McCloy Consulting

Sustainable Drainage (SuDS) Design Statement

Cappaghfinn, Finglas, Dublin 11

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CLIENT	McMahon Associates
CLIENT CONTACT	Muriel Kerr
PROJECT MANAGER	Anthony McCloy
AUTHOR(S)	Anthony McCloy, Paul Singleton
BRANCH	DUBLIN Unit 12, The BEaT Centre, Stephenstown Industrial Estate, Balbriggan T: +353 (0)1 5138963 | W: www.mccloyconsulting.ie

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1 INTRODUCTION

1.1 Terms of Reference

This Sustainable Drainage (SuDS) Design Statement was commissioned by McMahon Associates to support a planning application for lands at Cappaghfinn, Finglas, Dublin 11 (hereafter 'the site') which form part of the wider Cappaghfinn Plan Area.

The Cappaghfinn Plan Ares has previously been subject to a Surface Water Management Plan (SWMP) comprising of a Strategic Flood Risk Assessment (SFRA) and Sustainable Drainage Strategy (SDS). The surface water / SuDS design for the site has been prepared in line with the requirements and principles of the SWMP.

1.2 Introduction

Sustainable Drainage Systems or SuDS is a way of managing rainfall that minimises the negative impacts on the quantity and quality of runoff whilst maximising the benefits of amenity and biodiversity for people and the environment as defined in The SuDS Manual C753 (2015)[1] published by CIRIA.

The Greater Dublin Strategic Drainage Study (GDSDS) provides the following definitions for SuDS:

- *SuDS involve a change in our way of managing urban run-off from solely looking at volume control to an integrated multi-disciplinary approach which addresses water quality, water quantity, amenity and habitat (Vol 3 p.132)*
- *SuDS minimise the impacts of urban runoff by capturing runoff as close to source as possible and then releasing it slowly (Vol 3 p.133)*

SuDS, if designed and constructed correctly, has the ability to deliver multiple benefits. The Cappaghfinn SWMP outlined the preferred approach for the management of rainfall runoff within the site to ensure no increase in flood risk to any part of the proposed development or elsewhere with delivery of wider water quality, amenity and biodiversity benefits.

1.3 Sustainable Drainage Design Statement Objectives

The purpose of the SuDS Design Statement is to:

- Outline how the SUDS design delivers against the requirements of the Plan Area SWMP which refers objectives set out in Fingal Development Plan (2017 – 2023) and requirements set out in GDSDS (Volume 3).
- Describe how the system will operate.
- Explain the proposed maintenance regime.
- Demonstrate that the system proposed will deliver against requirements set out in the Plan Area SWMP from both quantity and quality perspectives.

The overall detail provided will be sufficient to support a planning application for development at the site.

The Plan Area SWMP that includes the site states the aspiration for "*the delivery of a drainage system which will integrate multi-functional SuDS components within the site to manage water at or near the surface, providing high quality blue / green infrastructure which enhances and improves biodiversity and brings significant community benefits within developed areas.*"

[1] CIRIA (2015). The SuDS Manual C753. [online] Available at: https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx [Accessed 20th May 2019]

2 BASELINE CHARACTERISTICS

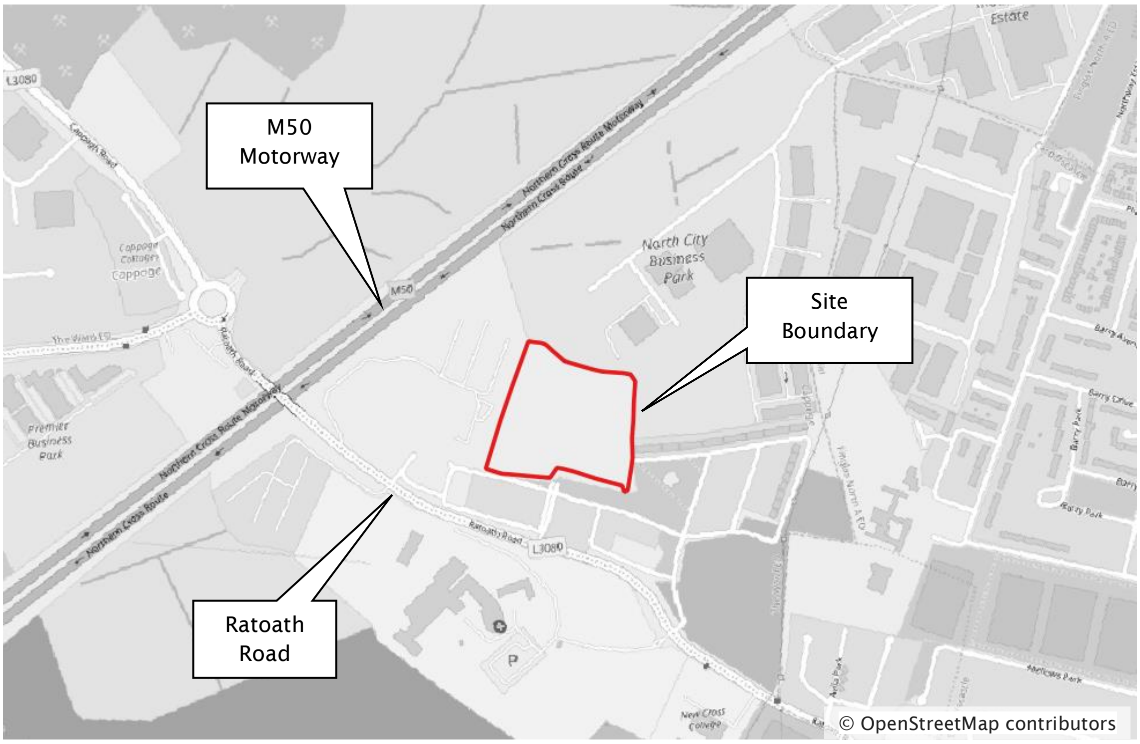
2.1 Site Description

The site is located in Cappagh, Dublin 11, west of Finglas, and lies north of the Ratoath Road and east of the M50 motorway between Junctions 5 and 6. The Heathfield development lies to the east, Cappagh Hospital to the south and Dublin City Business Park to the north.

The site has an extent of 3.2 ha. Heathfield Terrace is contiguous with the site and provides access from the east. Access to the west is via the Ratoath Road.

The site contains a Recorded Monument which is considered as part of the development of surface water drainage proposals.

Figure 2-1 Site Location



2.2 Existing Land Use

Site observations and review of readily available mapping and orthophotography indicate that the site currently comprises undeveloped green space as shown on Figure 2-2.

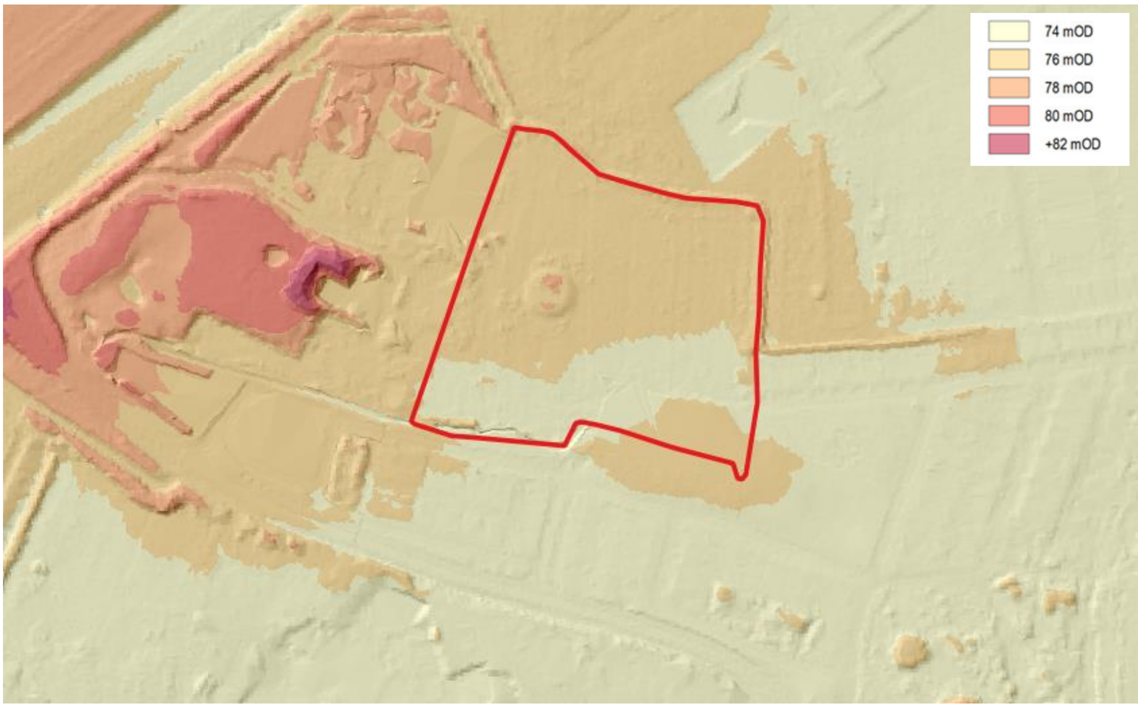
Figure 2-2 Existing Land Use

2.3 Topography

Land within the site generally falls from west to east with ground levels varying between 73.5 metres Ordnance Datum (m OD) to 75.6 m OD. Topography is shown in Figure 2-3.

A topographical survey and photographs of the existing site are included Appendix A and Appendix D respectively.

Figure 2-3 Site Topography



2.4 Geology

Geological mapping indicates that the site is underlain by a bedrock of calcareous shale and limestone conglomerate with superficial deposits of till derived from limestone.

Geological Survey of Ireland mapping and Site Investigation (SI) undertaken by Causeway Geotech were assessed to determine ground conditions at the site. During the SI, made ground comprising of sandy gravelly clay with general fill of construction and demolition waste interspersed throughout, extended to between 3-4 m below existing ground level. Glacial till comprising sandy gravelly silty clay becoming very stiff with increasing depth was found to extend to the maximum borehole depth of 6.5 m.

Soil and groundwater samples were collected and tested for a range of contaminants and the SI found there was no evidence of contamination within the site.

Soakaway testing was undertaken during the SI in accordance with BRE Digest 365[2]. The investigation found the rate of infiltration was too low to calculate due to the low permeability fine-grained soils which are considered poor infiltration media. The findings specified that the site is unsuitable for the use of infiltration drainage systems.

2.5 Water Environment

2.5.1 Existing Drainage Features

A drainage ditch, hereafter referred to as the 'southern drain', is located adjacent to the southern boundary of the site and is culverted beneath Heathfield Park by a by a Ø1000 mm concrete circular pipe and sinks beneath the south-east of the site via a Ø300 mm PVC pipe. The drainage asset data provided no indication of the flow route of the Ø300 mm pipe from the southern drain once it leaves the site.

Another ditch, hereafter referred to as the 'secondary drain', flows from north to south along the western boundary and discharges to the southern drain as shown in Figure 2-4.

Drainage asset information for Heathfield development to the south east indicates that it is served by a separate drainage system that flows south-east to the Cappagh Road. Prior to this discharge point the surface water sewer network is controlled by two flow control devices beneath Heathfield Park, and beneath lands linking Heathfield Drive and Heathfield Way. The flow control device in Heathfield Park is immediately downstream of an attenuation basin within green space north and west of Heathfield Park and Heathfield Green, respectively.

[2] Building Research Establishment (2007), BRE Digest 365: Soakaways.

Figure 2-5 indicates the surface water sewer network within the Heathfield development that may have hydraulic connectivity with the site.

It is noted that flood risk to the site is considered within the SFRA that forms part of the Plan Area SWMP.

