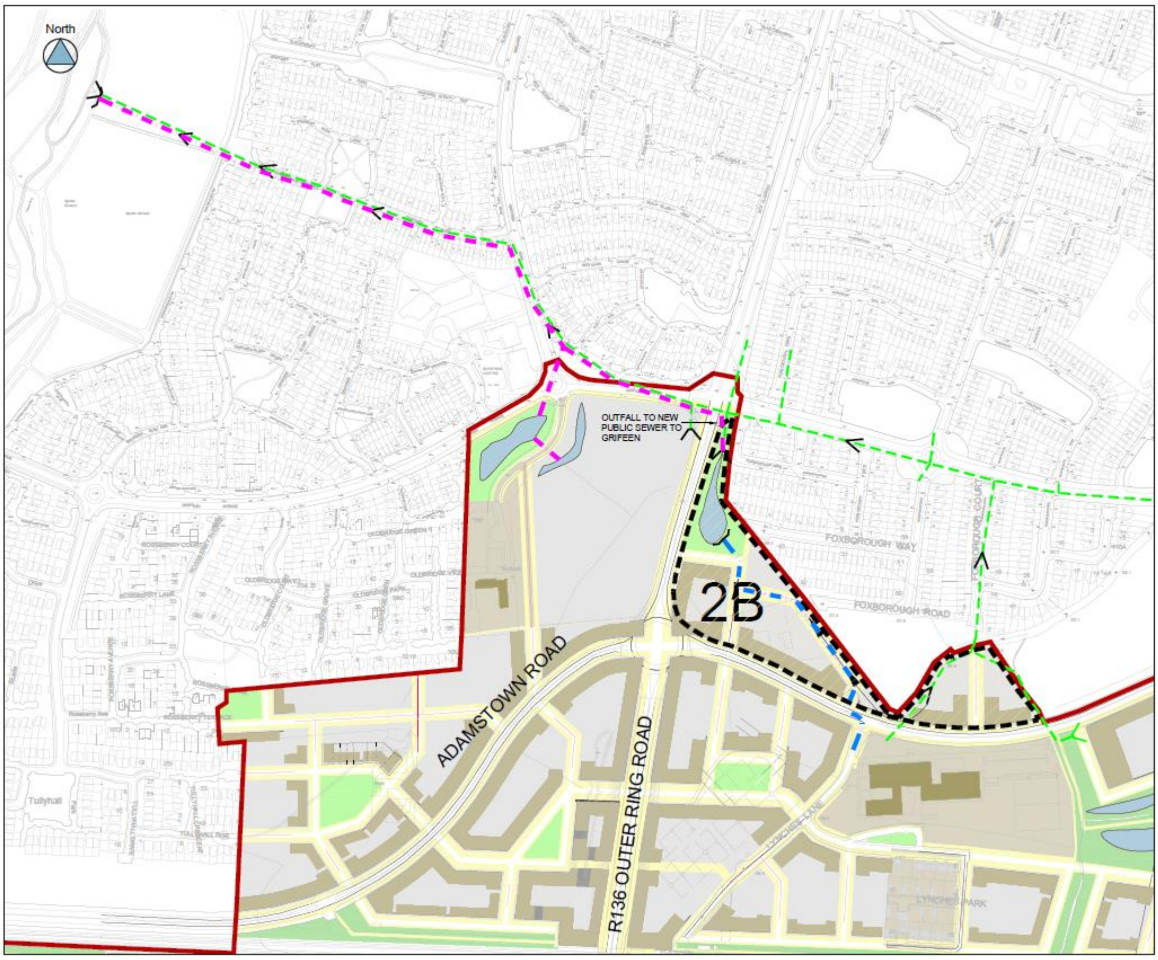
  - To proposed pond within sub-catchment 2b (Option 2):
- Discharge from individual sites/plots at 2 l/sec/ha
- Potential connection from sub-catchment 3.

Kishoge Community School is understood to have its own attenuation system and has not been accounted for within the Clonburris SDZ drainage strategy

5.2.2 Stormwater Infrastructure Requirements Sub-catchment 2b

Sub-catchment 2b comprises lands north of the Thomas Omer Way and east of the Outer Ring Road, refer Figure 5-4.

Figure 5-4: Strategic Drainage Approach to Sub-catchment 2b



5.2.2.1 Stormwater Requirements

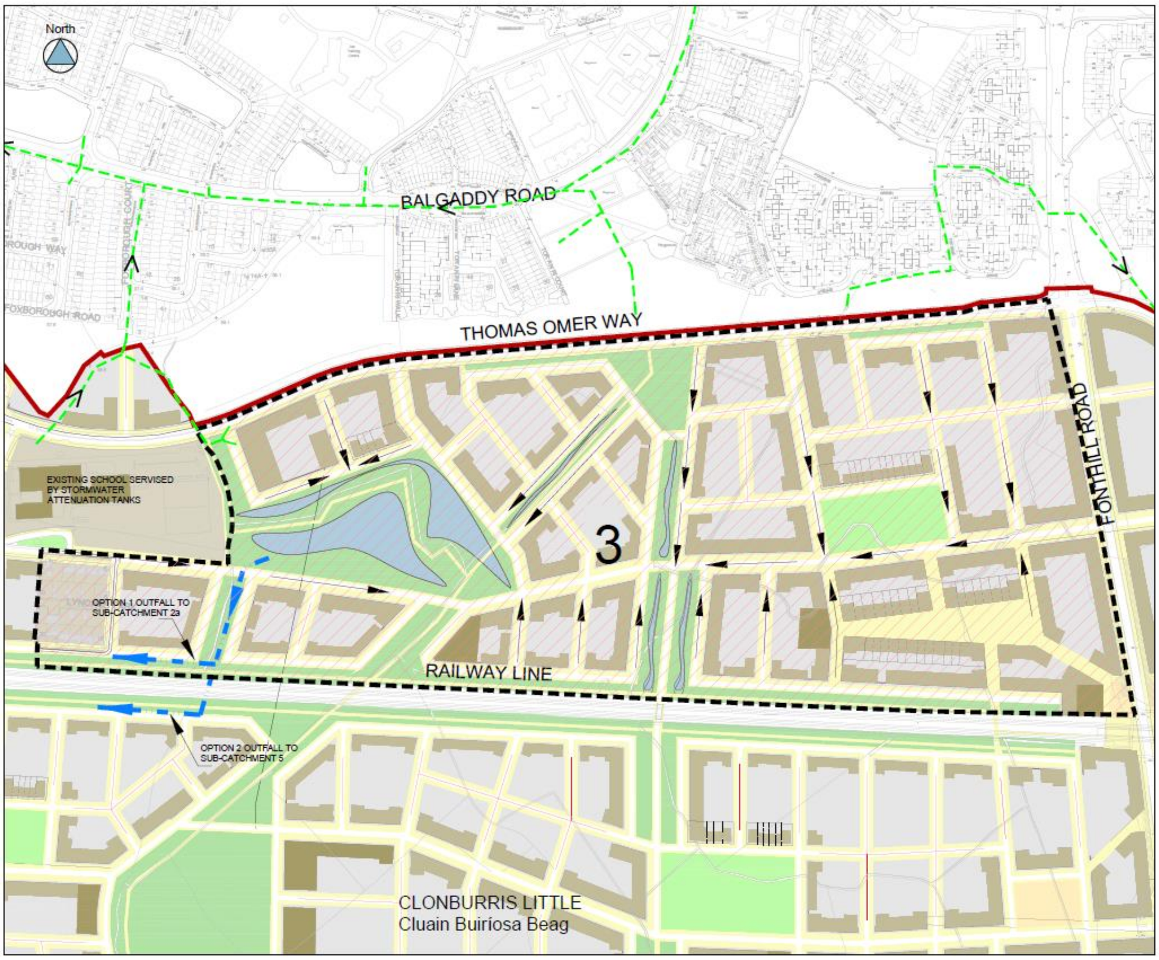
- Provision of a regional pond (ICW) adjacent Griffeen Avenue;
- Discharge from regional pond at 2 l/sec/ha to:
  - Existing 1500mm diameter surface water culvert on Griffeen Avenue subject to upstream retro-fitting of SuDS to alleviate flooding for the 1 in 100-year storm event; or
  - New surface water culvert to the Griffeen River;

- Existing road drainage of Outer Ring Road (refer section 2.1.5) to be maintained or diverted into future site drainage at detailed design stage;
- Discharge from individual sites/plots at 2 l/sec/ha.

5.3 Stormwater Infrastructure Requirements Sub-catchment 3

Sub-catchment 3 comprises lands north of the railway line and west of Fonthill Road, refer Figure 5-5.

Figure 5-5: Strategic Drainage Approach to Sub-catchment 3



5.3.1 Stormwater Requirements

- Provision of a regional pond (ICW) within central green open space;
- Discharge from regional pond at 2 l/sec/ha to:
  - Sub-catchment 2a (Option 1), together with all associated surface water infrastructure requirements, refer section 0, or;
  - Proposed attenuation Pond within sub-catchment 5 (Option 2). This will require a crossing of the railway line and associated Irish Rail discussions;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Site filling adjacent Fonthill Road.

