SOCIAL HOUSING BUNDLE 3

PROPOSED DEVELOPMENT AT FORTBARRINGTON ROAD

Drainage and Watermain Design Report

SHB3-ATY-CS-RPS-RP-001
Drainage and Watermain Planning
Design Report
P03

19th November 2021

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RPS	**Kildare County Council**

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1 INTRODUCTION

RPS are the appointed Civil and Structural Engineering advisors for the proposed residential development at Fortbarrington Road, Athy, County Kildare. This project will deliver 73 dwellings to Kildare County Council Planning Authority.

New watermain, storm water and foul water networks will be constructed to service the proposed development. The foul water network will outfall to an existing Irish Water (IW) system on the Fortbarrington road. The storm water generated on site will infiltrate to ground. The watermain, storm water and foul water drainage proposals are shown in **Appendix A**.

The maximum occupancy of the development is to be approximately 200 residents, the proposed maximum design population for the purposes of drainage is approximately 200 residents. This report addresses the following design streams:

- Foul flows which are dealt with in Section 2 of the report,
- Surface water flows, and infiltration are dealt with in Section 3 of the report, and
- Water supply to the site which is dealt with in Section 4 of the report.

This report should be read in conjunction with the following RPS drawings, being submitted with this planning application:

- SHB3-ATY-CS-RPS-DR- DA001 - Watermain Layout
- SHB3-ATY-CS-RPS-DR- DA002 - Foul & Storm Water Network Layout

1.1 Site Characteristics

1.1.1 Existing Services

A topographical and underground utility survey was completed by NCW Surveys in May 2021. This survey verified the location of the existing services as determined by the equipment and methodology employed by the surveyor. The survey provides information on service locations, indicative depth, and the nature (type) of the underground service/utility. This information is used to assist with preparing the drainage design for the proposed development.

1.1.1.1 Existing Foul and Watermain Infrastructure

IW database shows a 225mm Ø PVC foul water network and a 200 mm Ø Cast iron watermain on the Fortbarrington road. NCW survey has confirmed the location and diameter of the foul water network and the location of the watermain. It is proposed to tie into the existing foul water network and to connect to the existing watermain on the Fortbarrington road.

RPS propose to connect to existing IW infrastructure as shown in drawings **SHB3-ATY-CS-RPS-DR-DA001** and **SHB3-ATY-CS-RPS-DR-DA002.**

1.1.1.2 Existing Storm Water Infrastructure

The existing site is a greenfield site, as such there is no existing surface water network within the site area, with rainfall discharging directly to the ground. There are no watercourses in the vicinity of the site that can be reached by gravity, due to the site topography.

In light of the fact that there isn't a suitably deep outfall manhole and to comply with criteria 2 of the Greater Dublin Strategic Drainage Study (GDSDS), RPS will store and discharge water on site to a suitably designed infiltration system.

2 FOUL FLOWS

2.1 Foul Sewer Design Procedure

The proposed foul sewerage system was designed using the Wallingford Tables and Microdrainage design software. Wastewater loadings were based on EPA Guidance document, 'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'.

Drainage calculations submitted in **Appendix B** have been generated by 'Micro Drainage' flow modelling software, and the 'Hydraulic Design for Gravity Sewers' method to Irish Water Code of Practice for Wastewater Infrastructure. Gradients should be selected so that self-cleansing velocities can be maintained under normal operating conditions. The range of flow velocity within the sewers should be between 0.75m/s at low flow and 3m/s, when flowing full.

The proposed foul drainage network will be constructed in accordance with Irish Water Code of Practice for Wastewater Infrastructure, The Building Regulations 'Part H' & the Regional Code of Practice for Drainage Works. The sewers will be compliant with the requirements of the Irish Water Code or Practice for Wastewater Infrastructure and will be from 150mm to 225mm in diameter. Foul sewers within the building plots may be as small as 100mm dia. In accordance with TGH H – Drainage specifications and with Irish Water Code of Practice.

Foul water will outfall to the existing IW foul water network located to north west corner of the proposed development via an existing manhole, See drawing **SHB3-ATY-CS-RPS-DR- DA002** for details.

2.2 Foul Services design parameters

The following parameters were used for the basis of design (refer to **Table 2-1**).