Figure 2-4 Site Water Features

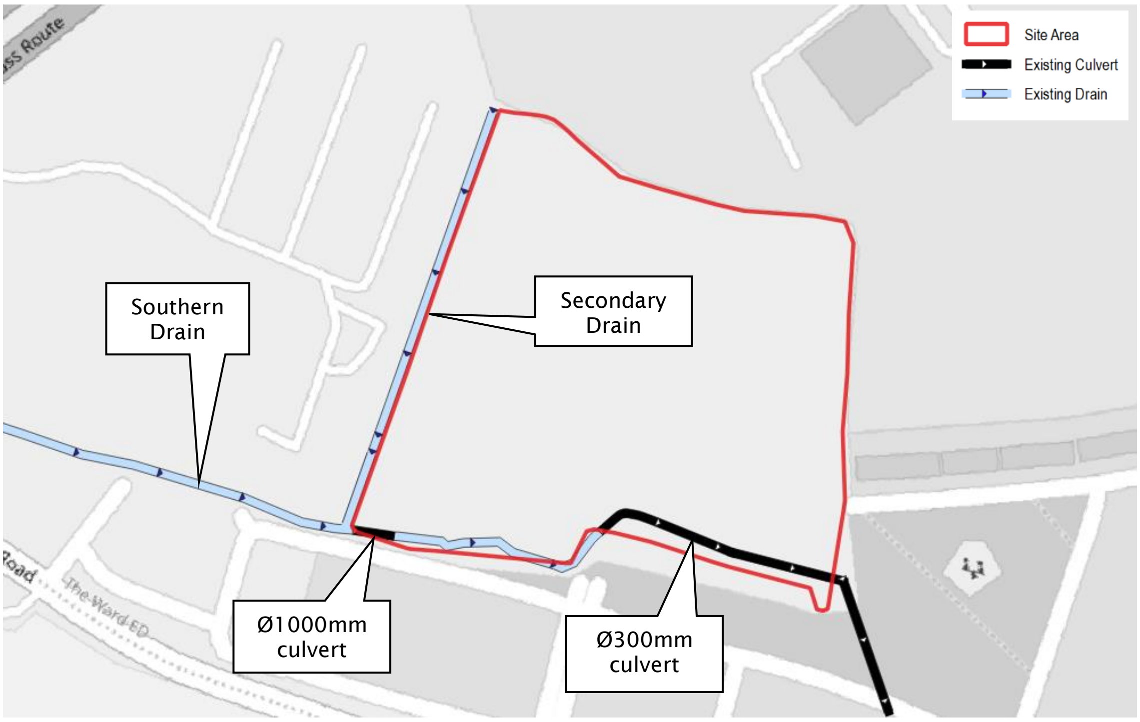
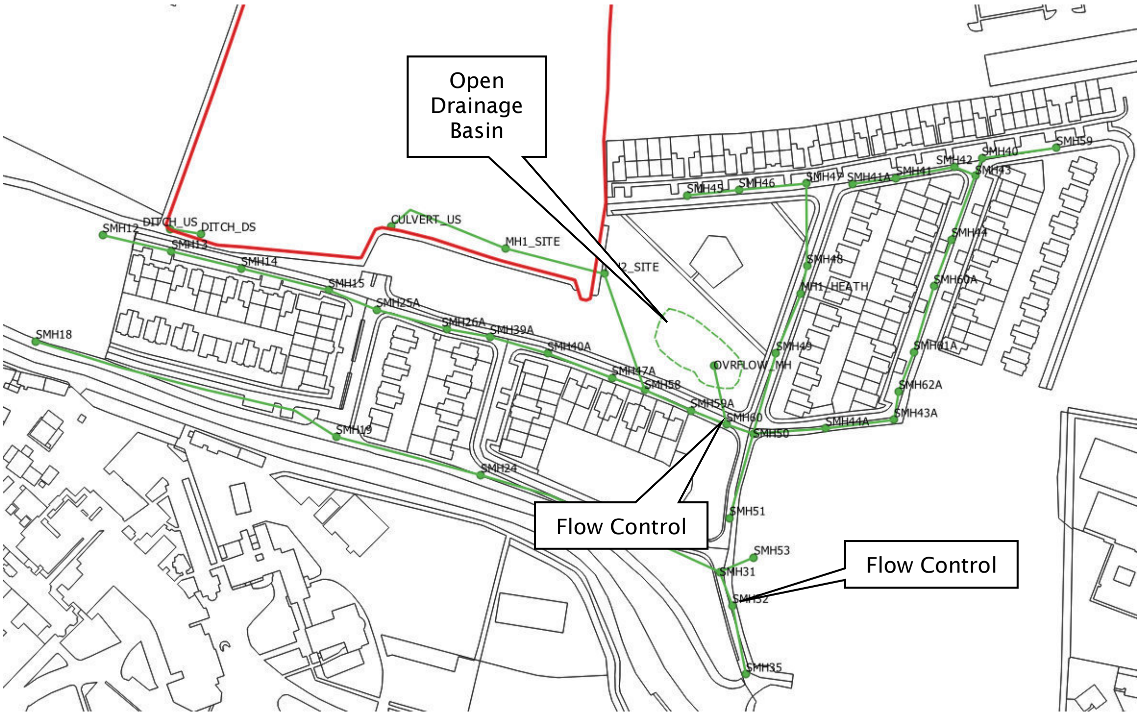


Figure 2-5 Heathfield Drainage Asset Information



2.6 Existing Utilities

No utility records (other than surface water sewer records) have been provided for the purposes of undertaking the SuDS Design Statement. The proposed site is Greenfield but is bounded by existing or previous development sites. Therefore, the presence of utilities which may run through the site cannot be ruled out.

For the purposes of the outline design, no allowance will be made for presence of existing utilities. It is recommended that the presence or otherwise of utilities be confirmed prior to progressing detailed design for the site, as this may affect full site design and consequently affect the layout of the SuDS.

2.7 Site Constraints

Table 2-1 summarises the constraints / parameters which will inform the development of the SuDS design.

Table 2-1 Site Constraints / Parameters

Attribute	Description	Dataset Confidence Rating (L/M/H)	Comment / Influence on SuDS design
Flooding	Flood risk at the site is assessed in the Plan Area SWMP.	H	Hydraulic model results, presented in the SFRA, have determined existing flow routes, informed modified flow routes and pluvial flow routes and extents have been / should be considered at all stage of design.
Existing Drainage Infrastructure	Existing drainage infrastructure is established by the Plan Area SWMP. Data gaps exist in relation to the outfall of the southern drain leaving the site and a contributing piped drain / culvert identified by surveys within the site whose drainage function is unknown.	M	A detailed design stage drainage strategy will be required to ensure that the route and downstream connectivity of the main downstream drainage culvert is established where this conduit is intended to convey flows from the site. A detailed design stage drainage strategy will be required to ensure that any off-site drainage function served by existing assets within the site is preserved.
Utilities	Utilities may be present – location unknown.	L	CAT scan / trial pits required – extent dependent on options taken to detailed design.
Topography	Overall levels vary between 72.5 metres Ordnance Datum (m OD) to 75.6 m OD generally falling from west to east.	M / H	The topography influences the existing and modified flow routes / management train.

Attribute	Description	Dataset Confidence Rating (L/M/H)	Comment / Influence on SuDS design
Land use existing and proposed	Greenfield site. Proposals include residential development.	H	SuDS components / design should be compatible with residential development design and landscape character.
Size of Site	Site is approximately 31,500 m^2.	H	Areas of greenspace are available in lower parts of the site, that will inform SuDS design.
Ground Contamination	No evidence of contamination was recorded within the SI Report undertaken for the Plan Area SWMP.	M / H	
Depth of Water Table	Isolated cases of high ground water table	M	Consideration given to likely seasonal high ground water table levels.
Infiltration potential	Soakaway testing found the rate of infiltration was too low to calculate due to the low permeability fine-grained soils which are considered poor infiltration media.	M / H	Infiltration is unsuitable as primary means of discharge of runoff from site.
Archaeological and Architectural Heritage	A Ringfort[3] (circular mound) is located within the site which is designated as a recorded monument and protected structure.	H	No SuDS features within 20 m of the protected structure/recorded monument.
Local Authority requirements	Fingal CC Parks Department has indicated that SuDS in open green space should not take up greater than 10% of the space identified for amenity space.	H	Where SuDS space overlaps within the amenity allowance, design ensures the space will be useable in day to day circumstances, with exception of periods of significant rainfall where SuDS areas will perform a stormwater retention function.

[3] Fingal County Council. (2016). Appendix 2: Record of protected structures | Fingal County Council Online Consultation Portal. [online] Available at: https://consult.fingal.ie/en/consultation/draft-fingal-development-plan-2017-%E2%80%93-2023-stage-2/chapter/appendix-2-record-protected [Accessed 22 May 2019]

3 SUSTAINABLE DRAINAGE STRATEGY – DESIGN APPROACH

This SuDS Design Statement outlines the proposed approach for the management of rainfall runoff within the development to ensure no increase in flood risk to any development within the site or elsewhere with delivery of wider water quality, amenity and biodiversity benefits.

The approach to the SuDS Design is per the guidance from the CIRIA SuDS Manual, as outlined in the Plan Area SWMP, which is summarised as follows:

- Identify existing and modified flow routes.
- Identify suitable mechanism of discharge for site drainage.
- Allocate a management train and appropriate number of subcatchments to provide the collection, treatment, storage, conveyance of runoff across the site.
- Identify suitable SuDS components which are in keeping with the proposed landscape character.

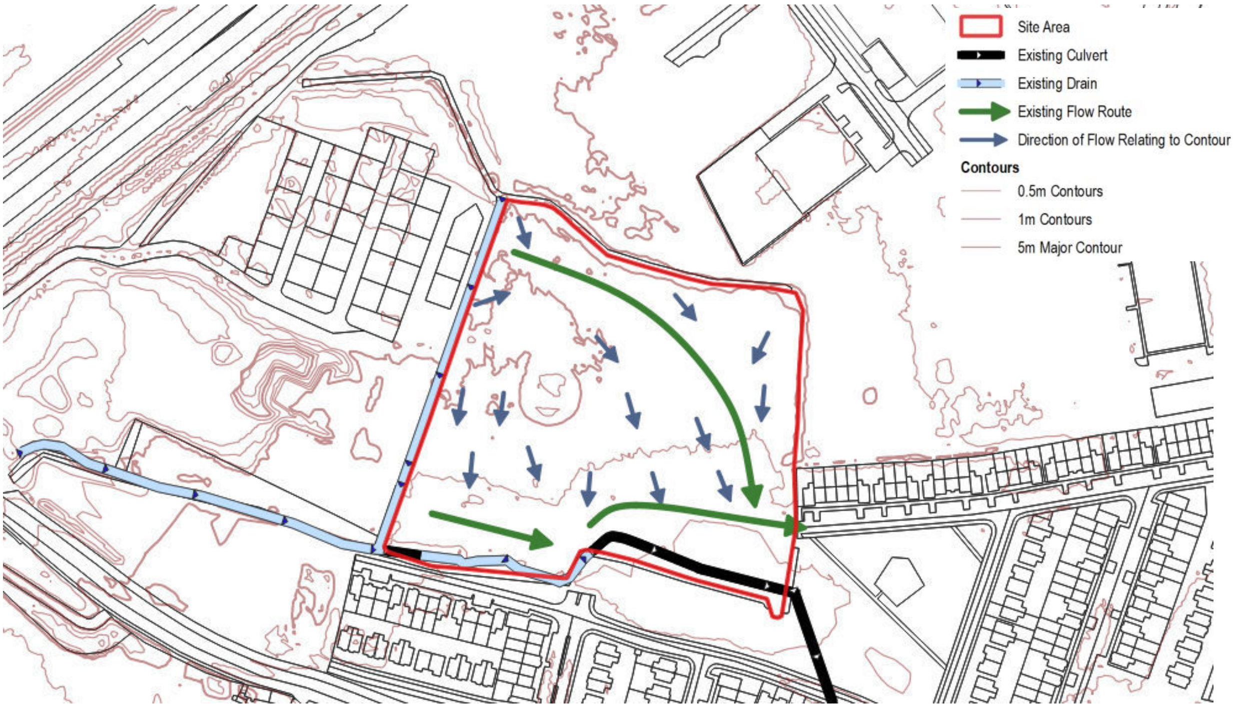
It is noted that the design presented and summarised in this report is outline / planning stage and surface water drainage at the site will be subject to detailed design post-planning.

3.1 Flow Route Analysis

3.1.1 Existing Flow Route Analysis

The natural hydrology and existing characteristics have been assessed through flow route analysis to determine how the site behaves naturally before development and are illustrated in Figure 3-1.

Figure 3-1 Existing Flow Route Analysis



3.1.2 Modified Flow Route Analysis

The modified flow route analysis is the basis for low flow conveyance, overflow arrangements and exceedance routes when design criteria are exceeded. The modified flow routes have been assessed, based on proposed site layout drawing included in Appendix A, and inform the overall design by predicting the flow of runoff through the site as shown in Figure 3-2.

Figure 3-2 Modified Flow Route Analysis

3.2 Drainage Hierarchy

The way that runoff is disposed from the site is considered in accordance with the following hierarchy of discharge:

- Re-Use – Where opportunities arise for rainfall harvesting within proposed development plans, these should be maximised. There is no current provision for rain harvesting made by development proposals.
- Infiltration – Infiltration has been discounted within the assessment as it was deemed unsuitable within the Phase 2 SI Report as discussed in Section 2.4.
- Watercourse – There are no natural watercourses in the vicinity of the site.
- Surface Water Sewer – An existing pipe is located at the southern boundary of the site and conveys water from an existing drain to the downstream storm sewer system. This culvert will be used to drain the site.
- Combined Sewer – Not applicable

For the purposes of this outline SuDS design, following the drainage hierarchy outlined above, the southern drain at the 300 mm culvert inlet is taken as the preferred point of discharge. In the absence of re-use, sufficient infiltration potential or presence of a local watercourse, the surface water drainage pipe is the only viable means of drainage. It is noted that the drainage pipe currently provides a drainage function for the current site draining flows from the site at greenfield runoff rates. The proposed SuDS ensures that this rate of flow is not increased.