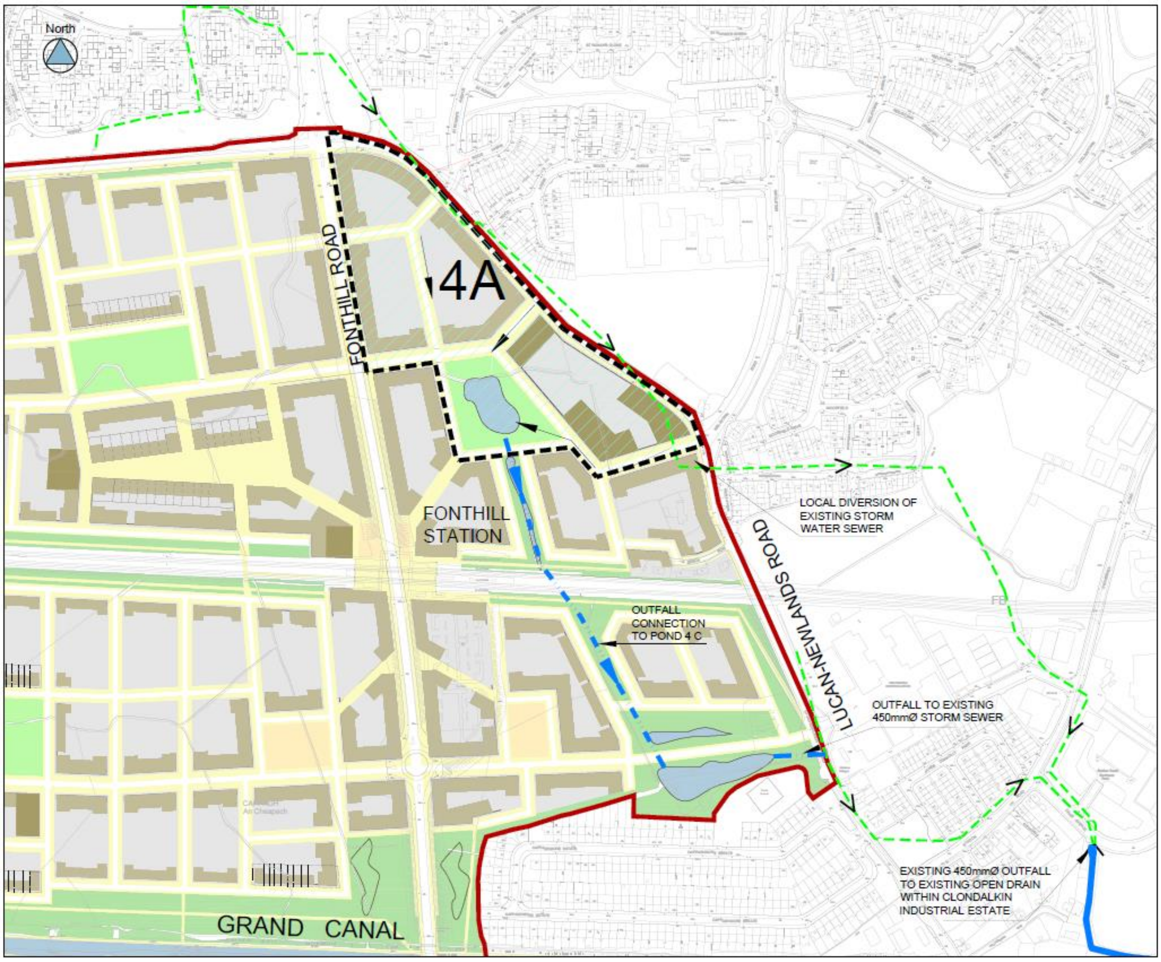
5.4 Stormwater Infrastructure Requirements Sub-catchment 4

Area 4 comprises 3 separate sub-catchments as outlined hereunder.

5.4.1 Sub catchment 4a

Sub-catchment 4a comprises lands north of the railway line and east of Fonthill Road, refer Figure 5-6.

Figure 5-6: Strategic Drainage Approach to Sub-catchment 4a



5.4.1.1 Stormwater Requirements

- Provision of a pond within the proposed green area;
- Discharge from the pond at 2 l/sec/ha to proposed regional pond within sub-catchment 4c which will require a crossing of the railway line and associated Irish Rail discussions;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Diversion of part of existing primary surface water culvert from Foxdene.

5.4.2 Sub catchment 4b

Sub-catchment 4b comprises lands south of the railway line and west of Fonthill Road, refer Figure 5-7.

Figure 5-7: Strategic Drainage Approach to Sub-catchment 4b

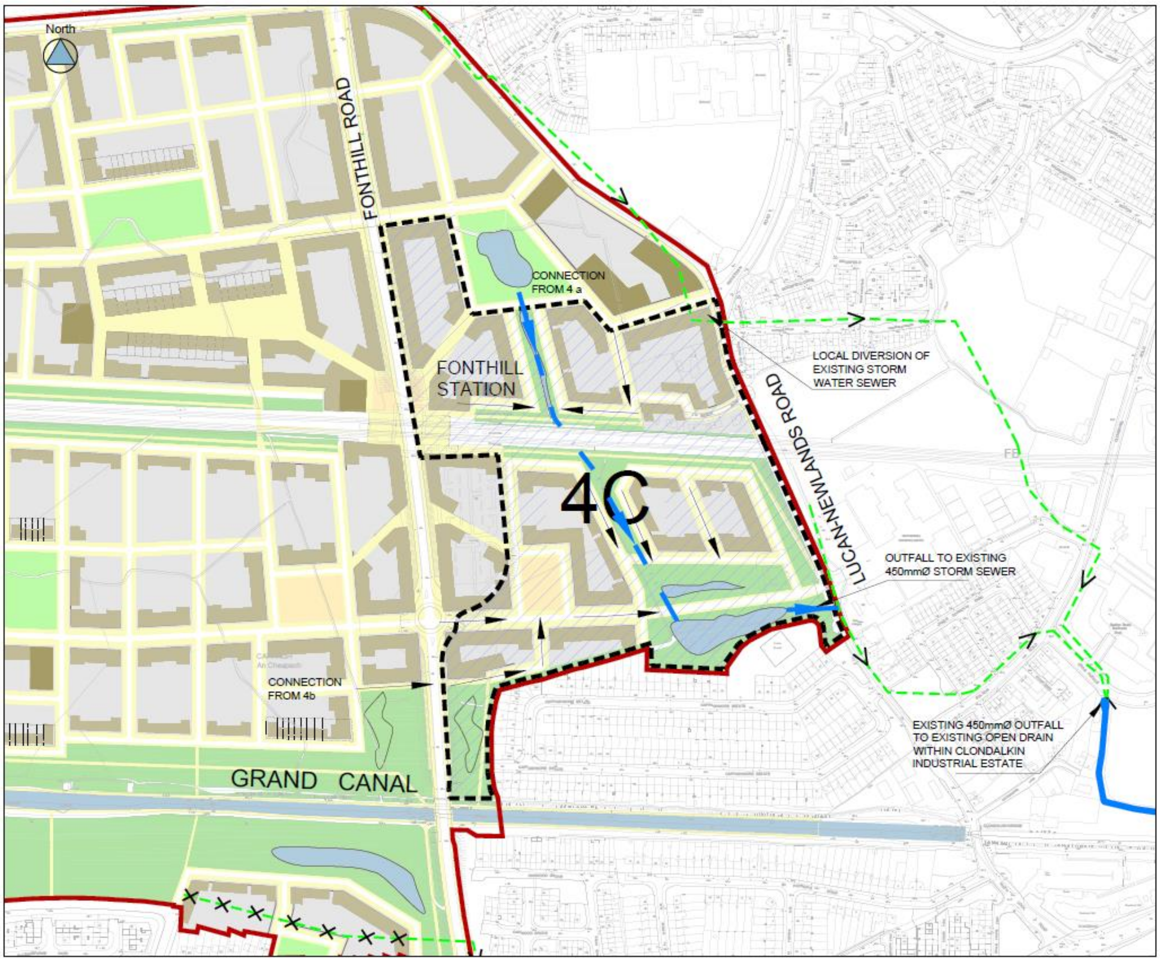
5.4.2.1 Stormwater Requirements

- Provision of 2 no. detention basins within the proposed pubic open space;
- Discharge from the detention basins at 2 l/sec/ha to proposed regional pond within sub-catchment 4c;
- Discharge from individual sites/plots at 2 l/sec/ha.

5.4.3 **Sub catchment 4c**

Sub-catchment 4c comprises lands north and south of the railway line and east of Fonthill Road, refer Figure 5-8.

Figure 5-8: Strategic Drainage Approach to Sub-catchment 4c



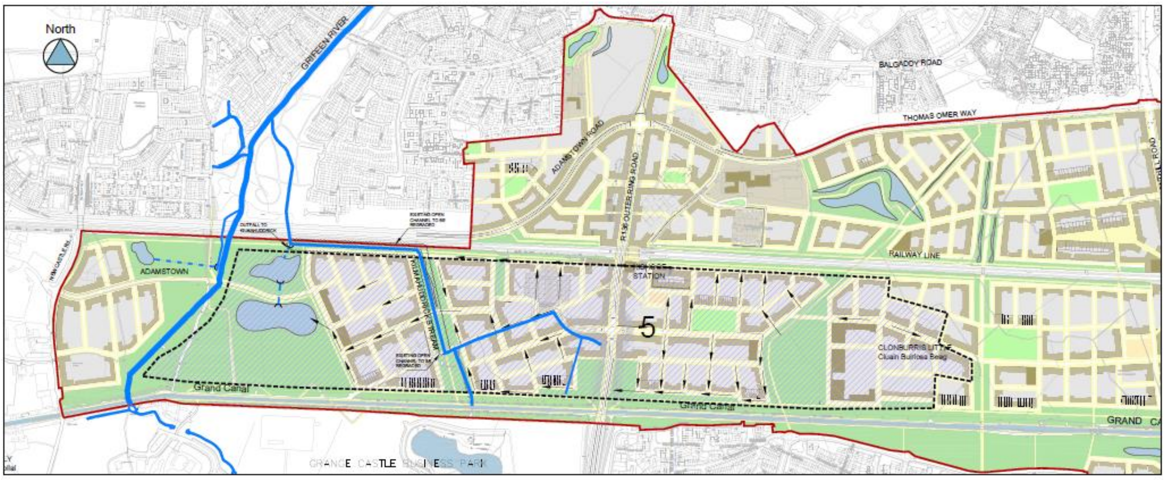
5.5.2.1 Stormwater Requirements

- Provision of a regional pond (ICW) adjacent Lucan - Newlands Road;
- Discharge at 2 l/sec/ha to existing 450mm diameter storm culvert on Lucan - Newlands Road;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Diversion of part of existing primary surface water culvert from Foxdene.

5.5 Stormwater Infrastructure Requirements Sub-catchment 5

Sub-catchment 5 comprises lands south of the railway line and both east and west of the Outer Ring Road, refer Figure 5-9.