Table 2-1 Design Parameters

Parameters	Values	Reference
Flow Rates	Varies	Irish Water Code of Practice for Wastewater Infrastructure.
Peak Flow	6.0 x Dry Weather Flow (DWF) (based on a 10hr working day)	Irish Water Code of Practice for Wastewater Infrastructure.
Min Velocity	0.75m/s.	Irish Water Code of Practice for Wastewater Infrastructure & Sewers for Adoption
Pipe Roughness	1.50mm	(Colebrook/White)
Pipe Cover	1.2m minimum without concrete encasement– light trafficked areas 0.6m minimum without concrete encasement – gardens	Irish Water Code of Practice for Wastewater Infrastructure Technical Guidance Document H – Drainage and Waste Water Disposal

2.3 Pipe and manhole numbering

The manhole numbers define the structure of the network. The foul water manholes are labelled such that labels in the direction of flow are typically in increasing order. F01, F02, etc. is used for foul sewers located inside the site boundary of this development. Existing manholes will be labelled EF01 (refer to Drawing **SHB3-ATY-CS-RPS-DR- DA002 in Appendix A**).

2.4 Foul loadings from proposed development

Foul loadings from the proposed development are shown in **Table 2.2**. The maximum foul flow from the proposed development has been calculated as 3.28 litres/sec. This value is based on a peak factor of 6:

- 446l/day per residential unit (based on 2.7 persons per unit x 150l/person/day, + a 10% increase factor).
- 446l/day/unit x 73 units = 32,558 l/day = 32.5 m3/day;
- 0.38 l/sec Average flow (1 DWF);
- 2.29 l/sec Peak Flow (6 DWF – Population between 0 and 750)

The minimum capacity of any sewer in the proposed design is **29.9 litres/sec** as such the design can cater for the proposed developments flow. For detailed output from the foul sewer design refer to **Appendix B.**

3 SURFACE WATER FLOWS

3.1 Storm Water Design Procedure

The site is approximately 2.286 ha and has a total impermeable area of 0.824ha which is to be drained to the new proposed surface water systems. Storm flows will infiltrate to ground.

All proposed developments must ensure that SUDS are incorporated into the development. SUDS requires that post development run-off rates be maintained at the equivalent to, or lower than, the pre-development run-off levels. Thus, the development must be able to retain, within its boundaries, storm water volumes from extreme storm events up to and including a design for a 1 in 100 year storm event, more commonly expressed as a 1.0% AEP (Annual Exceedance Probability), while also allowing for climate change factors.

Any new development must have physical capacity to retain storm water volumes as directed under the Greater Dublin Strategic Drainage Study (GDSDS) and, if necessary, release this attenuated surface water runoff before it enters a natural watercourse or into a public sewer, which ultimately discharges to a water body. This is to ensure the highest possible standard of storm water quality. In this instance, Infiltration storage will be provided, designed to drain the site for storm events up to and including a 1 in 100 year event, including 20% for climate change.

The new surface water system was designed using Innovyze MicroDrainage software which is based on the Wallingford Tables and the Modified Rational Method of storm flow modelling. The rainfall and climate data used in all designs was extracted directly from maps built into the program. The M5-60, R, SAAR, soil infiltration values etc were all derived for the site. Such data is given in the appropriate appendices of this report of MicroDrainage outputs for surface and grey water networks, see **Appendix B.**

Ground investigation infiltration tests were undertaken by Priority Geotechnical Limited in October 2021 to assess the infiltration rate on site. The infiltration rates were found to be favourable to the design of an infiltration system. The design shows that the proposed surface water drainage system for this development can use infiltration systems within the open spaces to drain the site for storm events up to and including a 1 in 100 year event, including 20% for climate change. Infiltration design is outlined in **section 3.7** of this report.

3.2 Surface Water Impact Assessment

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the GDSDS and with the requirements of KCC. The guidelines require the following 4 main criteria to be provided by the design:

3.2.1 Criterion 1: River Water Quality Protection:

Interception storage of at least 5mm, and preferably 10mm, of rainfall where runoff to the receiving water can be prevented. It is proposed that the overall drainage system, serving this development, will contain a range of surface water treatment methods such as:

- Car parking spaces on site to incorporate a permeable paving system;
- Interception storage and treatment within the site;
- All road gullies to be trapped;

- Intensive landscaping where possible;
- Fuel separator and silt trap prior to entering the infiltration area;
- Tree pits;
- Bioretention Swales

3.2.2 Criterion 2: River Regime Protection

Surface water will infiltrate to ground via an infiltration system designed to meet the requirements of the GDSDS.