3.3 Proposed SuDS Components

The SuDS components that form the surface water design approach are outlined in the following sections. Fingal CC's SuDS / Green Infrastructure feasibility checklist as provided by the Architects Department and completed as part of the SuDS design is included in Table 3-1.

3.3.1 Tree Pits

Trees pits attenuate surface water runoff underneath by utilising the void within the root zone of each tree. The SuDS tree pits will be provided with drain down pipes which will convey flows downstream.

3.3.2 Bioretention Channels

Bioretention channels are shallow landscaped depressions used to reduce runoff rates, volumes and treat pollution through the use of engineered soils and vegetation.

3.3.3 Detention Basins

Detention basins are landscaped depressions that are normally dry except during and immediately after extreme rainfall events. In addition to small localised depressions, there are 3 storage basins proposed for the site. These are located within the central area of the site, the location of the existing southern drain along the southern boundary of the site and within existing greenspace in the south eastern corner of the site.

Table 3-1 Fingal CC SuDS / Green Infrastructure Feasibility Checklist

SuDS Measures	Measures to be used on this site	Rationale for selecting/not selecting measure
Source Control		
Swales	Y	Linear basin will function as a swale at low flow.
Tree Pits	Y	See Section 3.3
Rainwater butts	N	Limited attenuation / reliance on residents
Rainwater harvesting	N	Not suitable on non commercial / industrial sites
Soakaways	N	Low infiltration potential on site
Infiltration trenches	N	Low infiltration potential on site
Permeable pavement Grasscrete Block paving Porous Asphalt	N	Permeable surfaces will be specified to within curtilage parking areas. Elsewhere, including out of curtilage parking areas -permeable surfaces have not been specified as per Fingal County Council taking in charge policy.
Green Roofs	N	Roof type not suitable
Filter strips	N	Low pollution loading on site
Bio-retention systems / Raingardens	Y	See Section 3.3
Blue Roofs	N	Roof type not suitable
Filter Drain	N	Low infiltration potential on site
Site Control		
Detention Basins	Y	See Section 3.3
Retentions basins	N	
Regional Control		
Ponds	N	Preference for basin / no open water
Wetlands	N	Preference for basin / no open water
Other		
Petrol/Oil interceptor	N	Not deemed required / effective
Attenuation tank – only as a last resort where other measures are not feasible	N	Other measures deemed feasible / more effective
Oversized pipes– only as a last resort where other measures are not feasible	N	Other measures deemed feasible / more effective

3.4 Water Quantity

Sufficient attenuation is to be provided to ensure that there is no unpredictable flooding within the site, future buildings are protected and no increase in flood risk elsewhere.

3.4.1 Climate Change

Requirements for climate change allowances are as per OPW 'General Map User Guidance Notes' found through floodinfo.ie[4]. A 20% uplift in extreme rainfall depths (Mid-Range Future Scenario (MRFS)) has been adopted for the purposes of undertaking hydraulic calculations to validate the outline design proposal.

3.4.2 Runoff Rates

The flow rates in Table 3-2 indicate the restricted post-development runoff rates for the site to which the surface water drainage has been designed. The rates are based on those outlined in the Plan Area SWMP and reflect the requirements of Fingal CC.

In addition, the surface water drainage has been designed in accordance with the criteria established by GDSDS[5] Stormwater Management Policy as follows:

- Criterion 1.1: interception storage is provided through of vegetated and soil based SuDS which will generate losses in runoff for the majority of runoff events. The losses generated will achieve this criterion.
- Criterion 1.2: N/A
- Criterion 2.1: Table 3-2identifies the flow rate acceptable, which is demonstrated by the hydraulic calculations provided in Appendix C.
- Criterion 2.2: All flows retained to Qbar for the 1 in 100 year rainfall event.
- Criterion 3.1: Compliance demonstrated by the hydraulic calculations provided in Appendix C.
- Criterion 3.2: Compliance demonstrated by the proposed layout drawing in Appendix B. Detailed design site levels will ensure that any exceedance flow will cascade from one SuDS component to the next.
- Criterion 3.3: Lowest property finished floor level is defined as 73.75 m OD. Highest proposed water level proposed in main storage basin is 73.50 m OD. An exceedance flow path is situated between storage location and basin which will route flows away from the properties. Therefore, properties are not directly connected to peak storage level.
- Criterion 3.4: Compliance demonstrated by drawing provided in Appendix B and calculations provided in Appendix C.
- Criteria 4.1, 4.2 and 4.3: Table 3-2 and calculations in Appendix C demonstrate compliance with Criterion 4.3 in lieu of 4.1 and 4.2.

The flow rates in Table 3-2 provide guidance on the extent to which flows will be controlled from any proposed development within the site and are calculated using IoH 124 methodologies based on catchment specific characteristics; Soil WRAP Class 4 and SAAR of 740 mm.

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[4] OPW (2019) General Map User Guidance Notes (2019) Available at: https://www.floodinfo.ie/map/general_map_user_guidance_notes/ [Accessed 18 June 2019]

[5] Greater Dublin Regional Code of Practice for Drainage Works (2005) Available at: https://www.dublincity.ie/sites/default/files/content//SiteCollectionDocuments/Greater%20Dublin%20Regional%20Code%20of%20Practice%20for%20Drainage%20Works.pdf

Table 3-2 Attenuation Flow Rates

Return period	Greenfield Rate (l/s/ha)	Attenuation Rate (l/s/ha)	Site Discharge Rate (l/s)** (Drained Area: 2.34 ha)
100% AEP (1 in 1 year)	3.98	3.98	9.31
3.33% AEP (1 in 30 year)	7.71	4.66	10.90
1% AEP (1 in 100 year) + CC	9.17	4.66	10.90

*Long term storage (LTS) not provided; all return periods attenuated to lower of Qbar / greenfield rate

**Large green spaces not connected to the drainage system not included with flow control rates for the site

3.4.3 Storage of Runoff & Discharge Location

Runoff is attenuated throughout the site as it passes through or is stored in SuDS components which have been chosen to collect, convey and store water based on site and hydraulic requirements.

In line with GDSDS requirements, attenuation storage will be sized for the 1% AEP (with allowance for climate change) critical rainfall event while limiting the 1-year and 100-year events to the rates shown above. Storage volumes, based on restricted rates shown in Table 3-2, are provided in Table 3-3.

Table 3-3 Attenuation Storage Volumes

Return period	Attenuation Volume* (m^3)
100% AEP (1 in 1 year)	180 m^3
3.33% AEP (1 in 30 year)	505 m^3
1% AEP (1 in 100 year) + CC	875 m^3

* Attenuated to rates shown in Table 3-2

Final discharge from the proposed development will be to the existing southern drain storm pipe to the south east corner of the site.

This existing drain is retained as open channel in its present location with minor realignment and reprofiled proposed to allow for more ease of access and egress.

Consideration has been given to de-culverting / daylighting of the existing surface water drain within the downstream green area. For the purposes of the SuDS design decision has been taken to retain the surface water pipe as is and keep the storage in the existing greenspace area as shallow as possible, only coming into function during higher return period rainfall events (greater than 1 in 1 year).

The proposed SuDS layout for the site is included in Appendix B. Hydraulic modelling of the proposed SuDS layout design for the site is summarised in Appendix C.

3.4.4 Designing for Exceedance

Site levels and landscaping have been designed to route exceedance flows away from buildings. Overland flow routes are defined using road corridors. Detail design will set final levels from individual SuDS components to ensure that flows are controlled and routed across the site in a predictable manner. Off-site exceedance routes are detailed in Appendix B.

3.5 Water Quality

3.5.1 Water Quality Requirements

Proposals for the site will comprise residential development and therefore considered to be low risk. Treatment provision is summarised as follows:

- Roof only runoff – removal of solids. All roofed areas will pass through at least one stage of treatment as per the proposed SuDS design drawing included in Appendix B.
- Roads used for vehicular movement. The SuDS design developed makes provision for collection of runoff through a range of techniques namely; SuDS tree planters, shallow basins, bioretention channels. Where proposed site levels allow, SuDS components are connected in series. Flows pass into a (site control) basin prior to final discharge.

Analysis of the effectiveness of chosen SuDS components to achieve water quality criteria follows the 'simple index approach' described in the CIRIA C753 SuDS Manual chapter 29.

3.5.2 Simple Index Approach

The simple index approach assigns a risk index to areas of development dependent on their land use to represent the level of pollution that is typically generated and therefore must be 'treated' within SuDS components to meet water quality standards.

Table 3-4 Risk Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Residential car parks, low traffic roads	Low	0.5	0.4	0.4

As per the simple index approach, each SuDS component is assigned a 'mitigation index' relative to the three primary sources of pollution listed above; TSS, metals and hydrocarbons. Mitigation indices are added together and water quality criteria are met if the mitigation index is greater than the risk index.

Secondary / further stages in the treatment train are assigned treatment indices 50% of stated value identified by SuDS Manual (as per advice provided by SuDS Manual).

As demonstrated in Table 3-5, the total of the mitigation indices is greater than the risk indices for both types of development on site so water quality requirements are deemed to have been met. It is noted that tree pits will act similarly to bioretention so have been included a single component for a conservative water quality assessment.

Table 3-5 Mitigation Indices

SuDS Component	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Bioretention Channel / Tree Pit	0.8	0.8	0.8
Detention Basin	0.25	0.25	0.3
TOTAL	***1.05***	***1.05***	***1.1***

3.6 Amenity and Biodiversity

Biodiversity is be considered in the SuDS design process with the creation of blue / green infrastructure to provide habitat and connectivity linkages within the proposed development. The SuDS components are spread across the site as a series of 'nodes' (shallow basins and trees / tree pits) and 'links' (bioretention channels and linear basins).

The SuDS strategy retains water at or near the surface. In particular;

- The creation of habitats within the SuDS corridor will assist in meet Fingal Development Plan 2017-2023 objectives NH02, GI03 and GI25.
- The basins located to the southern boundary can be used for recreation and public open space which support Objectives GI03, GI11, GI21, GI25 and NH02 in the Fingal Development Plan 2017-2023 which encourages the provision of accessible parks, open spaces and recreational facilities alongside the sustainably managing water within the site.

4 MAINTENANCE AND MANAGEMENT

The proposed maintenance plan for the SuDS components on site is outlined in Table 4-1 along with the party who is anticipated to be responsible for maintenance of each type of component.

Table 4-1 Management and Maintenance Plan of SuDS Features

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required action	Typical frequency
Permeable Paving	Homeowners	Regular maintenance	Brushing (standard cosmetic sweep over whole surface)	Once a year after leaf fall or reduced frequency as required
		Occasional maintenance	Removal of weeds or management using glyphosate or other suitable week killer.	As required – once a year on less frequently used pavements
		Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
			Remediate any landscaping which has been raised to within 50 mm of the level of the paving	As required
			Rehabilitation of surface and upper sub-structure by remedial sweeping	Every 10 to 15 years or as required (if performance is reduced due to significant clogging)
		Monitoring	Initial inspection	Monthly for three months after installation
			Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Every 3 months, 48h after large storms in first six months
			Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
			Monitor inspection chambers	Annually

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required action	Typical frequency
Tree Pits	Fingal County Council	Regular maintenance	Remove litter and debris	Monthly (or as required)
			Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
			Inspect inlets and outlets	Inspect monthly
		Occasional maintenance	Check tree health and manage tree appropriately	Annually
			Remove all silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
			Water	As required (in periods of drought)
		Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly
Bioretention Systems	Fingal County Council	Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain to determine if maintenance is necessary	Quarterly
			Check operation of underdrains by inspection of flows after rain	Annually
			Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
			Inspect inlets and outlets for blockage	Quarterly
		Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
			Replace any plants, to maintain planting density	As required