Figure 5-9: Strategic Drainage Approach to Sub-catchment 5



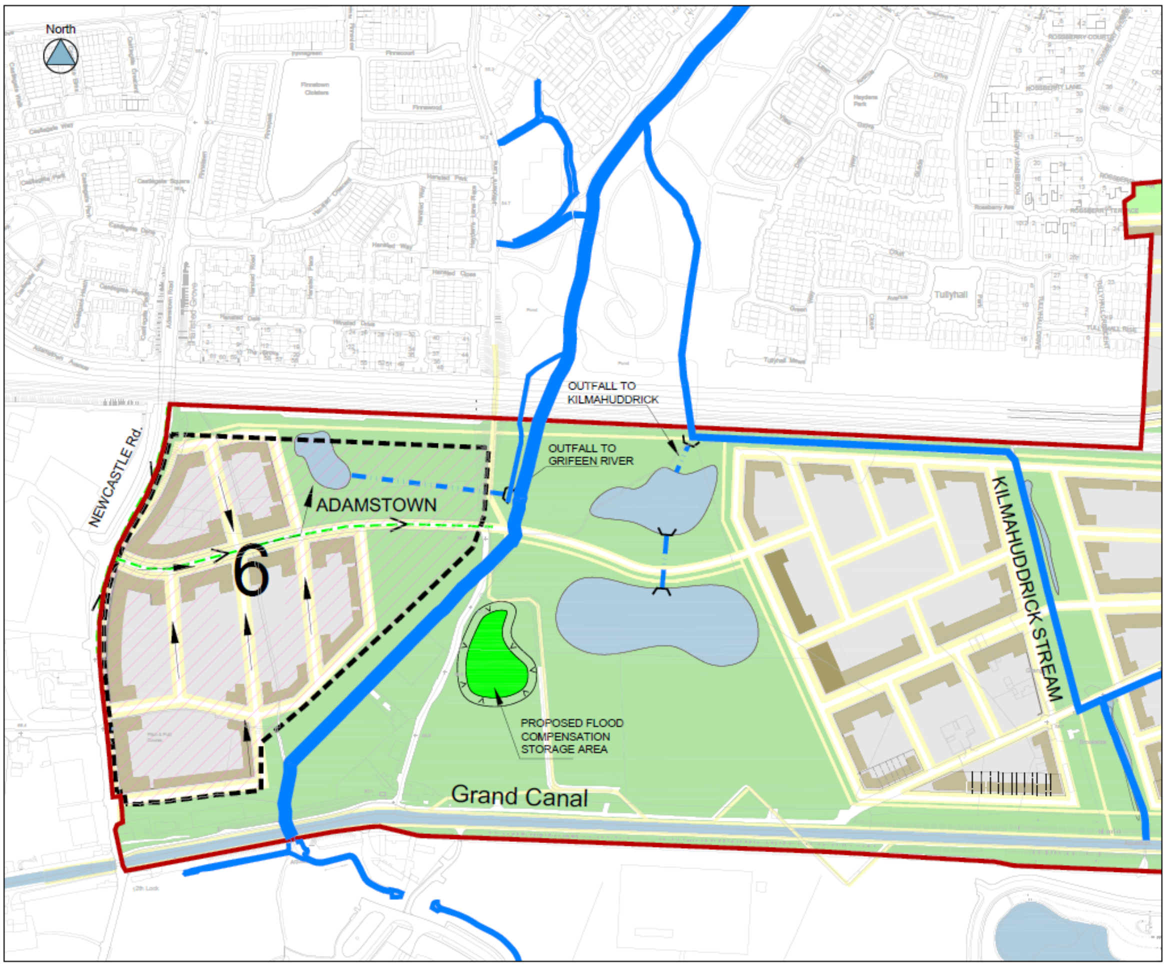
5.5.1 Stormwater Requirements

- Provision of a regional pond (ICW) within Griffeen Park;
- Discharge from regional pond at 2 l/sec/ha to existing culvert (ref 1) under the railway line, refer section 2.1.1;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Potential attenuated discharge from sub-catchment 3, refer section 5.3.1;
- Existing Kilmahuddrick Stream to be regraded downstream of Lynch's Lane;
- Existing road drainage of Outer Ring Road (refer section 2.1.5) to be maintained or diverted into future site drainage at detailed design stage.

5.6 Stormwater Infrastructure Requirements Sub-catchment 6

Sub-catchment 6 comprises lands immediately east of the Newcastle Road and south of the Railway line, refer Figure 5-10.

Figure 5-10: Strategic Drainage Approach to Sub-catchment 6



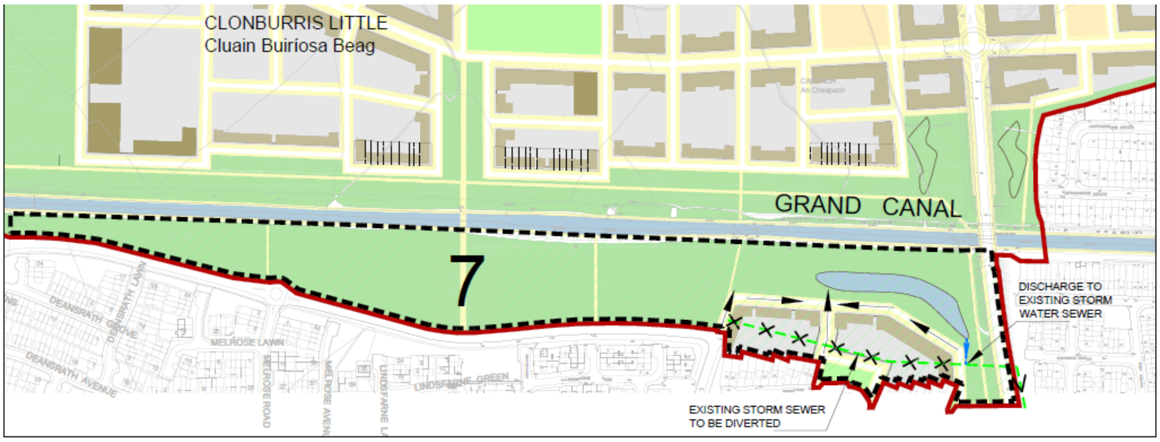
5.6.1 Stormwater Requirements

- Provision of a regional pond (ICW) within Griffeen Park;
- Discharge from regional pond at 2 l/sec/ha to existing culvert 1(b) under the railway line, refer section 2.1.1;
- Discharge from individual sites/plots at 2 l/sec/ha;
- Existing road drainage of the Newcastle Road (R120), refer Section 2.8 to be maintained or diverted into future site drainage at detailed design stage;
- Flood compensation storage to be provided due to provision of regional pond which is likely to impact on the Flood Zone B, refer Figure 2-10.

5.7 Stormwater Infrastructure Requirements Sub-catchment 7

Sub-catchment 7 comprises lands south of the Grand Canal, refer Figure 5-11.

Figure 5-11: Strategic Drainage Approach to Sub-catchment 7



5.7.1 Stormwater Requirements

- Provision of a regional pond (ICW) south of the Grand Canal and west of Fonthill Road;
- Discharge from regional pond at 2 l/sec/ha to existing culvert traversing the site which will be diverted;
- Discharge from individual sites/plots at 2 l/sec/ha;

6 Design Criteria and required storage provision

6.1 Introduction

The subject strategy provides a framework for the detailed design stage. It is considered that the detailed design should be provided for through a coordinated Surface Water Management Plan. The SuDS measures within the Surface Water Management Plan shall incorporate best practice and have regard to the SuDS Manual (CIRIA C753) for guidance.

The SuDS Manual (CIRIA C753) set out appropriate design criteria based on four main parameters:

1. Runoff Destination (in order of preference) to:
    a. Ground;
    b. Surface water body;
    c. Road drain or surface water sewer; or to
    d. Combined sewer.
2. Peak flow rate and volume (pre-and post-development).
3. Water Quality (based on potential hazards arising from development and sensitivity of the runoff destination).
4. Function (design; flood risk; biodiversity, amenity, operation and maintenance).

The Surface Water Management Plan shall provide for a balance of the four main parameters within the Planning Scheme.

6.1.1 Run-off destination

Surface water will be discharged off site to either the Griffeen or Camac River via existing and/or new surface water infrastructure. Geotechnical investigative works may identify infiltration potential within the site which can be utilised to reduce the volume of runoff into adjacent watercourses. Such investigation is required to inform detailed design.

6.1.2 Peak flow rate and volume

The Greater Dublin Strategic Drainage study (GDSDS) requirements are as outlined in Table 6-1.

Table 6-1: Compliance with GDSDS Criteria

Criteria	Sub-criteria	Return Period (Years)	Design objective
Criterion 1 River water quality	1.1	<1	Interception storage of at 5mm, and preferably 10mm, of rainfall where run-off to the receiving water can be prevented
	1.2	<1	Where initial run-off from at least 5mm of rainfall

Criteria	Sub-criteria	Return Period (Years)	Design objective
protection			cannot be intercepted, treatment of run-off is required.
Criterion 2 River regime protection	2.1	1	Discharge rate equal to 1 year Greenfield site peak run-off rate or 2l/s/ha, whichever is greater. Site critical duration storm to be used to assess attenuation storage volume.
Criterion 3 Level of Service	3.1	30	No flooding on site except where specifically planned flooding is approved. Summer design storm of 15 or 30 minutes are normally critical.
	3.2	100	No internal property flooding. Planned flood routing and temporary flood storage accommodated on site for short high intensity storms. Site critical duration events.
	3.3	100	No internal property flooding. Floor levels at least 500mm above maximum river level and adjacent on-site storage retention.
	3.4	100	No flooding of adjacent urban areas. Overland flooding managed within the development.
Criterion 4 River flood protection (4.1 , 4.2 or 4.3 to be applied)	4.1	100	“Long term” floodwater accommodated on site for development runoff volume which is in excess of the Greenfield run-off volume. Temporary flood storage drained by infiltration on a designated flooding area brought into operation by extreme events only. 100 year 6-hour duration to be used for assessment of the additional volume of run-off.
	4.2	100	Infiltration storage provided equal in volume to “long term” storage. Usually designed to operate for all events. 100 year 6-hour duration to be used for assessment of the additional volume of run-off.
	4.3	100	Maximum discharge rate of QBAR or 2l/s/ha, whichever is greater, for all attenuation storage where separate “long term” storage cannot be provided.