3.2.3 Criterion 3: Level of Service (flooding) for the site.

There are four sub-criteria for the required level of service, for a new development; as set out in the GDSDS Volume 2, Section 6.3.4 (Table 6.3):

- No flooding on site except where planned (30-year high intensity rainfall event);
- No internal property flooding (100-year high intensity rainfall event);
- No internal property flooding (100-year river event and critical duration for site) and;
- No flood routing off site except where specifically planned. (100-year high intensity rainfall event).

3.2.3.1 Sub-Criteria 3.1

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding. Therefore, the system has capacity for the 30-year return period rainfall event without flooding. The performance of the proposed drainage system has been analysed for design rainfall events up to, and including, the 1% AEP event (including 20% for climate change) using the MicroDrainage Network Design Software, by Innovyze Inc. Refer to **Appendix B** for details of design criteria, calculations, and results. The analyses indicate that no flooding will occur for design rainfall events up to, and including, the 1% AEP.

3.2.3.2 Sub Criteria 3.2

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding. The performance of the proposed drainage system in 100-year return period storm events (including 20% for climate change) has been analysed – Refer to **Appendix B** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

3.2.3.3 Sub Criteria 3.3

There is no apparent risk of internal property flooding. The maximum water level in the proposed infiltration system will not pose a risk to the proposed buildings. It is also noted that the surface water drainage network is designed with no flooding experienced in a 1 in 100 year rainfall event (including 20% for climate change).

3.2.3.4 Sub Criteria 3.4

The surface water drainage systems, serving the proposed development, have been designed to accommodate the 100-year return period rainfall event (including an allowance of 20% increase in rainfall intensity for climate change) without flooding, so no flood routing off site will be experienced for such a rainfall event. The performance of the proposed drainage system in 100-year return period storm events (including 20% for climate change) has been analysed – Refer to **Appendix B** for calculations. The analyses show that no flooding will occur in 100-year return period storm events.

3.2.4 Criterion 4: River flood protection

Storage is to be provided for the 100-year return period rainfall event (including an increased 20% rainfall intensity; to allow for climate change). Surface water will infiltrate to ground via an infiltration system designed to meet the requirements of the GDSDS. Refer to **Appendix B** for details of hydraulic modelling calculations of attenuation and infiltration systems, as carried out using MicroDrainage software by Innovyze Inc.

3.3 Site Specific SUDS Measures

Sustainable Drainage Systems (SuDS) were considered for the site, in line with recommendations of Greater Dublin Strategic Drainage Strategy (GDSDS). SuDS are a method of replicating the natural characteristics of rainfall runoff from any site. The various types of SuDS considered are outlined below.

- Infiltration – Soaking water into the ground. This is the most desirable solution to runoff management as it restores the natural hydrological process. Based on site investigation infiltration testing carried out by Priority Geotechnical Ltd., infiltration rates in this area are suitable for infiltration of a 100 year, 6 hour duration storm event within the site. Infiltration to ground will also be accommodated to the rear of the proposed dwellings using a soakaway systems design to meet the requirements of BRE 365. Figure 13.1 from the CIRIA SUDS Manual 2016 shows the characteristics of a typical geocellular soakaway system. A typical crate system shown in **Appendix G.**

- Conveyance – the transfer of surface water runoff from one place to another. Controlled conveyance can provide links between various SuDS components. Conveyance is implemented within this development through the use of landscaped swales. The swales will be placed where appropriate to drain roads next to public open spaces. The swale will be broad and shallow and covered in suitable vegetation to slow water, facilitating sedimentation, filtration through root zones and soil matrix, evapotranspiration and infiltrating into the underlying soil. Excess flows will be conveyed into the stormwater system in periods of high rainfall.

- Pervious pavements – Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before infiltrating to ground. Pervious pavements are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Pervious Paving is to be provided for all car parking (i.e., Off street parking). The type of permeable paving system proposed in this case is a Type B system as indicated in Figure 20.13 from the CIRIA SUDS Manual 2016.

- Tree pits – Tree pits are to be provided adjacent to public footpath areas to act as a first level of treatment for surface water runoff. Each pit will have a surface depression where water will be temporarily stored before if flows down through the tree pit soil. This depression will be sized to hold the excess water from a 1:1 year, critical duration event – for water quality treatment. Each tree pit will be constructed using a suitable tree soil.