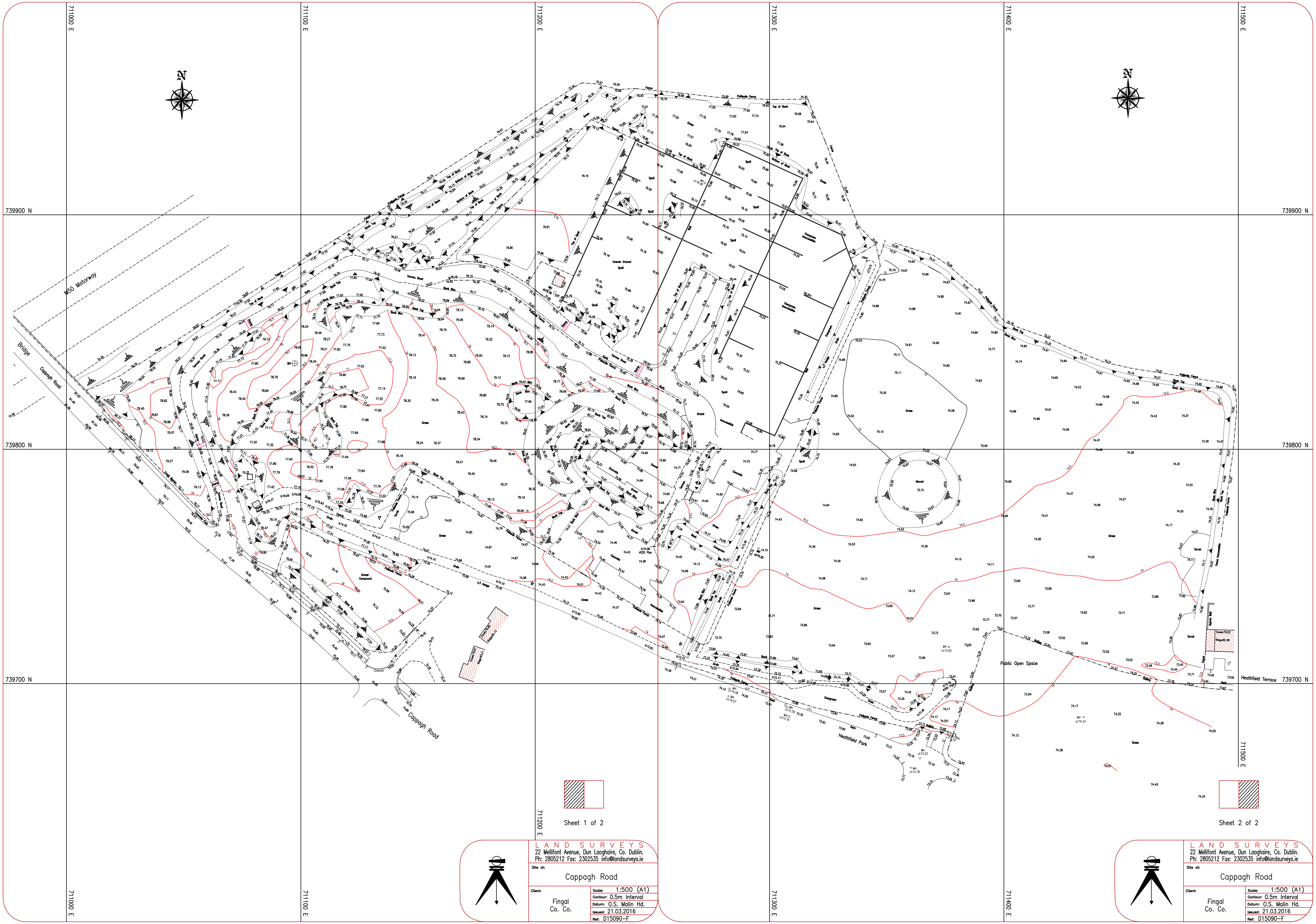
SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required action	Typical frequency
			Remove sediment, litter and debris build-up from around inlets	Quarterly to biannually.
		Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
			Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
		Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years
Basin	Fingal County Council	Regular Maintenance	Remove litter and debris	Monthly
			Cut grass – for spillways and access routes	Monthly (during growing season) or as required
			Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
			Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
			Inspect inlets and outlets for blockages, and clear if required	Monthly
			Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
			Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year) then annually or as required
			Check any mechanical devices (none currently proposed).	Annually

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required action	Typical frequency
			Tidy all dead growth before start of growing season	Annually
			Remove sediments from inlets and outlets	Annually (or as required)
			Manage plants (where specific planting regime is adopted).	Annually
		Occasional Maintenance	Reseed areas of poor vegetation growth	As required
			Prune and trim any trees and remove cuttings	Every 2 years, or as required.
			Remove sediment from inlets, outlets and main basin when required	Every 5 years, or as required (likely to be minimal requirements as upstream source control is provided)
		Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
			Realignment of rip-rap	As required
			Repair/rehabilitation of inlets and outlets	As required
			Relevel uneven surfaces and reinstate design levels	As required
Open ditch	Fingal County Council	Regular maintenance	Remove litter and debris	Monthly, or as required
			Cut grass – to retain grass height within specified design range	Monthly (during growing season) or as required
			Manage other vegetation and remove nuisance plants	Monthly at start, then as required.
			Inspect inlets, outlets for blockages, and clear if required	Monthly
			Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly

SuDS Component	Maintenance Responsibility	Maintenance Schedule	Required action	Typical frequency
			Inspect inlets and bed for silt accumulations, establish site removal frequencies	Half yearly
		Occasional maintenance	Reseed areas of poor vegetation growth. Alter plant types to better suit conditions if required	As required/if bare soil is exposed over 10% of swale treatment area
		Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
			Re-level uneven surfaces and reinstate design levels	As required
			Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required

Appendix A

Existing and Proposed Site Drawings



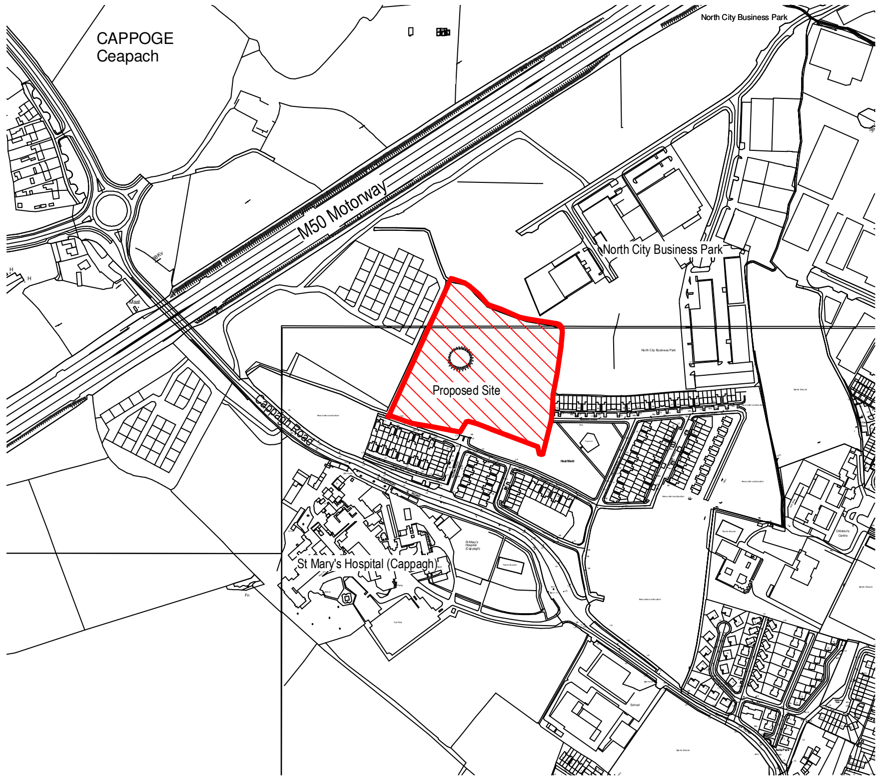
711000 E
711100 E
711200 E
711300 E
711400 E
711500 E
739900 N
739800 N
739700 N
N
M50 Motorway
Bridge
Cappagh Road
Heathfield Park
Heathfield Terrace
Public Open Space
Mound
Sheet 1 of 2
Sheet 2 of 2
LAND SURVEYS
22 Mellifont Avenue, Dun Laoghaire, Co. Dublin.
Ph: 2805212 Fax: 2302535 info@landsurveys.ie
Site at:
Cappagh Road
Client:
Fingal Co. Co.
Scale: 1:500 (A1)
Contour: 0.5m Interval
Datum: O.S. Malin Hd.
Issued: 21.03.2016
Ref: D15090-F

Cappaghfinn Phase 3 - Parking Allowance:

Block no.	No. of 1-bed units	No. of 2-bed units	No. of 3-bed units	No. of 4-bed units	No. of bays required 1-bed = 1 bay each	No. of bays required 2-bed = 1.5 bays each	No. of bays required 3&4-bed = 2 bays each	No. of parking bays required	No. of parking bays provided (sorted by proximity)
1	1	8	0	0	1	12	0	13	15
2	2	4	0	0	2	6	0	2	20
3	0	0	6	2	0	0	16	16	16
4	0	0	6	2	0	0	16	16	17
5	0	0	8	0	0	0	16	16	16 *
6	0	0	2	1	0	0	6	6	6 *
7	1	5	0	0	1	7.5	0	8.5	9
8	1	8	0	0	1	12	0	13	13
9	0	6	0	0	0	9	0	9	10
10	0	0	2	1	0	0	6	6	6
11	0	0	4	0	0	0	8	8	8 *
TOTAL no. of Parking Bays								**113.5**	**136**

* en-curtilage parking

Site Development Plan
1 : 500



Site Location Map
1 : 5000

Phase 3: Proposed Development of 70 no. Dwellings

Overall Site Area:	3.22Ha
Density:	**21.7 Dwellings/Ha**
Site Area excl. Riparian and archaeology exclusion zone:	2.55Ha
Density:	**27.5 Dwellings/Ha**
Public Open Space:	10,600m² = 30.4%

Comhairle Contae Fhine Gall
Fingal County Council

Architects Department
County Hall, Main Street, Swords, Co Dublin.
County Architect: Fionnuala May Dip.Arch B.Arch.Sc. MUBC MRIAI
Tel: 01 890 5050
architects@fingal.ie

Client
Fingal County Council Housing Department

Project Title
Proposed new Housing at Cappaghfinn Phase 3

Drawing Title
Proposed Site Location & Development Plan

Project number 18-362
Project stage PP
Date 2019-06-10
Drawn by AP, CE
Project Team CB, AP, CE
Scale As indicated
Drawing number **18-362 - PP - 001B**
Revision number

29/07/2019 12:18:28

Appendix B

Proposed SuDS Design Drawing

LEGEND

- PROPOSED BIORETENTION
- PROPOSED BASIN
- PROPOSED TREE PIT
- PROPOSED PERMEABLE PAVEMENT
- PROPOSED KERBDRAIN
- PROPOSED STORM SEWER
- PROPOSED STORM CONNECTION
- PROPOSED CULVERT DIVERSIONARY ROUTE
- EXISTING CULVERT TO BE MAINTAINED
- EXISTING CULVERT TO BE ABANDONED
- PROPOSED BUILDING
- OPEN GREEN SPACE
- SURFACE FLOW DIRECTION
- EXCEEDANCE FLOW PATH

ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
2	SK	AMC	26/08/2019	ISSUED FOR INFORMATION
1	SK	AMC	15/08/2019	ISSUED DRAFT FOR REVIEW / APPROVAL

STATUS

FOR INFORMATION

McCloy Consulting

T: 028 9084 8694
F: 028 9084 1525
E: info@mccloyconsulting.com
W: www.mccloyconsulting.com

Mossley Mill, Lower Ground (West)
Carnmoney Road North
Newtownabbey
Co. Antrim, BT36 5QA