6.2 **Design storage volumes**

A full suite of attenuation requirements has been undertaken using Micro Drainage (Windes), summary as per Table 6-2.

The attenuation ponds have been sized to cater for all public roads and green open spaces up to and including the 100-year storm event plus 20% climate change.

It is a requirement that all individual plots will attenuate storm flows internally up to and including the 1 in 100-year storm event plus climate change. Attenuated flows can be discharged into the public drainage system to be provided to all internal roads.

For the purpose of these preliminary calculations, it has been assumed that there is no soil infiltration available on-site. Future site investigation whereby the capacity of the ground for infiltration will be assessed may allow a reduction in the overall attenuation requirements.

6.2.1 **Drain Down Times**

Based on the volumes of attenuation and associated discharge rates, drain down times are envisaged to be prolonged. The probability of subsequent storms, whereby, the pond will not have emptied completely prior to the onset of further rainfall should be considered at detail design.

The primary requirements for attenuation volumes within the regional ponds is a function of the total area of roads and public open spaces contributing surface water run-off. In reality, it is expected the provision of SuDS devices at source (i.e. via swales and other SuDS devices flanking the roads) the requirement for attenuation volume at the regional ponds may reduce. SuDS measures must be incorporated along roadways and greenways, to reduce the demand on regional ponds. Proper design and implementation of SuDS measures at source will further improve the hydraulic resilience within the regional ponds.

This coupled with the potential volume reduction due to infiltration is likely to reduce the drain down times to occeptable limits.

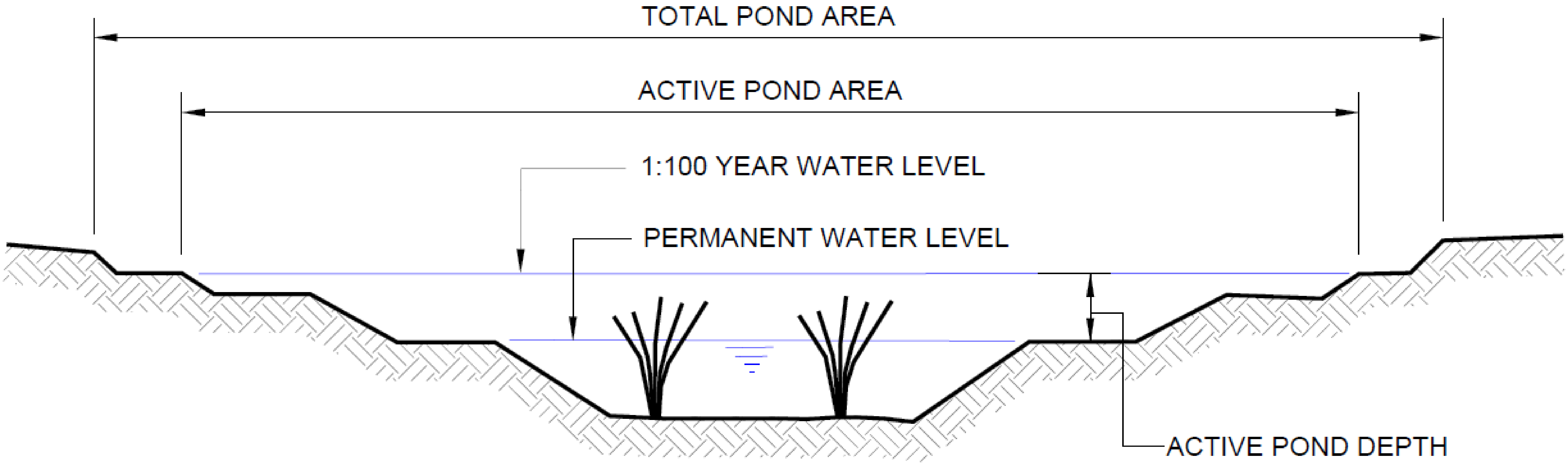
Table 6-2: Estimation of Attenuation Storage Volumes

Surface water sub-catchment		**Approximate limiting discharge**	**Breakdown of volume required**		**Typical Active Depth of Pond (above permanent water level)**	**Approx. active pond area i.e. area with fluctuating water levels**	**Approx. Footprint of pond area for 1 in 3 side slopes (i.e. total pond area incorporating benching and side slopes to tie in with GL)**	**Storage Structure proposed**
			Estimated Permanent water volume (for water quality)	**Estimated 1 in 100-year storage volume**				
		(l/sec)	**(m^3)**	**(m^3)**	**(m)**	**(m^2)**	**(m^2)**	
1	Northwest (NW)	43.4	3,253	3,562	1.0	3,562	7,022	Pond
2a	North A (NA) in part	20.7		2,648	NA	2545	NA	Detention Basin
2b	North A (NA) in part	16.0	1,200	927	0.5	1,854	3,312	Pond
3	North A (NA) in part and North B (NB)	105.1	7,886	13,920	0.8	17,400	22,083	Pond
4a	Northeast (NE)	19.5	1,465	3,252	1.0	3,252	6,408	Pond
4b1	South B (SB in part)	65.4	4,902	8,033	NA	6032	NA	Detention Basin
4b2	South B (SB in part)							Detention Basin
4c	southeast (SE)	117.5	2,445	3,189	0.5	6,378	6,752	pond
5	South B (SB) in part, South A (SA) and South West (SW)	198.1	14,856	22,614	1.2	18,845	24,130	pond
6	Adamstown Extension (AE)	27.6	2,072	4,258	1.0	4,258	7,851	pond
7	Canal Extension (CE)	14.2	1,068	1,514	1.0	1,514	2,220	Pond

Notes:

1. Above water depths and volumes are preliminary only and subject to change at detailed design stage
2. Typical Active Depth of Pond based on existing topography and invert level of proposed outfalls - subject to change at detailed design which may impact overall volumes and pond dimensions
3. The above table should be read in conjunction with Section 6.2 of this strategy document.
4. A typical schematic of an attenuation pond in support of the above terminology is as shown in Figure 6-1

Figure 6-1: Typical Attenuation Pond Layout & Terminology



6.2.2 Climate Change

The capacity of the drainage system must take account of the likely impacts of climate change and likely changes in impermeable area within the development over the design life of the development.

SuDS and integrated blue/green networks must be designed to manage all surface water runoff up to 1 in 100-years including an allowance for 20% climate change for rainfall.

6.3 Hydraulic Design Criteria

It is proposed that hydraulic design criteria shall comply with the GDSDS unless otherwise stated within this report.

Appendices

A JBA Strategy Drawings

2016s5230-001	Site Location Map	PL0
2016s5230-002	Stormwater Sub-catchments	PL0
2016s5230-003	Stormwater Management Strategy	PL0
2016s5230-004	Sub-catchment 1 Northwest Sector	PL0
2016s5230-005	Sub-catchment 2a North Sector	PL0
2016s5230-006	Sub-catchment 2b North Sector	PL0
2016s5230-007	Sub-catchment 3 North A and B Sector	PL0
2016s5230-008	Sub-catchment 4a Northeast Sector	PL0
2016s5230-009	Sub-catchment 4b South B Sector	PL0
2016s5230-010	Sub-catchment 4c Southeast Sector	PL0
2016s5230-011	Sub-catchment 5 Southwest Sector	PL0
2016s5230-012	Sub-catchment 6 Adamstown Extension	PL0
2016s5230-013	Sub-catchment 7 Canal Extension	PL0
2016s5230-014	Existing Stormwater Infrastructure	PL0
2016s5230-015	Proposed Drainage Catchments	PL0
2016s5230-016	Existing Drainage Catchment	PL0
2016s5230-017	Level Strategy (to facilitate the SWMP)	PL0

References

Catchment Flood Management Plans

Eastern Catchment Flood Risk Assessment and Management Study by RPS on behalf of the Office of Public Works

Stormwater Management

Greater Dublin Strategic Drainage Study (GDSDS), 2005

Construction Industry Research and Information Association (CIRIA) C753 - The SuDS Manual (2016)

The NRA (now Transport Infrastructure Ireland) Design Manual for Roads and Bridges

http://www.uksuds.com/

www.gsi.ie

Institute of Hydrology (1985). The FSR rainfall-runoff model parameter estimation equations updated, FSSR no. 16, Institute of Hydrology.

Institute of Hydrology (1999). Flood Estimation Handbook, Vols 1-5, Wallingford: Institute of Hydrology

MicroDrainage Drainage Design (Windes)

Defra 2010 SWMP Technical Guidance


Legend
SDZ Boundary
Flood Zone A
Flood Zone B
Google Satellite

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SITE LOCATION MAP

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2016s5230-001	PL0	1 of 1	Planning

LEGEND

🟧	1	NORTHWEST SECTOR
🟨	2a	NORTH SECTOR
🟩	2b	NORTH SECTOR
🟥	3	NORTH A & B SECTOR
🟩	4a	NORTHEAST SECTOR
🟦	4b	SOUTH B SECTOR
🟦	4c	SOUTHEAST SECTOR
🟪	5	SOUTHWEST SECTOR
🟪	6	ADAMSTOWN SECTOR
🟩	7	CANAL EXTENSION

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Clonburris SDZ
STORMWATER SUB-CATCHMENTS

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PROPOSED MAIN STORMWATER PIPES —·—▶—·—

ATTENUATION POND 💧

DETENTION BASIN 🟧

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
STORMWATER MANAGEMENT STRATEGY