- Bioretention swale - Bioretention swales are shallow, vegetated, landscaped depressions with sloped sides. They are designed to capture, treat and infiltrate stormwater runoff as it moves downstream. The bioretention swale is located within the POS and will act as a first level of treatment for surface water runoff as it moves downstream.

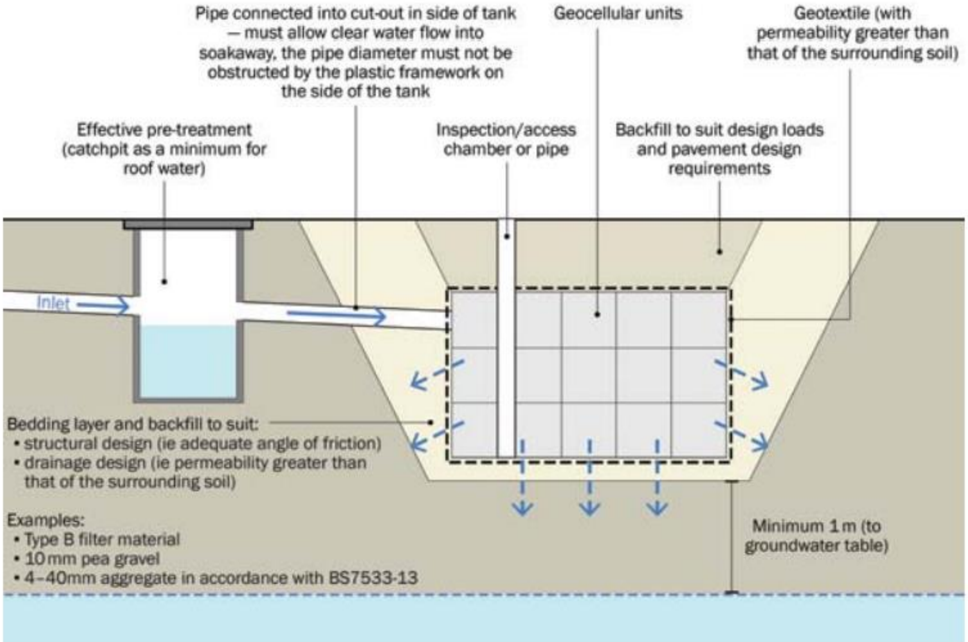


Figure 13.1 Soakaway details (including a pre-treatment system)

Figure 3-1 Typical Soakaway Details

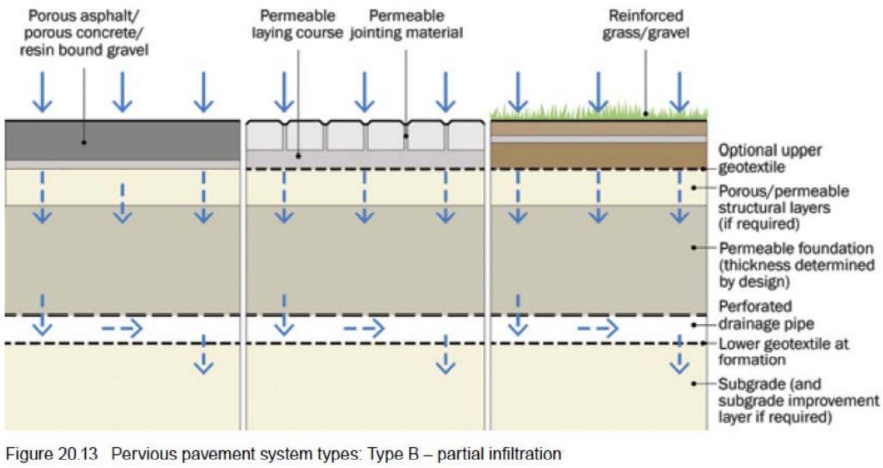


Figure 3-2 Typical Permeable Paving Details

3.4 Design Parameters

The following parameters were used for the basis of design in the Innovyze MicroDrainage Module.