PROJECT

CAPPAGHFINN, FINGLAS
DUBLIN 11

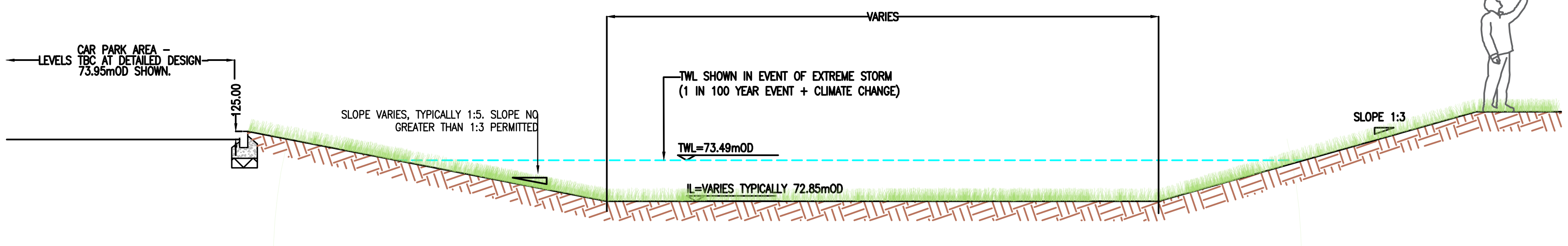
CLIENT

MCMAHON ASSOCIATES

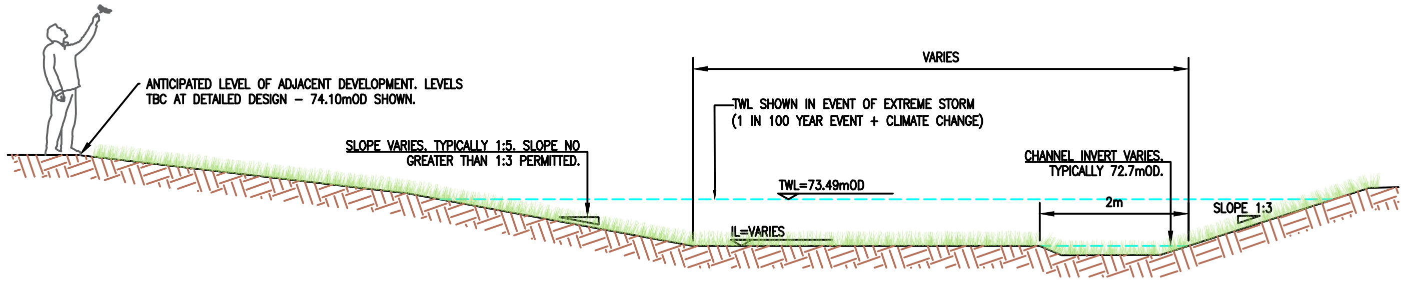
DRAWING TITLE

SURFACE WATER / SuDS OUTLINE DESIGN PROPOSED LAYOUT

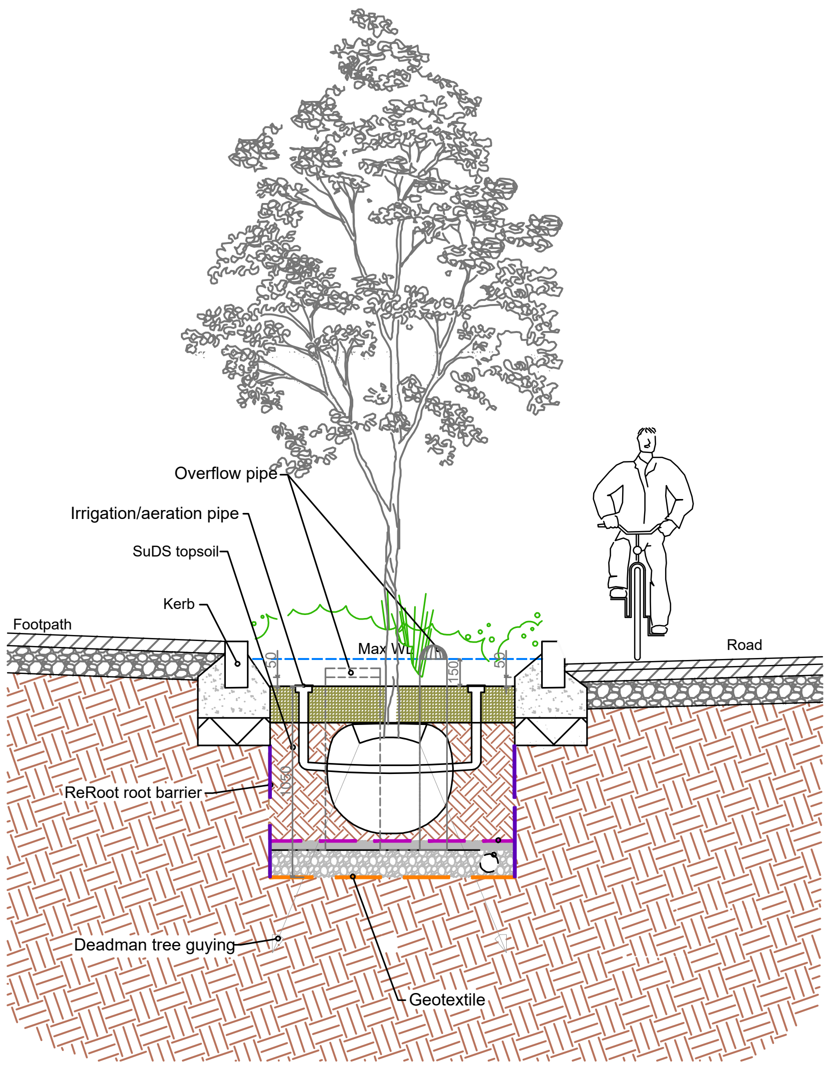
SCALE	ORIGINAL SIZE		
NTS	A1		
DRAWN	CHECKED	DATE	
SK	AMC	26/08/2019	
PROJECT No.	DRAWING No.	ISSUE NO.	
M02114-03	DWG_SK01	2	



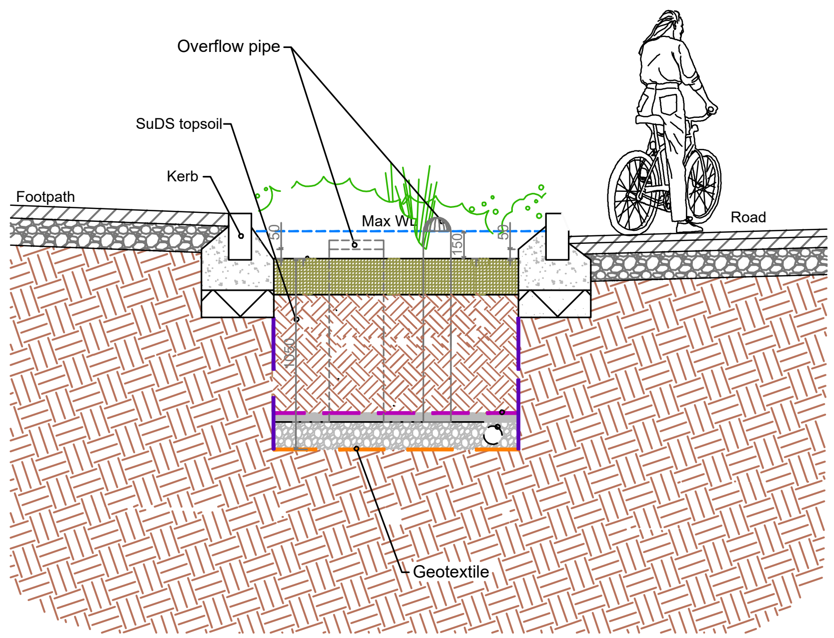
TYPICAL BASIN DETAIL (EAST)



TYPICAL BASIN DETAIL (WEST)



TYPICAL TREEPIT



TYPICAL BIORETENTION

ISSUE	DRN	APP	DATE	NOTES / DESCRIPTION
1	JD	AMC	26/08/2019	ISSUED FOR INFORMATION

STATUS: FOR INFORMATION

McCloy Consulting

T: 028 9084 8694
F: 028 9084 1525
E: info@mccloyconsulting.com
W: www.mccloyconsulting.com

Mossley Mill, Lower Ground (West)
Carnmoney Road North
Newtownabbey
Co. Antrim, BT36 5QA

PROJECT: CAPPAGHFINN, FINGLAS DUBLIN 11

CLIENT: MCMAHON ASSOCIATES

DRAWING TITLE: SURFACE WATER / SuDS OUTLINE DESIGN PROPOSED DETAILS AND SECTIONS

SCALE	ORIGINAL SIZE	
NTS	A1	
DRAWN	CHECKED	DATE
JD	AMC	26/08/2019
PROJECT No.	DRAWING No.	ISSUE NO.
M02114-03	DWG_SK02	1

Appendix C

SuDS Design Hydraulic Model Results

CAUSEWAY

Drainage Design Report

Flow+

v8.1

Network	Storm Network
Filename	R:_Projects\M02114 McMahon Associates\03 Cappaghfinn, Finglas, Dublin 11\04 Calcs\Causeway flow+\[M012114-03] Surface water outline design [REV1].pfd
Username	Jill Dick (jill.dick@mccloyconsulting.com)
Last analysed	15/08/2019 16:22:02
Report produced on	15/08/2019 16:25:06

Causeway Sales

Tel:	+44(0) 1628 552000
Fax:	+44(0) 1628 552001
Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

CAUSEWAY

Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	10
FSR Region	Scotland and Ireland
M5-60 (mm)	14.000
Ratio-R	0.300
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Inverts
Minimum Backdrop Height (m)	0.200
Preferred Cover Depth (m)	0.750
Include Intermediate Ground	
Enforce best practice design rules	x

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Node Type	Manhole Type	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)	Notes
1	0.051	5.00		75.200	Junction						0.630	
4				74.950	Junction						0.583	
2	0.050	5.00		75.200	Junction						0.630	
3				74.950	Junction						0.504	
5	0.034	5.00		75.140	Junction						0.881	
6	0.065	5.00		75.150	Manhole	1200	1200				0.948	
7	0.129	5.00		75.140	Junction						1.041	
8				74.400	Junction						0.638	
9	0.071	5.00		74.149	Junction						0.617	
10	0.027	5.00		74.250	Manhole	1200	1200				0.900	
11	0.125	5.00		74.250	Junction						0.936	
12	0.137	5.00		74.700	Manhole	1200	1200				0.900	
13	0.047	5.00		74.650	Junction						0.959	
14	0.074	5.00		74.550	Manhole	1200	1200				0.900	
15	0.067	5.00		74.550	Junction						0.940	
16				74.250	Junction						0.766	
17	0.066	5.00		74.000	Manhole	1200	1200				0.900	
18	0.032	5.00		73.950	Manhole	1200	1200				0.900	
19				73.900	Junction						0.996	
21	0.084	5.00		74.400	Manhole	1200	1200				0.750	
22	0.057	5.00		74.300	Manhole	1200	1200				0.600	
23	0.088	5.00		74.350	Manhole	1200	1200				0.900	
24				74.215	Manhole	1200	1200				0.797	
25	0.059	5.00		73.950	Manhole	1200	1200				0.740	
26	0.181	5.00		73.950	Manhole	1200	1200				0.750	
27				73.810	Manhole	1200	1200				0.698	
28				73.600	Manhole	1200	1200				0.628	
29	0.090	5.00		73.750	Manhole	1200	1200				0.900	
30	0.115	5.00		73.750	Manhole	1200	1200				0.929	

CAUSEWAY
Flow+ v8.1 Design Report: Nodes

31				73.790	Manhole	1200	1350				1.002	
32				73.810	Manhole	1200	1350				1.223	
33	0.151	5.00		73.490	Manhole	1200	1500				0.975	
34	0.091	5.00		73.490	Manhole	1200	1200				0.690	
35				73.500	Manhole	1200	1500				0.992	
36				73.500	Manhole	1200	1500				0.999	