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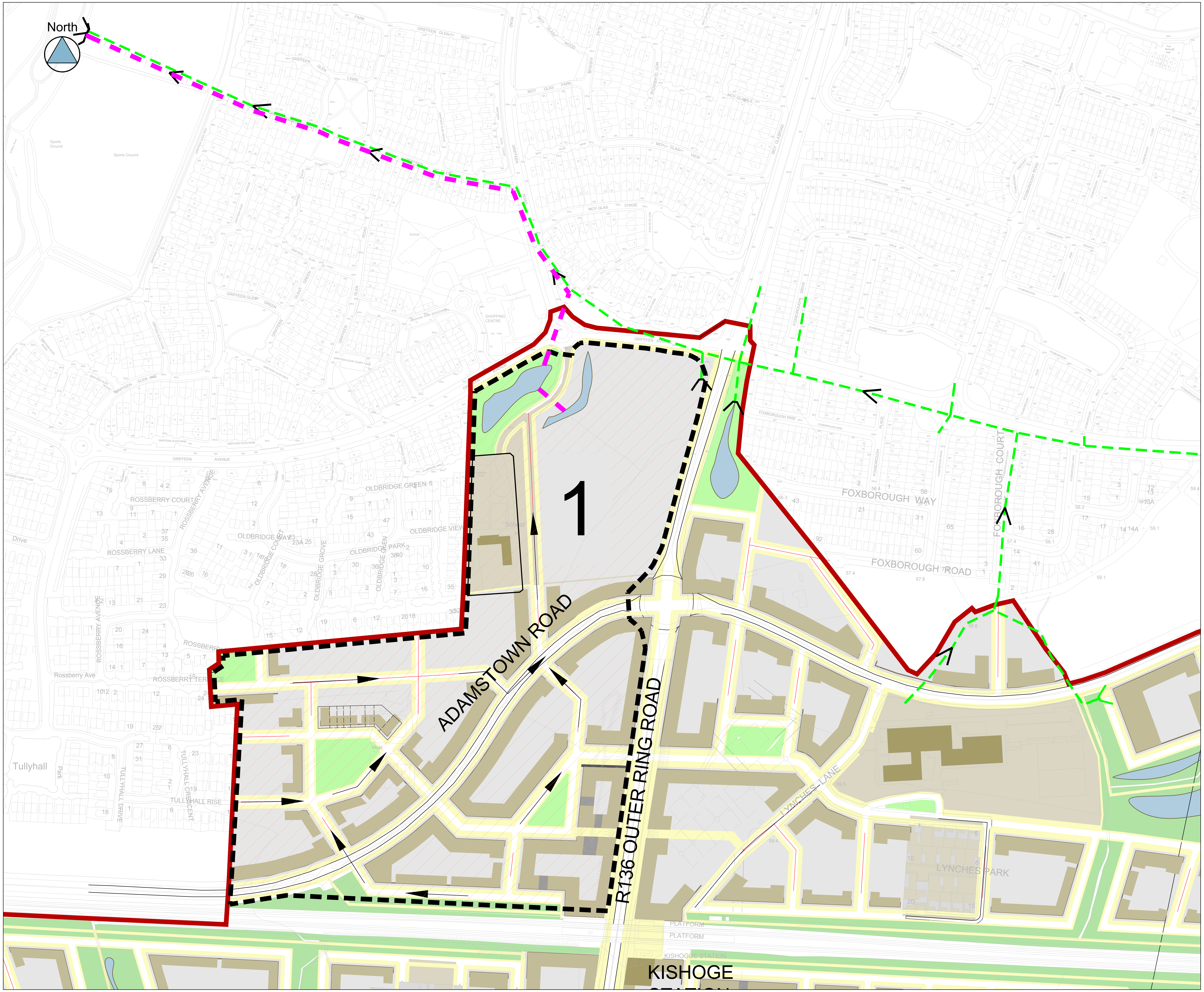

LEGEND

▨	NORTHWEST SECTOR
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ · ▬	PROPOSED STORM SEWER TO GRIFFEEN
▬ · ▬ · ▬	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
→	INDICATIVE DRAINAGE PATH
▰	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE FROM POND AT 2 litre\sec\ha TO EITHER

1. NEW STORM SEWER TO GRIFFEEN ,OR
2. EXISTING 1500mmØ STORM NETWORK SUBJECT TO RETRO FITTING OF SUDS UPSTREAM TO ALLEVIATE 1in100 YEAR FLOOD WITHIN

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Clonburris SDZ
SUB-CATCHMENT 1 NORTHWEST SECTOR

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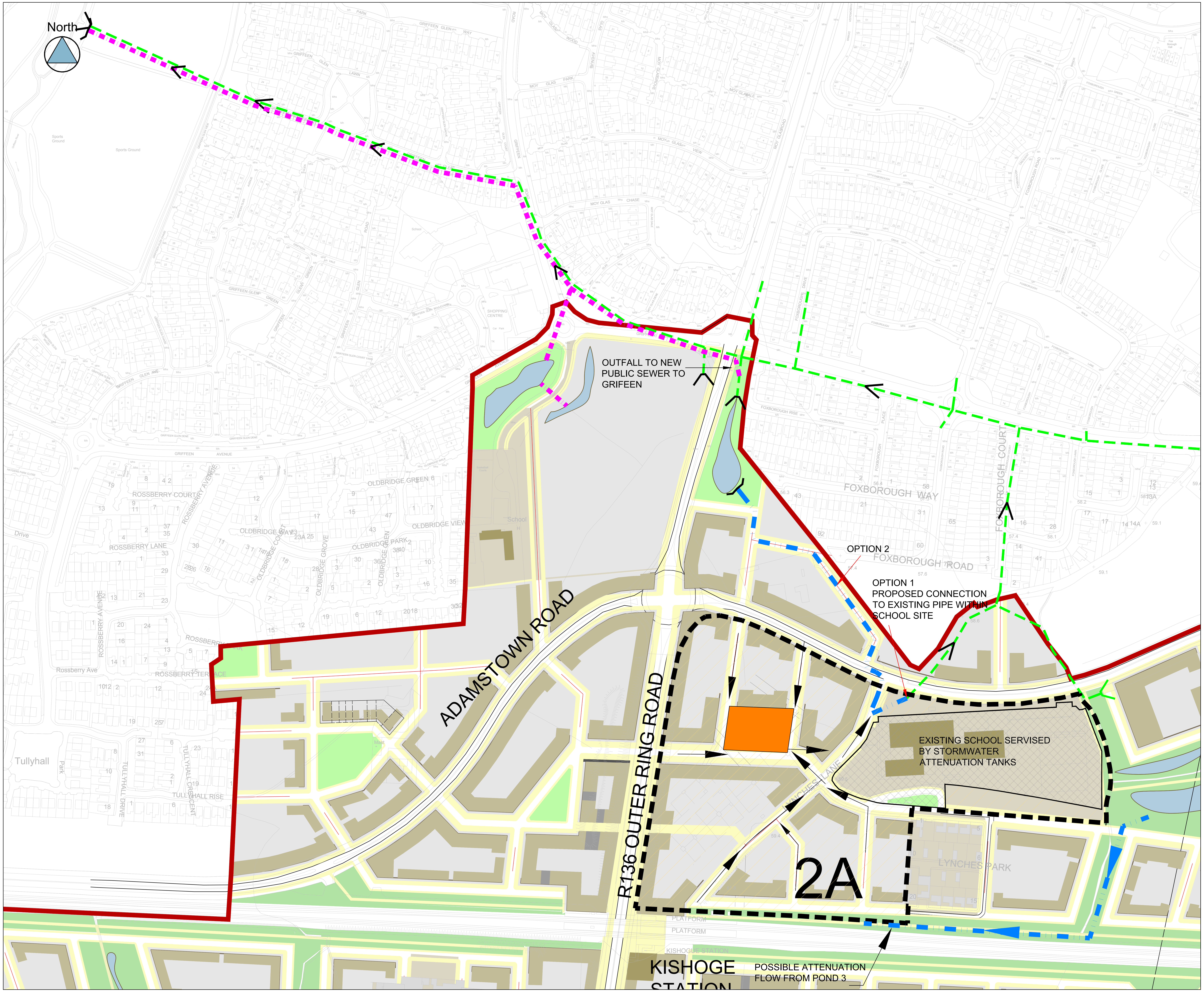

LEGEND

▭	2a NORTH SECTOR
■ ■ ■	SUB-CATCHMENT BOUNDARY
▪ ▪ ▪	PROPOSED STORM SEWER TO GRIFFEEN
▬ · ▬	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▱	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND
■	DETENTION BASIN

NOTE

ATTENUATED DISCHARGE FROM UNDERGROUND ATTENUATION SYSTEM TO EITHER

1. EXISTING 1050mmØ STORM SEWER WITH KISHOGE SCHOOL SITE SUBJECT TO

a) NEW STORM SEWER TO GRIFFEEN OR

b) RETRO FITTING OF SUDS UPSTREAM TO ALLEVIATE 1 in 100 YEAR FLOODING OR

2. SUB-CATCHMENT 2b

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SUB-CATCHMENT 2a NORTH SECTOR