R:_Projects\M02114 McMahon Associates\03 Cappaghfinn, Finglas, Dublin 11\04 Calcs\Causeway flow
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	Name	US Node	DS Node	Length (m)	ks (mm) / n	Velocity Equation	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	Link Type	T of C (mins)	Rain (mm/hr)	Con Offset (m)	Min DS IL (m)	Lateral Area (ha)	Lateral Ins Point (%)	Lateral T of E (mins)
?	2.000	1	4	29.290	0.600	Colebrook-White	74.570	74.424	0.146	200.0	1500	Bioretention	5.33	43.0					
?	1.000	2	3	24.744	0.600	Colebrook-White	74.570	74.446	0.124	200.0	1500	Bioretention	5.27	43.1					
?	1.001	3	4	11.832	0.600	Colebrook-White	74.446	74.367	0.079	150.0	150	Circular	5.52	42.4					
?	1.002	4	5	16.133	0.600	Colebrook-White	74.367	74.259	0.108	150.0	150	Circular	5.84	41.4					
?	1.003	5	7	17.800	0.600	Colebrook-White	74.259	74.170	0.089	200.0	1500	Bioretention	6.04	40.8					
?	3.000	6	7	15.410	0.600	Colebrook-White	74.202	74.099	0.103	150.0	150	Circular	5.31	43.0					
?	1.004	7	8	67.468	0.600	Colebrook-White	74.099	73.762	0.337	200.0	1500	Bioretention	6.79	38.9					
?	1.005	8	9	11.493	0.600	Colebrook-White	73.762	73.532	0.230	50.0	200	Circular	6.90	38.6					
?	1.006	9	11	19.094	0.600	Colebrook-White	73.532	73.437	0.095	200.0	1500	Bioretention	7.11	38.1					
?	4.000	10	11	5.464	0.600	Colebrook-White	73.350	73.314	0.036	150.0	150	Circular	5.11	43.6					
?	1.007	11	19	46.420	0.600	Colebrook-White	73.314	73.082	0.232	200.0	1500	Bioretention	7.63	36.9					
?	5.000	12	13	21.734	0.600	Colebrook-White	73.800	73.691	0.109	200.0	200	Circular	5.42	42.6					
?	5.001	13	15	15.146	0.600	Colebrook-White	73.691	73.615	0.076	200.0	1500	Bioretention	5.59	42.1					
?	6.000	14	15	6.000	0.600	Colebrook-White	73.650	73.610	0.040	150.0	150	Circular	5.12	43.6					
?	5.002	15	16	25.177	0.600	Colebrook-White	73.610	73.484	0.126	200.0	1500	Bioretention	5.87	41.3					
?	5.003	16	17	13.658	0.600	Colebrook-White	73.484	73.393	0.091	150.0	250	Circular	6.07	40.8					
?	5.004	17	19	4.753	0.600	Colebrook-White	73.100	73.068	0.032	150.0	250	Circular	6.14	40.6					
?	7.000	18	19	21.924	0.600	Colebrook-White	73.050	72.904	0.146	150.0	150	Circular	5.45	42.6					
?	1.008	19	32	24.622	0.600	Colebrook-White	72.904	72.781	0.123	200.0	375	Circular	7.95	36.2					
?	8.000	21	24	15.649	0.600	Colebrook-White	73.650	73.546	0.104	150.0	150	Circular	5.32	43.0					
?	9.000	22	24	10.282	0.600	Colebrook-White	73.700	73.631	0.069	150.0	150	Circular	5.21	43.3					
?	10.000	23	24	4.738	0.600	Colebrook-White	73.450	73.418	0.032	150.0	150	Circular	5.10	43.7					
?	8.001	24	27	49.683	0.600	Colebrook-White	73.418	73.170	0.248	200.0	250	Circular	6.16	40.5					
?	12.000	25	27	4.122	0.600	Colebrook-White	73.210	73.183	0.027	150.0	150	Circular	5.08	43.7					
?	11.000	26	27	13.203	0.600	Colebrook-White	73.200	73.112	0.088	150.0	200	Circular	5.22	43.3					
?	8.002	27	28	27.978	0.600	Colebrook-White	73.112	72.972	0.140	200.0	300	Circular	6.58	39.4					
?	8.003	28	31	27.411	0.600	Colebrook-White	72.972	72.862	0.110	250.0	300	Circular	7.04	38.3					
?	13.000	29	30	5.803	0.600	Colebrook-White	72.850	72.821	0.029	200.0	250	Circular	5.10	43.7					
?	13.001	30	31	4.892	0.600	Colebrook-White	72.821	72.788	0.033	150.0	250	Circular	5.17	43.5					
?	8.004	31	32	50.323	0.600	Colebrook-White	72.788	72.587	0.201	250.0	375	Circular	7.78	36.6					
?	14.000	34	33	11.480	0.600	Colebrook-White	72.800	72.750	0.050	229.6	200	Circular	5.24	43.2					
?	1.009	32	33	17.954	0.600	Colebrook-White	72.587	72.515	0.072	250.0	450	Circular	8.18	35.8					
?	1.010	33	35	2.000	0.600	Colebrook-White	72.515	72.508	0.007	285.7	525	Circular	8.21	35.7					
?	1.011	35	36	2.000	0.600	Colebrook-White	72.508	72.501	0.007	285.7	525	Circular	8.24	35.7					

	Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Minimum Depth (m)	Maximum Depth (m)	Σ Area (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)	Notes
?	2.000	1	4	1.501	489.4	6.5	0.030	-0.074	-0.074	0.030	0.051	0.0	45	0.641	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.000	2	3	1.501	489.4	6.4	0.030	-0.096	-0.096	0.030	0.050	0.0	45	0.637	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.001	3	4	0.818	14.5	6.3	0.354	0.433	0.354	0.433	0.050	0.0	69	0.791	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.002	4	5	0.818	14.5	12.5	0.433	0.731	0.433	0.731	0.101	0.0	108	0.918	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.003	5	7	1.501	489.4	16.4	0.281	0.370	0.281	0.370	0.135	0.0	87	0.842	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	3.000	6	7	0.818	14.5	8.3	0.798	0.891	0.798	0.891	0.065	0.0	82	0.847	Velocity is less than the specified minimum
?	1.004	7	8	1.501	489.4	38.1	0.441	0.038	0.038	0.441	0.329	0.0	166	1.029	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.005	8	9	1.718	54.0	37.9	0.438	0.417	0.417	0.438	0.329	0.0	124	1.857	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.006	9	11	1.501	489.4	45.4	0.017	0.213	0.017	0.213	0.400	0.0	190	1.066	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	4.000	10	11	0.818	14.5	3.5	0.750	0.786	0.750	0.786	0.027	0.0	50	0.674	Velocity is less than the specified minimum
?	1.007	11	19	1.501	489.4	60.8	0.336	0.218	0.218	0.336	0.552	0.0	241	1.123	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	5.000	12	13	0.853	26.8	17.4	0.700	0.759	0.700	0.759	0.137	0.0	118	0.907	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum
?	5.001	13	15	1.501	489.4	23.1	0.359	0.335	0.335	0.359	0.184	0.0	112	0.919	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	6.000	14	15	0.818	14.5	9.6	0.750	0.790	0.750	0.790	0.074	0.0	89	0.874	Velocity is less than the specified minimum
?	5.002	15	16	1.501	489.4	40.0	0.340	0.166	0.166	0.340	0.325	0.0	172	1.040	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	5.003	16	17	1.140	56.0	39.5	0.516	0.357	0.357	0.516	0.325	0.0	156	1.234	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	5.004	17	19	1.140	56.0	47.3	0.650	0.582	0.582	0.650	0.391	0.0	177	1.274	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	7.000	18	19	0.818	14.5	4.1	0.750	0.846	0.750	0.846	0.032	0.0	54	0.702	Velocity is less than the specified minimum
?	1.008	19	32	1.277	141.1	105.4	0.621	0.654	0.621	0.654	0.975	0.0	242	1.395	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	8.000	21	24	0.818	14.5	10.8	0.600	0.519	0.519	0.600	0.084	0.0	96	0.895	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	9.000	22	24	0.818	14.5	7.4	0.450	0.434	0.434	0.450	0.057	0.0	76	0.822	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	10.000	23	24	0.818	14.5	11.5	0.750	0.647	0.647	0.750	0.088	0.0	101	0.906	Velocity is less than the specified minimum | Downstream Depth is less than the specified minimum
?	8.001	24	27	0.985	48.4	27.7	0.547	0.390	0.390	0.547	0.229	0.0	135	1.017	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	12.000	25	27	0.818	14.5	7.7	0.590	0.477	0.477	0.590	0.059	0.0	78	0.830	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	11.000	26	27	0.987	31.0	23.4	0.550	0.498	0.498	0.550	0.181	0.0	130	1.082	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	8.002	27	28	1.108	78.3	55.1	0.398	0.328	0.328	0.398	0.469	0.0	186	1.197	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	8.003	28	31	0.990	70.0	53.5	0.328	0.628	0.328	0.628	0.469	0.0	197	1.087	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	13.000	29	30	0.985	48.4	11.7	0.650	0.679	0.650	0.679	0.090	0.0	83	0.815	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	13.001	30	31	1.140	56.0	26.6	0.679	0.752	0.679	0.752	0.205	0.0	122	1.127	Upstream Depth is less than the specified minimum
?	8.004	31	32	1.141	126.0	73.6	0.627	0.848	0.627	0.848	0.674	0.0	206	1.184	Upstream Depth is less than the specified minimum
?	14.000	34	33	0.795	25.0	11.7	0.490	0.540	0.490	0.540	0.091	0.0	96	0.783	Velocity is less than the specified minimum | Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.009	32	33	1.281	203.7	175.8	0.773	0.525	0.525	0.773	1.649	0.0	324	1.433	Downstream Depth is less than the specified minimum
?	1.010	33	35	1.320	285.7	201.4	0.450	0.467	0.450	0.467	1.891	0.0	326	1.425	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum
?	1.011	35	36	1.320	285.7	201.1	0.467	0.474	0.467	0.474	1.891	0.0	326	1.424	Upstream Depth is less than the specified minimum | Downstream Depth is less than the specified minimum

Link Name	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node Name	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node Name	Dia (mm)	Width (mm)	Node Type	MH Type
2.000	29.290	200.0	1500	Bioretention	75.200	74.570	0.030	74.950	74.424	-0.074	1			Junction		4			Junction	
1.000	24.744	200.0	1500	Bioretention	75.200	74.570	0.030	74.950	74.446	-0.096	2			Junction		3			Junction	
1.001	11.832	150.0	150	Circular	74.950	74.446	0.354	74.950	74.367	0.433	3			Junction		4			Junction	
1.002	16.133	150.0	150	Circular	74.950	74.367	0.433	75.140	74.259	0.731	4			Junction		5			Junction	
1.003	17.800	200.0	1500	Bioretention	75.140	74.259	0.281	75.140	74.170	0.370	5			Junction		7			Junction	
3.000	15.410	150.0	150	Circular	75.150	74.202	0.798	75.140	74.099	0.891	6	1200		Manhole	1200	7			Junction	
1.004	67.468	200.0	1500	Bioretention	75.140	74.099	0.441	74.400	73.762	0.038	7			Junction		8			Junction	
1.005	11.493	50.0	200	Circular	74.400	73.762	0.438	74.149	73.532	0.417	8			Junction		9			Junction	
1.006	19.094	200.0	1500	Bioretention	74.149	73.532	0.017	74.250	73.437	0.213	9			Junction		11			Junction	
4.000	5.464	150.0	150	Circular	74.250	73.350	0.750	74.250	73.314	0.786	10	1200		Manhole	1200	11			Junction	
1.007	46.420	200.0	1500	Bioretention	74.250	73.314	0.336	73.900	73.082	0.218	11			Junction		19			Junction	
5.000	21.734	200.0	200	Circular	74.700	73.800	0.700	74.650	73.691	0.759	12	1200		Manhole	1200	13			Junction	
5.001	15.146	200.0	1500	Bioretention	74.650	73.691	0.359	74.550	73.615	0.335	13			Junction		15			Junction	
6.000	6.000	150.0	150	Circular	74.550	73.650	0.750	74.550	73.610	0.790	14	1200		Manhole	1200	15			Junction	
5.002	25.177	200.0	1500	Bioretention	74.550	73.610	0.340	74.250	73.484	0.166	15			Junction		16			Junction	
5.003	13.658	150.0	250	Circular	74.250	73.484	0.516	74.000	73.393	0.357	16			Junction		17	1200		Manhole	1200
5.004	4.753	150.0	250	Circular	74.000	73.100	0.650	73.900	73.068	0.582	17	1200		Manhole	1200	19			Junction	
7.000	21.924	150.0	150	Circular	73.950	73.050	0.750	73.900	72.904	0.846	18	1200		Manhole	1200	19			Junction	
1.008	24.622	200.0	375	Circular	73.900	72.904	0.621	73.810	72.781	0.654	19			Junction		32	1350		Manhole	1200
8.000	15.649	150.0	150	Circular	74.400	73.650	0.600	74.215	73.546	0.519	21	1200		Manhole	1200	24	1200		Manhole	1200
9.000	10.282	150.0	150	Circular	74.300	73.700	0.450	74.215	73.631	0.434	22	1200		Manhole	1200	24	1200		Manhole	1200
10.000	4.738	150.0	150	Circular	74.350	73.450	0.750	74.215	73.418	0.647	23	1200		Manhole	1200	24	1200		Manhole	1200
8.001	49.683	200.0	250	Circular	74.215	73.418	0.547	73.810	73.170	0.390	24	1200		Manhole	1200	27	1200		Manhole	1200
12.000	4.122	150.0	150	Circular	73.950	73.210	0.590	73.810	73.183	0.477	25	1200		Manhole	1200	27	1200		Manhole	1200
11.000	13.203	150.0	200	Circular	73.950	73.200	0.550	73.810	73.112	0.498	26	1200		Manhole	1200	27	1200		Manhole	1200
8.002	27.978	200.0	300	Circular	73.810	73.112	0.398	73.600	72.972	0.328	27	1200		Manhole	1200	28	1200		Manhole	1200
8.003	27.411	250.0	300	Circular	73.600	72.972	0.328	73.790	72.862	0.628	28	1200		Manhole	1200	31	1350		Manhole	1200
13.000	5.803	200.0	250	Circular	73.750	72.850	0.650	73.750	72.821	0.679	29	1200		Manhole	1200	30	1200		Manhole	1200
13.001	4.892	150.0	250	Circular	73.750	72.821	0.679	73.790	72.788	0.752	30	1200		Manhole	1200	31	1350		Manhole	1200
8.004	50.323	250.0	375	Circular	73.790	72.788	0.627	73.810	72.587	0.848	31	1350		Manhole	1200	32	1350		Manhole	1200
14.000	11.480	229.6	200	Circular	73.490	72.800	0.490	73.490	72.750	0.540	34	1200		Manhole	1200	33	1500		Manhole	1200
1.009	17.954	250.0	450	Circular	73.810	72.587	0.773	73.490	72.515	0.525	32	1350		Manhole	1200	33	1500		Manhole	1200
1.010	2.000	285.7	525	Circular	73.490	72.515	0.450	73.500	72.508	0.467	33	1500		Manhole	1200	35	1500		Manhole	1200
1.011	2.000	285.7	525	Circular	73.500	72.508	0.467	73.500	72.501	0.474	35	1500		Manhole	1200	36	1500		Manhole	1200

Node Name	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Node Type	MH Type		Link ID	IL (m)	Dia (mm)	Link Type
1			75.200	0.630			Junction						
									0	2.000	74.570	1500	Bioretention
4			74.950	0.583			Junction		1	2.000	74.424	1500	Bioretention
									2	1.001	74.367	150	Circular
									0	1.002	74.367	150	Circular
2			75.200	0.630			Junction						
									0	1.000	74.570	1500	Bioretention
3			74.950	0.504			Junction		1	1.000	74.446	1500	Bioretention
									0	1.001	74.446	150	Circular
5			75.140	0.881			Junction		1	1.002	74.259	150	Circular
									0	1.003	74.259	1500	Bioretention
6			75.150	0.948	1200		Manhole	1200					
									0	3.000	74.202	150	Circular
7			75.140	1.041			Junction		1	3.000	74.099	150	Circular
									2	1.003	74.170	1500	Bioretention
									0	1.004	74.099	1500	Bioretention
8			74.400	0.638			Junction		1	1.004	73.762	1500	Bioretention

									0	1.005	73.762	200	Circular
9			74.149	0.617			Junction		1	1.005	73.532	200	Circular
									0	1.006	73.532	1500	Bioretention
10			74.250	0.900	1200		Manhole	1200					
									0	4.000	73.350	150	Circular
11			74.250	0.936			Junction		1	4.000	73.314	150	Circular
									2	1.006	73.437	1500	Bioretention
									0	1.007	73.314	1500	Bioretention
12			74.700	0.900	1200		Manhole	1200					
									0	5.000	73.800	200	Circular
13			74.650	0.959			Junction		1	5.000	73.691	200	Circular
									0	5.001	73.691	1500	Bioretention
14			74.550	0.900	1200		Manhole	1200					
									0	6.000	73.650	150	Circular
15			74.550	0.940			Junction		1	6.000	73.610	150	Circular
									2	5.001	73.615	1500	Bioretention
									0	5.002	73.610	1500	Bioretention
16			74.250	0.766			Junction		1	5.002	73.484	1500	Bioretention

									0	5.003	73.484	250	Circular
17			74.000	0.900	1200		Manhole	1200	1	5.003	73.393	250	Circular
									0	5.004	73.100	250	Circular
18			73.950	0.900	1200		Manhole	1200					
									0	7.000	73.050	150	Circular
19			73.900	0.996			Junction		1	7.000	72.904	150	Circular
									2	5.004	73.068	250	Circular
									3	1.007	73.082	1500	Bioretention
									0	1.008	72.904	375	Circular
21			74.400	0.750	1200		Manhole	1200					
									0	8.000	73.650	150	Circular
22			74.300	0.600	1200		Manhole	1200					
									0	9.000	73.700	150	Circular
23			74.350	0.900	1200		Manhole	1200					
									0	10.000	73.450	150	Circular
24			74.215	0.797	1200		Manhole	1200	1	10.000	73.418	150	Circular
									2	9.000	73.631	150	Circular
									3	8.000	73.546	150	Circular
									0	8.001	73.418	250	Circular
25			73.950	0.740	1200		Manhole	1200					
									0	12.000	73.210	150	Circular

26			73.950	0.750	1200		Manhole	1200					
									0	11.000	73.200	200	Circular
27			73.810	0.698	1200		Manhole	1200	1	12.000	73.183	150	Circular
									2	11.000	73.112	200	Circular
									3	8.001	73.170	250	Circular
									0	8.002	73.112	300	Circular
28			73.600	0.628	1200		Manhole	1200	1	8.002	72.972	300	Circular
									0	8.003	72.972	300	Circular
29			73.750	0.900	1200		Manhole	1200					
									0	13.000	72.850	250	Circular
30			73.750	0.929	1200		Manhole	1200	1	13.000	72.821	250	Circular
									0	13.001	72.821	250	Circular
31			73.790	1.002	1350		Manhole	1200	1	13.001	72.788	250	Circular
									2	8.003	72.862	300	Circular
									0	8.004	72.788	375	Circular
32			73.810	1.223	1350		Manhole	1200	1	8.004	72.587	375	Circular
									2	1.008	72.781	375	Circular
									0	1.009	72.587	450	Circular
33			73.490	0.975	1500		Manhole	1200	1	14.000	72.750	200	Circular
									2	1.009	72.515	450	Circular
									0	1.010	72.515	525	Circular
34			73.490	0.690	1200		Manhole	1200					

									0	14.000	72.800	200	Circular
35			73.500	0.992	1500		Manhole	1200	1	1.010	72.508	525	Circular
									0	1.011	72.508	525	Circular
36			73.500	0.999	1500		Manhole	1200	1	1.011	72.501	525	Circular

Orifice

Node	Flap Valve	Online / Offline	Downstream Link	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Diameter (m)	Discharge Coefficient
10	x	Online				73.350			0.020	0.600
24	x	Online				73.418			0.150	0.600
27	x	Online				73.112			0.300	0.600
33	x	Online				72.515	0.890	10.9	0.075	0.600

Depth/Area/Inf Area

Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
33	0.00000	0.00000	2.0	1.00	72.850		0.000	550.0	0.0
							0.640	1591.0	0.0
34	0.00000	0.00000	2.0	1.00	73.000		0.000	100.0	0.0
							0.490	1039.0	0.0

Carpark

Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Width (m)	Length (m)	Slope (1:X)	Depth (m)	Inf Depth (m)
6	0.00000	0.00000	2.0	0.50	75.000		5.000	20.000	200.0	0.150	
6	0.00000	0.00000	2.0	0.15	74.202	3	5.000	20.000	200.0	0.750	
10	0.00000	0.00000	2.0	0.66	74.100		10.000	18.500	200.0	0.150	
10	0.00000	0.00000	2.0	0.15	73.350	108	10.000	18.500	200.0	0.750	
12	0.00000	0.00000	2.0	0.66	74.550		10.000	7.700	200.0	0.150	
12	0.00000	0.00000	2.0	0.15	73.800	4	10.000	7.700	200.0	0.750	
14	0.00000	0.00000	2.0	0.50	74.400		10.000	7.100	200.0	0.150	
14	0.00000	0.00000	2.0	0.15	73.650	5	10.000	7.100	200.0	0.750	
17	0.00000	0.00000	2.0	0.66	73.850		10.000	18.500	200.0	0.150	
17	0.00000	0.00000	2.0	0.15	73.100	10	10.000	18.500	200.0	0.750	
18	0.00000	0.00000	2.0	0.50	73.800		5.000	5.200	200.0	0.150	
18	0.00000	0.00000	2.0	0.15	73.050	13	5.000	5.200	200.0	0.750	
21	0.00000	0.00000	2.0	0.15	73.650	14	5.000	5.000	200.0	0.750	
22	0.00000	0.00000	2.0	0.30	73.700	13	13.000	10.000	80.0	0.450	
23	0.00000	0.00000	2.0	0.50	74.200		9.000	10.000	200.0	0.150	
23	0.00000	0.00000	2.0	0.15	73.450	18	9.000	10.000	200.0	0.750	
25	0.00000	0.00000	2.0	0.30	73.210	17	7.000	26.000	80.0	0.450	

26	0.00000	0.00000	2.0	0.66	73.660		24.000	10.000	200.0	0.150	
26	0.00000	0.00000	2.0	0.15	73.200	19	24.000	10.000	200.0	0.750	
29	0.00000	0.00000	2.0	0.50	73.600		7.100	10.000	200.0	0.150	
29	0.00000	0.00000	2.0	0.15	72.850		7.100	10.000	200.0	0.750	
30	0.00000	0.00000	2.0	0.50	73.600		5.000	20.000	200.0	0.150	
30	0.00000	0.00000	2.0	0.15	72.821		5.000	20.000	200.0	0.750	

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.58%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	10	74.614	0.044	6.4	0.0712	0.0000	OK	2.000	4	6.2	0.636	0.013	0.2956	
15 minute summer	4	11	74.470	0.103	12.3	0.0000	0.0000	OK	1.002	5	12.3	1.048	0.849	0.1887	
15 minute summer	2	10	74.613	0.043	6.3	0.0690	0.0000	OK	1.000	3	6.2	0.502	0.013	0.3074	
15 minute summer	3	11	74.514	0.068	6.2	0.0000	0.0000	OK	1.001	4	6.1	0.590	0.424	0.1224	
15 minute summer	5	11	74.345	0.086	16.4	0.0663	0.0000	OK	1.003	7	16.3	0.825	0.033	0.3576	
15 minute summer	6	12	74.279	0.077	8.2	0.6450	0.0000	OK	3.000	7	7.2	0.485	0.500	0.2060	
15 minute summer	7	11	74.263	0.164	38.5	0.4071	0.0000	OK	1.004	8	38.1	1.180	0.078	2.1805	
15 minute summer	8	12	73.887	0.125	38.1	0.0000	0.0000	OK	1.005	9	37.9	1.482	0.703	0.2887	
15 minute summer	9	12	73.712	0.180	45.6	0.4137	0.0000	OK	1.006	11	45.6	1.191	0.093	0.7308	
180 minute summer	10	128	73.475	0.125	1.3	2.4005	0.0000	OK	Orifice	11	0.3				
15 minute summer	11	12	73.541	0.227	59.2	0.6067	0.0000	OK	1.007	19	58.2	1.243	0.119	2.1737	
15 minute summer	12	11	73.912	0.112	17.2	1.5313	0.0000	OK	5.000	13	15.7	0.909	0.587	0.3795	
15 minute summer	13	11	73.797	0.106	21.3	0.1040	0.0000	OK	5.001	15	21.1	0.747	0.043	0.4271	
15 minute summer	14	12	73.772	0.122	9.3	1.4495	0.0000	OK	6.000	15	8.3	0.581	0.575	0.0989	
15 minute summer	15	12	73.762	0.152	35.2	0.2164	0.0000	OK	5.002	16	35.2	1.041	0.072	0.8515	
15 minute summer	16	12	73.634	0.150	35.2	0.0000	0.0000	OK	5.003	17	35.3	1.188	0.630	0.4054	
15 minute summer	17	13	73.261	0.161	41.8	3.6098	0.0000	OK	5.004	19	38.4	1.199	0.686	0.1521	
15 minute summer	18	13	73.147	0.097	4.0	0.5055	0.0000	OK	7.000	19	3.8	0.271	0.265	0.3245	
15 minute summer	19	13	73.139	0.235	96.0	0.0000	0.0000	OK	1.008	32	97.2	1.377	0.689	1.7389	
15 minute summer	21	11	73.747	0.097	10.5	0.6440	0.0000	OK	8.000	24	10.0	0.860	0.691	0.1832	
15 minute summer	22	12	73.768	0.068	7.2	0.9288	0.0000	OK	9.000	24	5.6	0.747	0.386	0.0768	
30 minute summer	23	21	73.659	0.209	10.3	3.1313	0.0000	SURCHARGED	10.000	24	8.3	0.470	0.572	0.0834	
30 minute summer	24	20	73.649	0.231	18.8	0.2613	0.0000	OK	Orifice	27	18.5				
30 minute summer	25	21	73.307	0.097	6.9	1.0561	0.0000	OK	12.000	27	4.4	0.621	0.303	0.0559	
30 minute summer	26	20	73.317	0.117	21.1	4.0067	0.0000	OK	11.000	27	13.8	0.564	0.445	0.3289	
30 minute summer	27	20	73.303	0.191	36.6	0.2161	0.0000	OK	Orifice	28	36.5				
30 minute summer	28	21	73.133	0.161	36.5	0.1818	0.0000	OK	8.003	31	36.6	1.005	0.524	0.9987	
480 minute summer	29	352	73.075	0.225	2.4	2.8386	0.0000	OK	13.000	30	1.7	0.230	0.035	0.2765	
480 minute summer	30	352	73.075	0.254	4.7	3.9834	0.0000	SURCHARGED	13.001	31	3.7	0.279	0.066	0.2392	
480 minute summer	31	352	73.075	0.287	16.0	0.4108	0.0000	OK	8.004	32	15.3	0.306	0.121	5.0536	
480 minute summer	32	352	73.075	0.488	40.2	0.6984	0.0000	SURCHARGED	1.009	33	39.6	0.255	0.195	2.8447	
480 minute summer	33	352	73.075	0.560	45.8	167.8310	0.0000	SURCHARGED	Orifice	35	8.3				
480 minute summer	34	352	73.075	0.275	4.8	13.9595	0.0000	SURCHARGED	14.000	33	-2.7	0.290	-0.110	0.3593	
480 minute summer	35	352	72.574	0.066	8.3	0.1162	0.0000	OK	1.011	36	8.3	0.585	0.029	0.0284	303.5
480 minute summer	36	352	72.559	0.058	8.3	0.0000	0.0000	OK							