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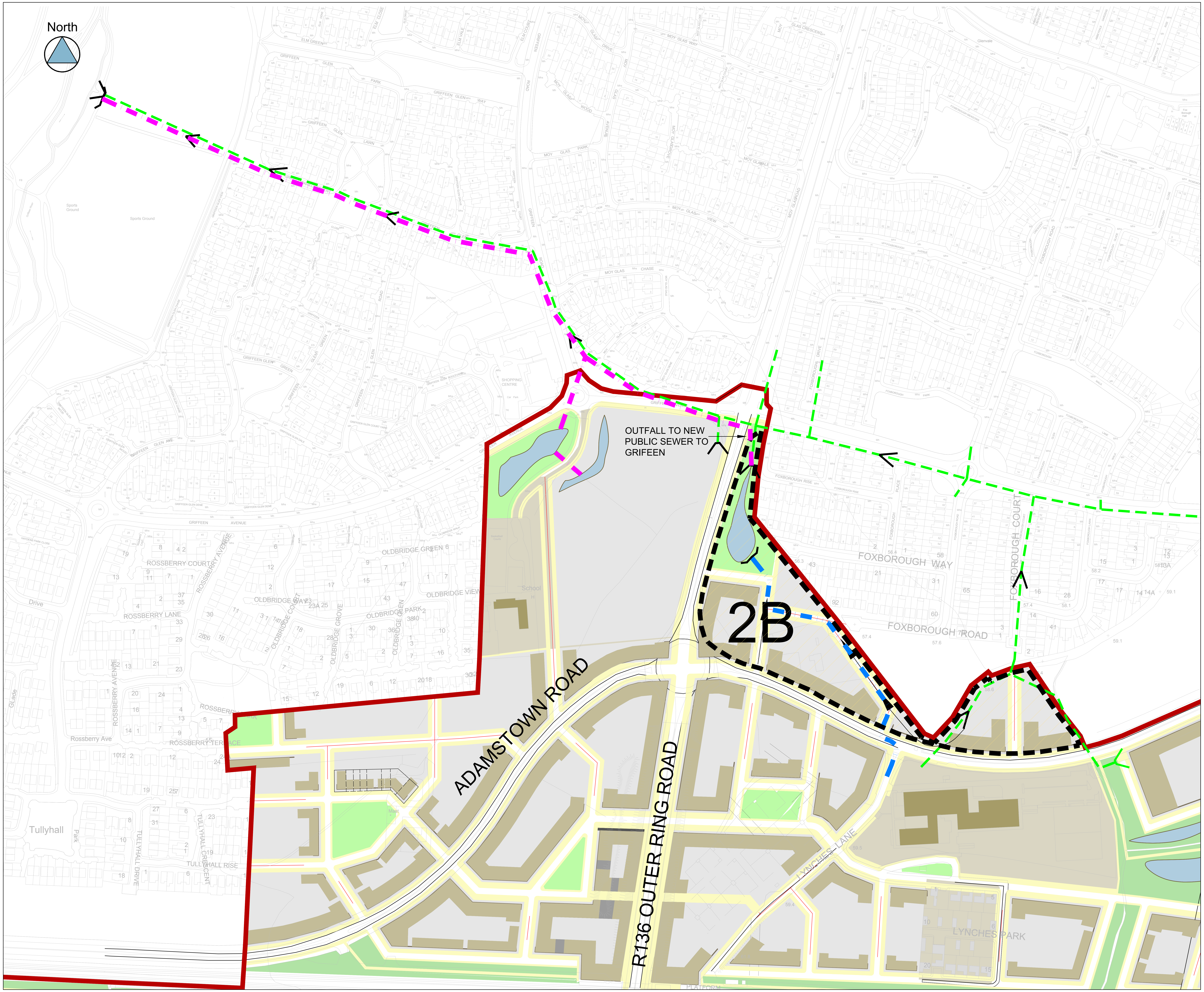

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▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ ·	PROPOSED STORM SEWER TO GRIFFEEN
▬ · ▬ ·	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▱	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE FROM POND AT 2 litre\sec\ha TO EITHER

1. NEW STORM SEWER TO GRIFFEEN ,OR
2. EXISTING 1500mmØ STORM NETWORK SUBJECT TO RETRO FITTING OF SUDS UPSTREAM TO ALLEVIATE 1in100 YEAR FLOOD WITHIN

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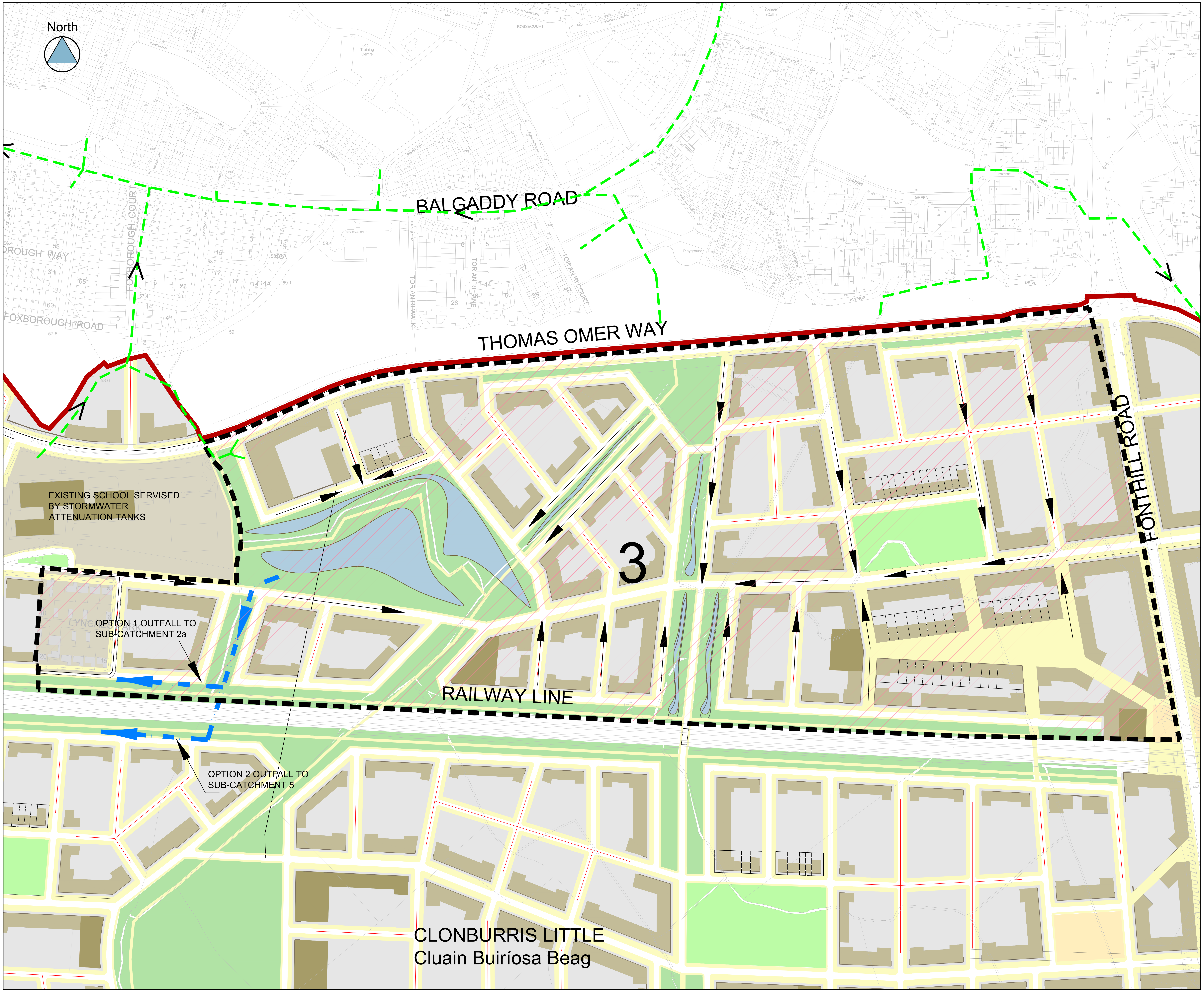

LEGEND

▨	3 NORTH A & B SECTOR
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ · ▬	PROPOSED STORM SEWER TO GRIFFEEN
▬ · ▬ · ▬	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▨	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE FROM POND AT 2 litre\sec\ha TO EITHER

1. SUB-CATCHMENT 2a OR
2. SUB-CATCHMENT 5

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SUB-CATCHMENT 3 NORTH A AND B SECTOR

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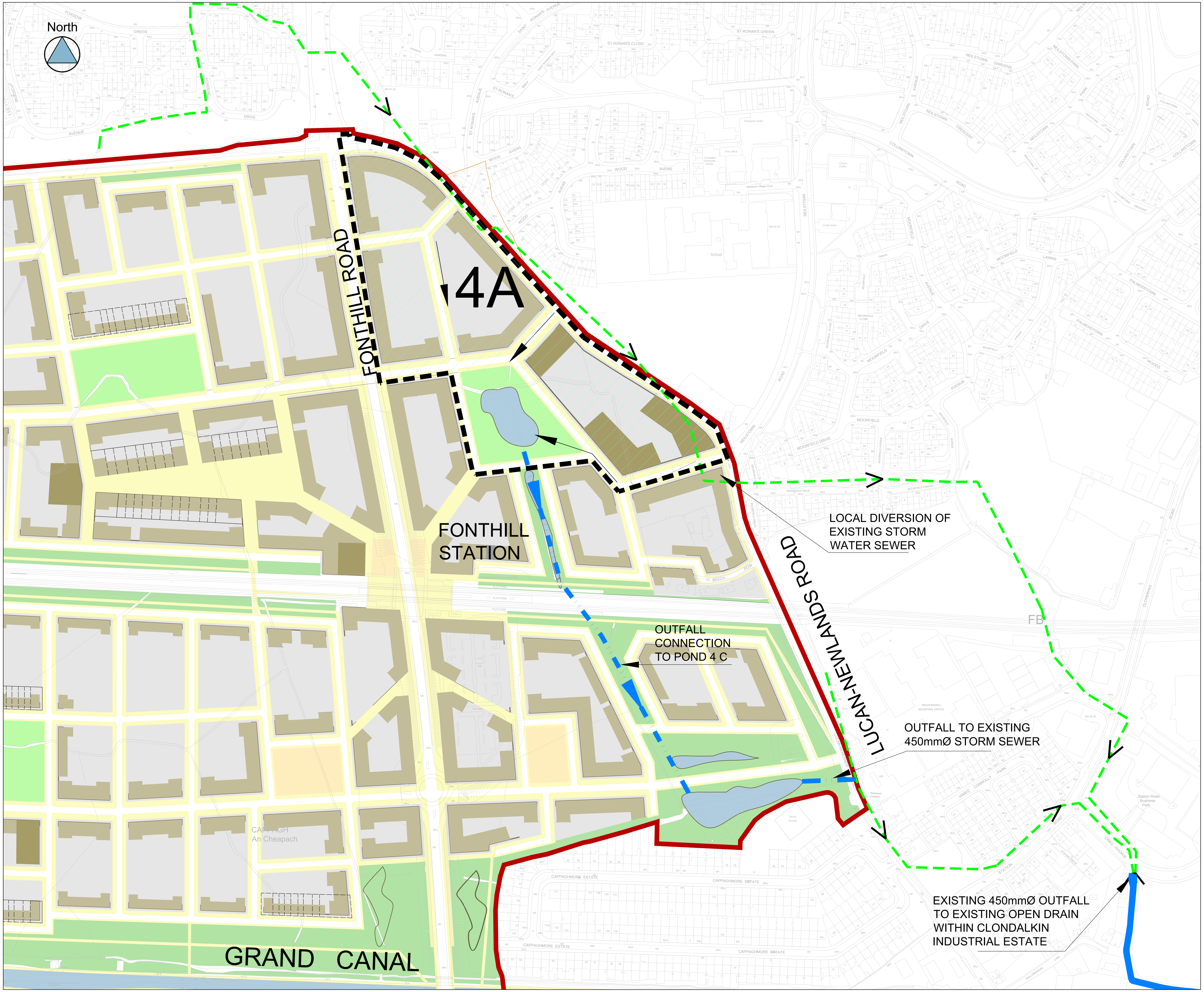

LEGEND

▨	4A NORTHEAST SECTOR
■ ■ ■ ■	SUB-CATCHMENT BOUNDARY
- · - · -	PROPOSED STORM SEWER TO GRIFFEEN
- · - · -	OUTFALL PIPE
- - - -	EXISTING STORMWATER SEWER
——►	INDICATIVE DRAINAGE PATH
▨	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE FROM POND AT 2 litre\sec\ha TO EITHER VIA PIPE AND\OR OPEN CHANNEL TO POND 4C

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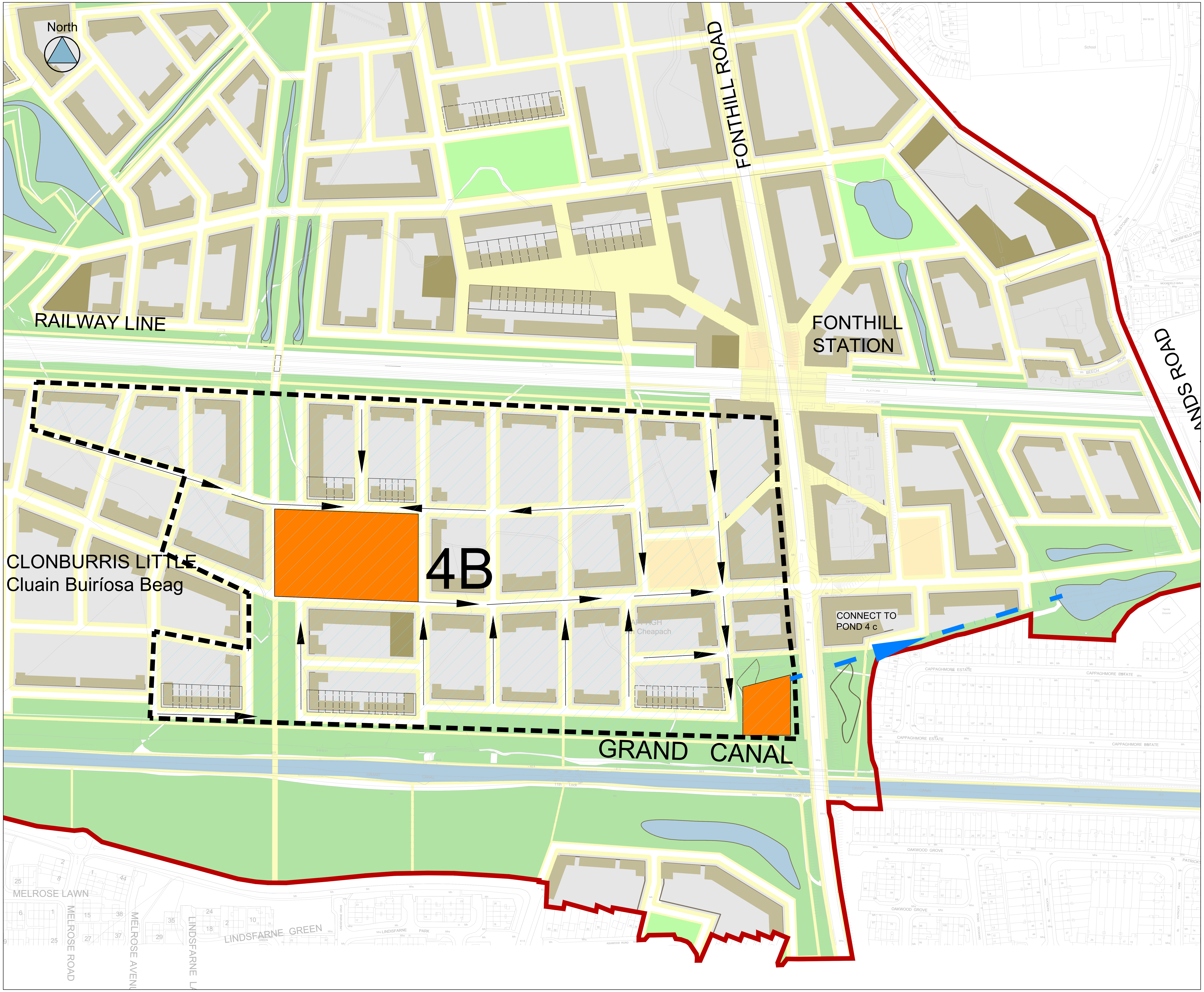

LEGEND

▨	4B SOUTH B SECTOR
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ ·	STORMWATER CONNECTION
▬ · ▬ ·	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▰	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND
🟧	DETENTION BASIN

NOTE

ATTENUATED DISCHARGE AT
2 litre\sec\ha FROM SUB-CATCHMENT
4B TO POND 4C

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for

CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SUB-CATCHMENT 4B SOUTH B SECTOR

Scale:
1:2000 @ A1

Drawn: 15/03/17
Designed: DMD 15/06/16
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Approved: JNC 15/06/16

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2016s5230-009	PL0	1 of 1	Planning

LEGEND

▨	4C SOUTHEAST SECTOR
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ ·	STORMWATER CONNECTION
▬ · ▬ ·	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▱	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND
🟧	DETENTION BASIN

NOTE

ATTENUATED DISCHARGE OF 2 litre\sec\ha TO EXISTING 450mmØ STORM PIPE

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SUB-CATCHMENT 4C SOUTHEAST SECTOR

Scale: 1:2000 @ A1

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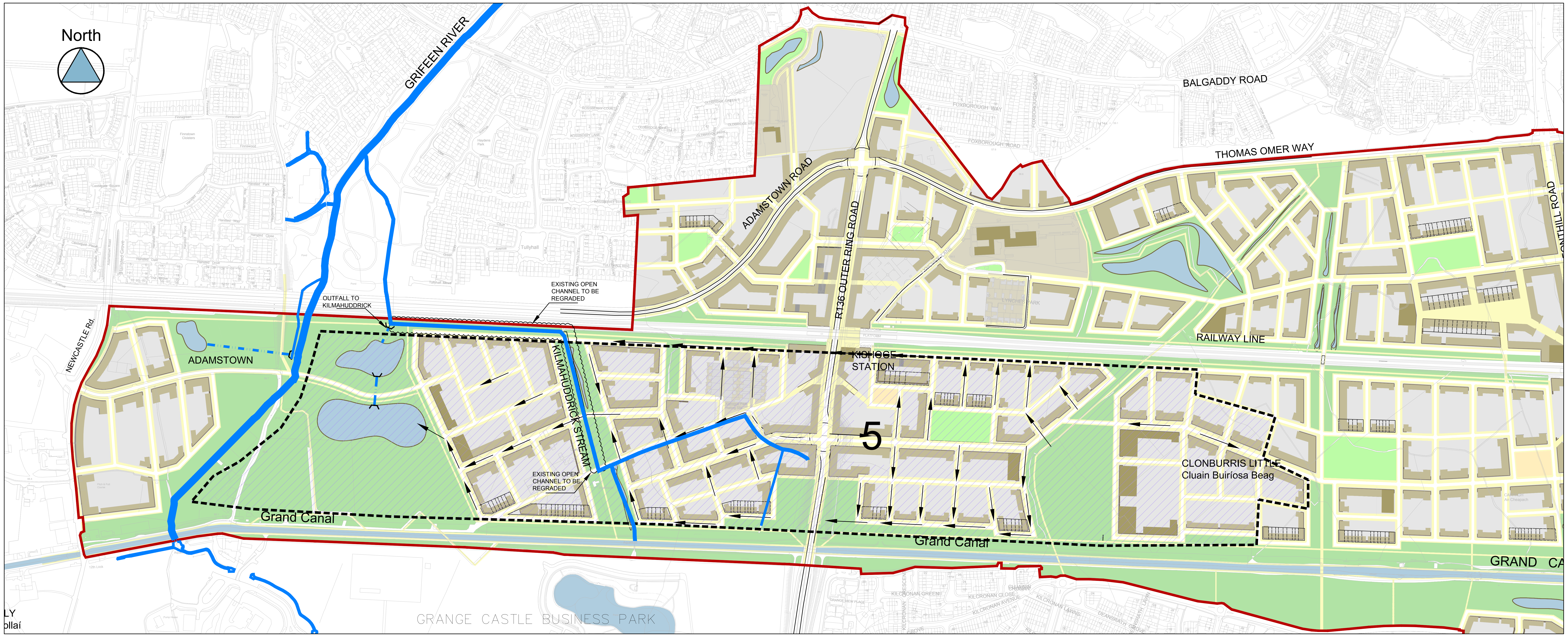

LEGEND

▨	5 SOUTHWEST SECTOR
▬ ▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ ▬ ▬ ▬	STORMWATER CONNECTION
▬ · ▬ · ▬	OUTFALL PIPE
▬ ▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▨	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE OF 2 litre\sec\ha
TO GRIFFEEN RIVER

ENLARGED LAYOUT PLAN
Scale 1:2000

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SUB-CATCHMENT 5 SOUTHWEST SECTOR