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.58%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	10	74.647	0.077	14.2	0.1240	0.0000	OK	2.000	4	14.0	0.695	0.029	0.9408	
15 minute summer	4	12	74.641	0.274	23.2	0.0000	0.0000	SURCHARGED	1.002	5	21.8	1.244	1.508	0.2809	
15 minute summer	2	12	74.682	0.112	13.9	0.1773	0.0000	OK	1.000	3	13.7	0.647	0.028	0.9713	
15 minute summer	3	12	74.684	0.238	13.7	0.0000	0.0000	FLOOD RISK	1.001	4	10.8	0.649	0.749	0.2083	
15 minute summer	5	11	74.401	0.142	29.9	0.1093	0.0000	OK	1.003	7	29.6	0.841	0.060	0.6725	
15 minute summer	6	12	74.431	0.229	18.1	3.2640	0.0000	SURCHARGED	3.000	7	13.2	0.802	0.911	0.2713	
15 minute summer	7	11	74.365	0.266	72.3	0.6596	0.0000	OK	1.004	8	70.4	1.266	0.144	5.0194	
15 minute summer	8	13	74.170	0.408	70.4	0.0000	0.0000	FLOOD RISK	1.005	9	66.4	2.121	1.229	0.3597	
15 minute summer	9	12	73.810	0.278	79.5	0.6404	0.0000	OK	1.006	11	79.5	1.394	0.162	1.1252	
180 minute summer	10	140	73.599	0.248	2.9	6.0265	0.0000	SURCHARGED	Orifice	11	0.4				
15 minute summer	11	12	73.683	0.369	108.9	0.9867	0.0000	OK	1.007	19	107.3	1.458	0.219	3.4173	
15 minute summer	12	12	74.051	0.251	38.1	3.7043	0.0000	SURCHARGED	5.000	13	29.8	0.969	1.113	0.6802	
15 minute summer	13	12	73.900	0.209	41.1	0.2053	0.0000	OK	5.001	15	40.4	0.829	0.083	0.8113	
15 minute summer	14	12	73.941	0.291	20.6	3.7126	0.0000	SURCHARGED	6.000	15	16.1	0.917	1.116	0.1056	
15 minute summer	15	12	73.883	0.273	71.7	0.3887	0.0000	OK	5.002	16	70.5	1.189	0.144	1.6134	
15 minute summer	16	12	73.782	0.298	70.5	0.0000	0.0000	SURCHARGED	5.003	17	70.7	1.454	1.264	0.6384	
30 minute summer	17	22	73.464	0.364	84.3	9.7413	0.0000	SURCHARGED	5.004	19	71.3	1.459	1.275	0.2324	
30 minute summer	18	21	73.398	0.348	8.3	1.9485	0.0000	SURCHARGED	7.000	19	7.2	0.407	0.495	0.3860	
30 minute summer	19	21	73.387	0.483	171.9	0.0000	0.0000	SURCHARGED	1.008	32	169.1	1.535	1.198	2.7157	
30 minute summer	21	20	73.999	0.349	21.8	2.4429	0.0000	SURCHARGED	8.000	24	15.9	0.905	1.102	0.2755	
30 minute summer	22	23	73.865	0.165	14.8	4.4982	0.0000	SURCHARGED	9.000	24	11.4	0.797	0.791	0.1810	
30 minute summer	23	21	73.893	0.443	22.8	7.0131	0.0000	SURCHARGED	10.000	24	13.5	0.766	0.933	0.0834	
30 minute summer	24	22	73.856	0.438	29.4	0.4952	0.0000	SURCHARGED	Orifice	27	28.3				
30 minute summer	25	23	73.435	0.225	15.3	4.8676	0.0000	SURCHARGED	12.000	27	8.1	0.583	0.564	0.0726	
30 minute summer	26	21	73.487	0.287	46.9	11.1596	0.0000	SURCHARGED	11.000	27	23.4	0.749	0.756	0.4132	
30 minute summer	27	22	73.430	0.318	53.2	0.3595	0.0000	SURCHARGED	Orifice	28	52.9				
60 minute summer	28	39	73.359	0.387	49.8	0.4373	0.0000	FLOOD RISK	8.003	31	49.9	0.957	0.714	1.9303	
60 minute summer	29	38	73.300	0.450	18.1	5.9323	0.0000	SURCHARGED	13.000	30	10.3	0.352	0.212	0.2838	
60 minute summer	30	38	73.298	0.477	30.7	8.1240	0.0000	SURCHARGED	13.001	31	23.1	0.594	0.413	0.2392	
60 minute summer	31	39	73.289	0.501	71.9	0.7164	0.0000	SURCHARGED	8.004	32	71.4	0.648	0.567	5.5505	
600 minute winter	32	555	73.284	0.697	47.5	0.9971	0.0000	SURCHARGED	1.009	33	47.4	0.299	0.233	2.8447	
600 minute winter	33	555	73.284	0.769	52.0	395.3755	0.0000	FLOOD RISK	Orifice	35	9.9				
600 minute winter	34	555	73.284	0.484	12.0	107.2875	0.0000	FLOOD RISK	14.000	33	-9.4	0.308	-0.378	0.3593	
600 minute winter	35	555	72.580	0.072	9.9	0.1272	0.0000	OK	1.011	36	9.9	0.607	0.034	0.0325	423.3
600 minute winter	36	555	72.565	0.064	9.9	0.0000	0.0000	OK							

Results for 100 year +20% Critical Storm Duration. Lowest mass balance: 99.58%

Event	US Node ID	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link ID	DS Node ID	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	13	74.833	0.263	22.0	0.4256	0.0000	OK	2.000	4	19.8	0.687	0.040	2.2024	
30 minute summer	4	20	74.832	0.465	27.6	0.0000	0.0000	FLOOD RISK	1.002	5	25.8	1.467	1.787	0.2840	
30 minute summer	2	21	74.896	0.326	20.3	0.5179	0.0000	OK	1.000	3	16.9	0.644	0.035	2.2106	
30 minute summer	3	21	74.896	0.450	16.9	0.0000	0.0000	FLOOD RISK	1.001	4	12.7	0.722	0.879	0.2083	
30 minute summer	5	20	74.479	0.220	37.1	0.1696	0.0000	OK	1.003	7	37.1	0.859	0.076	1.0283	
30 minute summer	6	21	74.595	0.393	26.3	6.1255	0.0000	SURCHARGED	3.000	7	16.8	0.955	1.163	0.2713	
15 minute summer	7	12	74.466	0.367	102.0	0.9099	0.0000	OK	1.004	8	99.6	1.276	0.203	12.7857	
30 minute summer	8	22	74.361	0.599	95.7	0.0000	0.0000	FLOOD RISK	1.005	9	76.8	2.454	1.422	0.3597	
15 minute summer	9	11	73.889	0.357	97.2	0.8222	0.0000	OK	1.006	11	96.5	1.393	0.197	1.5623	
240 minute summer	10	192	73.735	0.385	3.6	10.0314	0.0000	SURCHARGED	Orifice	11	0.5				
15 minute summer	11	11	73.807	0.493	147.2	1.3177	0.0000	OK	1.007	19	143.0	1.497	0.292	7.2529	
15 minute summer	12	12	74.303	0.503	59.0	7.6438	0.0000	SURCHARGED	5.000	13	42.5	1.357	1.585	0.6802	
30 minute summer	13	21	74.040	0.349	55.9	0.3421	0.0000	OK	5.001	15	56.0	0.818	0.115	1.3013	
15 minute summer	14	12	74.115	0.465	31.9	6.0476	0.0000	SURCHARGED	6.000	15	24.2	1.377	1.677	0.1056	
30 minute summer	15	21	74.030	0.420	100.9	0.5991	0.0000	OK	5.002	16	102.5	1.195	0.209	3.7074	
15 minute summer	16	13	74.016	0.532	105.9	0.0000	0.0000	FLOOD RISK	5.003	17	96.9	1.981	1.731	0.6679	
30 minute summer	17	22	73.767	0.667	116.7	18.9278	0.0000	FLOOD RISK	5.004	19	88.8	1.815	1.586	0.2324	
60 minute summer	18	38	73.674	0.624	10.1	3.5341	0.0000	FLOOD RISK	7.000	19	6.2	0.350	0.426	0.3860	
60 minute summer	19	38	73.655	0.751	210.4	0.0000	0.0000	FLOOD RISK	1.008	32	194.7	1.766	1.380	2.7157	
30 minute summer	21	20	74.333	0.683	34.0	4.8171	0.0000	FLOOD RISK	8.000	24	23.1	1.310	1.595	0.2755	
30 minute summer	22	24	74.050	0.350	30.7	12.2730	0.0000	FLOOD RISK	9.000	24	15.5	0.939	1.072	0.1810	
30 minute summer	23	21	74.103	0.653	35.7	10.4973	0.0000	FLOOD RISK	10.000	24	18.1	1.030	1.255	0.0834	
30 minute summer	24	24	74.039	0.621	41.1	0.7020	0.0000	FLOOD RISK	Orifice	27	31.3				
60 minute summer	25	43	73.636	0.426	27.2	15.5796	0.0000	SURCHARGED	12.000	27	11.5	0.654	0.796	0.0726	
30 minute summer	26	22	73.684	0.484	73.3	20.2842	0.0000	FLOOD RISK	11.000	27	29.3	0.937	0.945	0.4132	
60 minute summer	27	42	73.632	0.520	56.3	0.5882	0.0000	FLOOD RISK	Orifice	28	54.7				
60 minute summer	28	41	73.555	0.583	54.7	0.6591	0.0000	FLOOD RISK	8.003	31	54.9	0.940	0.784	1.9303	
60 minute summer	29	37	73.512	0.662	28.3	8.8541	0.0000	FLOOD RISK	13.000	30	18.6	0.380	0.384	0.2838	
60 minute summer	30	38	73.506	0.685	52.8	11.9961	0.0000	FLOOD RISK	13.001	31	41.9	0.856	0.748	0.2392	
60 minute summer	31	39	73.481	0.693	86.7	0.9920	0.0000	SURCHARGED	8.004	32	86.2	0.781	0.684	5.5505	
720 minute winter	32	690	73.453	0.866	61.8	1.2393	0.0000	SURCHARGED	1.009	33	61.7	0.390	0.303	2.8447	
720 minute winter	33	690	73.452	0.937	67.8	631.1501	0.0000	FLOOD RISK	Orifice	35	10.9				
720 minute winter	34	690	73.453	0.653	19.1	243.9955	0.0000	FLOOD RISK	14.000	33	-15.7	-0.500	-0.626	0.3593	
720 minute winter	35	690	72.584	0.076	10.9	0.1348	0.0000	OK	1.011	36	10.9	0.617	0.038	0.0355	532.8
720 minute winter	36	690	72.569	0.068	10.9	0.0000	0.0000	OK							

Appendix D

Site Visit Photographs

Photo Location 1: View of Plan Area from north along boundary between western and eastern extents	Photo Location 2: View of eastern Plan Area from the east
	
Photo Location 3: Upstream reach of secondary drain	**Photo Location 4:** Downstream reach of secondary drain
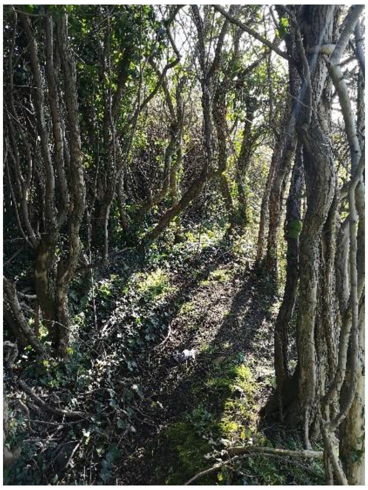	
Photo Location 5: Southern drain at culvert inlet	**Photo Location 6:** Culvert in southern drain beneath Heathfield Park
	

Photo Location 7: View of south-east corner of Plan Area (ponding surface water visible)	Photo Location 8: Ponding of surface water adjacent to southern drain and secondary drain
	
Photo Location 9: Localised depression in western Plan Area	**Photo Location 10:** Open drainage basin in Heathfield estate