Scale: 1:5000 @ A1
Drawn: 15/03/17
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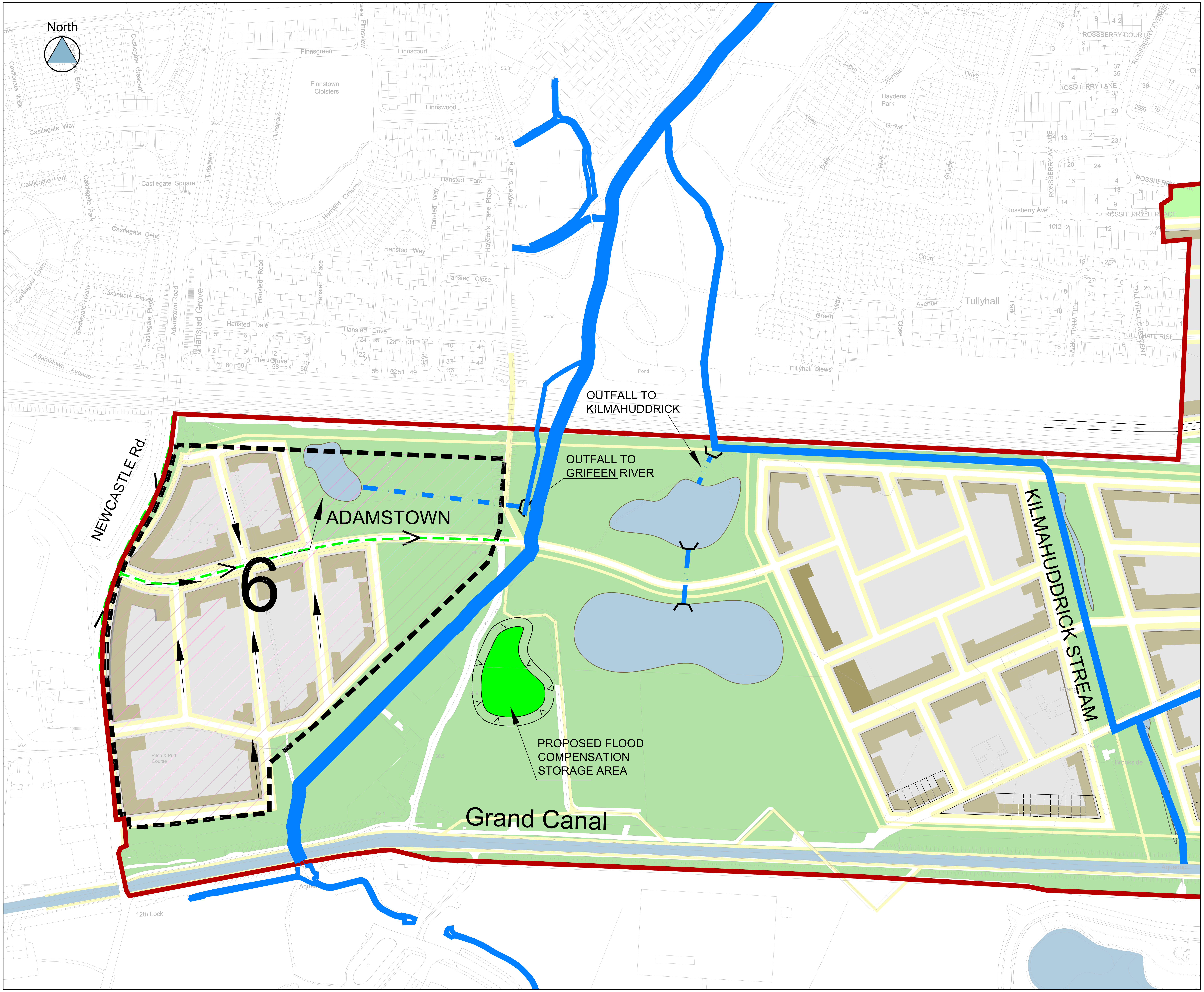

LEGEND

▨	6 ADAMSTOWN EXTENSION
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ ▬ ▬	STORMWATER CONNECTION
▬ · ▬ · ▬	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
──►	INDICATIVE DRAINAGE PATH
▰	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE OF 2 litre\sec\ha TO GRIFEEN RIVER

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SUB-CATCHMENT 6 ADAMSTOWN EXTENSION

Scale: 1:2000 @ A1

Drawn: 15/03/17
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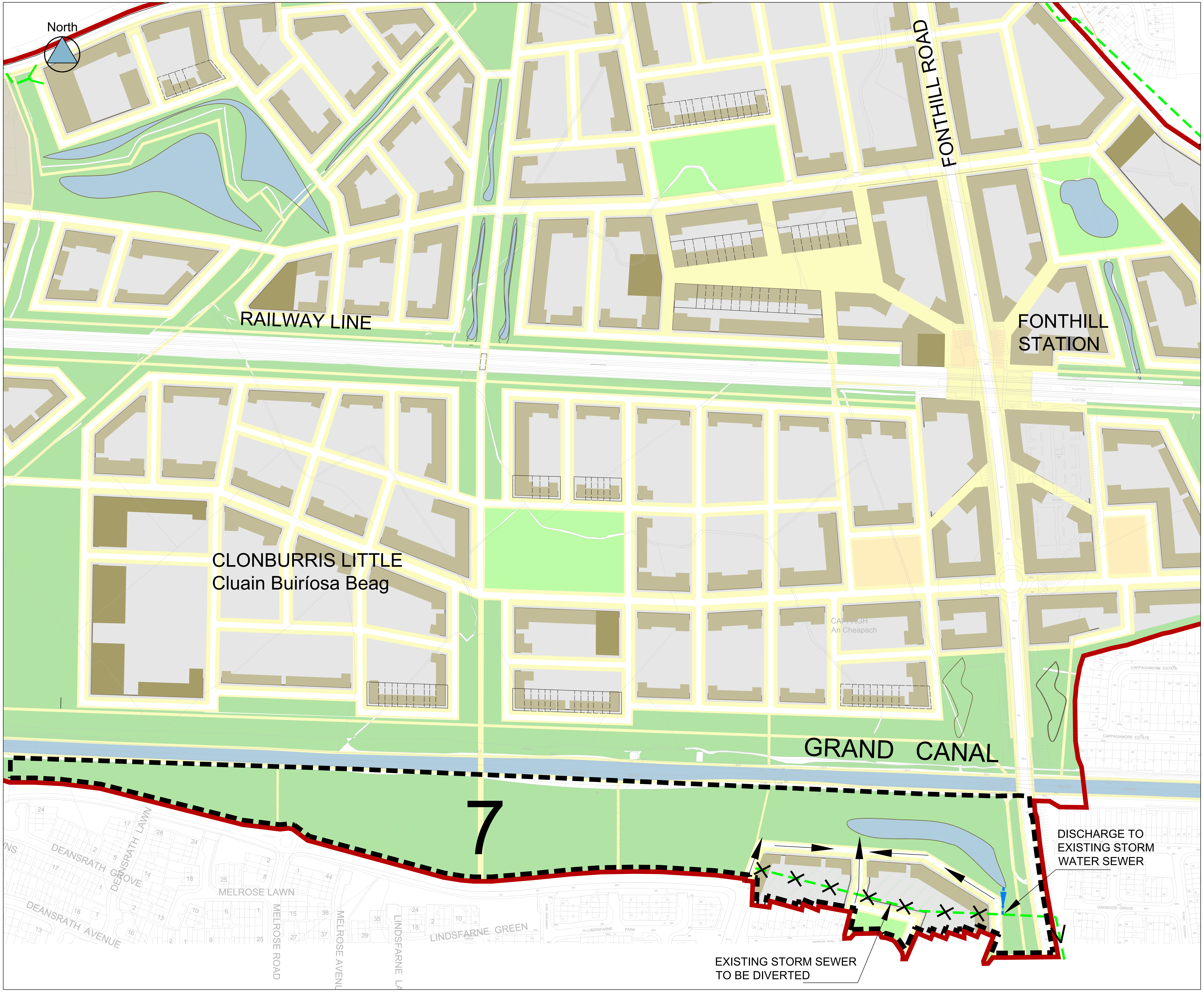

LEGEND

▨	7 CANAL EXTENSION
▬ ▬ ▬	SUB-CATCHMENT BOUNDARY
▬ · ▬ · ▬	STORMWATER CONNECTION
▬ · ▬ · ▬	OUTFALL PIPE
▬ ▬ ▬	EXISTING STORMWATER SEWER
⟶	INDICATIVE DRAINAGE PATH
▨	TYPICAL FOOTPRINT FOR REGIONAL ATTENUATION POND

NOTE

ATTENUATED DISCHARGE OF 2 litre\sec\ha TO EXISTING STORM SEWER NETWORK

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
SUB-CATCHMENT 7 CANAL EXTENSION

Scale:		
1:2000 @ A1	Drawn:	15/03/17
	Designed: DMD	15/06/16
	Checked: DW	15/06/16
	Approved: JNC	15/06/16

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LEGEND

EXISTING WATERCOURSE	━━
EXISTING STORMWATER SEWER	- - -

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
EXISTING STORMWATER INFRASTRUCTURE

Scale: 1:5000 @ A1

Drawn: 15/03/17
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LEGEND

PROPOSED DRAINAGE CATCHMENT TO GRIFFEEN	🟩
PROPOSED DRAINAGE CATCHMENT TO CAMAC	🟨

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
PROPOSED DRAINAGE CATCHMENTS

Scale:
1:5000 @ A1

Drawn: 15/03/17
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2016s5230-015	PL0	1 of 1	Planning

LEGEND

EXISTING DRAINAGE
CATCHMENT TO GRIFFEEN 🟩

EXISTING DRAINAGE
CATCHMENT TO CAMAC 🟨

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
EXISTING DRAINAGE CATCHMENTS

Scale:
1:5000 @ A1

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2016s5230-016	PL0	1 of 1	Planning

LEGEND

🟧 AREAS OF FILL REQUIRED FOR
SURFACE WATER MANAGEMENT PLAN
TYPICALLY 0.5 -1.0m

🟩 AREAS OF FILL REQUIRED FOR
SURFACE WATER MANAGEMENT PLAN
TYPICALLY 0.5 -2.5m

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CLONBURRIS DEVELOPMENT AREA

Clonburris SDZ
LEVEL STRATEGY TO FACILITATE SWMP

Scale:
1:5000 @ A1

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