Table 3-1 Design Parameters Road Runoff Surface Network

Parameters	Values	Reference
Return Period for pipe work	5 Year	Wallingford Procedure
M5-60	**18.1**	Wallingford Procedure
Ratio 'R'	**0.302**	Wallingford Procedure
Max Rainfall	Paved Areas 50mm/hr Roof Areas 75mm/hr	Wallingford Procedure
Global Time Entry	5 minutes	Wallingford Procedure
Minimum Velocity	0.75m/s	Site Development Works for Housing Areas
Run-Off Co-efficient	Roof Areas 1.0 Paved Areas 0.75	BS EN 16941-1
Pipe Roughness	0.6mm Concrete / 0.15mm uPVC	Colebrook/White
Pipe Cover	1.2m minimum without concrete encasement in trafficked areas 0.6m minimum with concrete encasement in trafficked areas	Technical Guidance Document H – Drainage and Waste Water Disposal
Climate Change	20%	Transport Infrastructure Ireland Drainage Systems for National Roads - DN-DNG-03022

3.4.1 Proposed Storm Water Services

Storm water generated from new hard landscaping and roofs on site will be directed to an onsite infiltration tank. Prior to entering the infiltration tank, the proposed surface water collection networks will outfall to a hydrocarbon interceptor and silt trap manhole. Terraced housing and apartment buildings will incorporate appropriately sized soakaways to rear gardens to capture storm water runoff. The soakaways are to be designed to BRE365 specifications and will infiltrate to ground.

Surface water from trafficked areas will be intercepted by a suitable petrol interceptor prior to entering the Infiltration system. In some instances, surface water from trafficked areas will enter tree pits / Bioretention swales.

The proposed storm water sewer system is shown on Drawings **SHB3-ATY-CS-RPS-DR- DA002.** For detailed outputs from the surface water network design, including network details and 100-year storm event simulation results)including 20% for climate change), refer to **Appendix B.**

3.5 Pipe and Manhole Numbering

The manhole numbers define the structure of the network. The surface manholes are labelled such that labels in the direction of flow are typically in increasing order. S01, S02, etc. is used for surface water sewers. Diverted manholes will be labelled DS01. Existing manholes will be labelled ES01. The manholes are labelled such that labels in the direction of flow are typically in increasing order. (refer to drawing **SHB3-ATY-CS-RPS-DR- DA002 in Appendix A**).

3.6 Hydrocarbon / Oil Interceptor

A hydrocarbon interceptor will be provided prior to the attenuation/infiltration areas. In accordance with the requirements of BS EN 858, 4.1 (b) '(run-off) from impervious areas, e.g., car parks, roads, factory yards areas;' the size of the separator will depend on the design, rainfall intensity and the catchment area draining to the separator.

A Class1 Bypass hydrocarbon Interceptor is proposed prior to entering the infiltration area. It is recommended to use a Kingspan Klargester or equivalent approved surrounded in 300 mm mass concrete. The location of the interceptor is outlined in drawing **SHB3-ATY-CS-RPS-DR- DA002, in Appendix A.**

The maximum rainwater flow rate Q_r in l/sec shall be calculated using the equation below in accordance with EN 752-4:

$$Q_r = \Psi.i.A$$

Where,

- i is the rainfall intensity, in litres /sec / hectare.
- A is the area receiving rainfall, measured horizontally, in ha;
- Ψ is a dimensionless coefficient (usually taken as one)

Pollution prevention guidelines (PPG 3) use rainfall intensity equal to 6.5mm/hr which corresponds to the following formula for a bypass separator:

$$NSB = 0.0018 \times A$$

Where,

- NSB: Nominal Size of Bypass separator
- A: Catchment Area in m^2

The impermeable area draining to the proposed bypass separators is approximately 8240m^2 which includes all impermeable surfaces on the site.

NSB required:

- 0.0018 x 8240 = 14.832 l/s NSBE025 is suitable

Details of the sizing of the proposed interceptor for NSBE025 is provided in **Appendix D**. The maximum storm water flow that the bypass facility can cater for is 250 l/s. The maximum design flows in the storm system is 221 l/s for a 1 in 100yr storm event so the bypass facility has sufficient capacity to cater for this flow.

3.7 Infiltration Design

RPS carried out further investigation to assess the possibility for localised infiltration within the site. RPS assessed the groundwater vulnerability of the area complying with TII publication (Road Drainage and the Water Environment – DN-DNG-03065) This document outlines the groundwater protection response matrix for use of permeable drains in road schemes, used in this instance to assess the appropriateness of infiltration within the site.

The Groundwater protection Response Matrix requires the identification of groundwater vulnerability and groundwater resources. GSI data indicates that the area is underlain by a Regionally important gravel aquifer (Figure 3.3 – Regionally Important Gravel Aquifer) overlain by well-drained soil with a High subsoil permeability (Figure 3.4 & 3.5). Mapping also shows a high groundwater vulnerability (Figure 3.6).

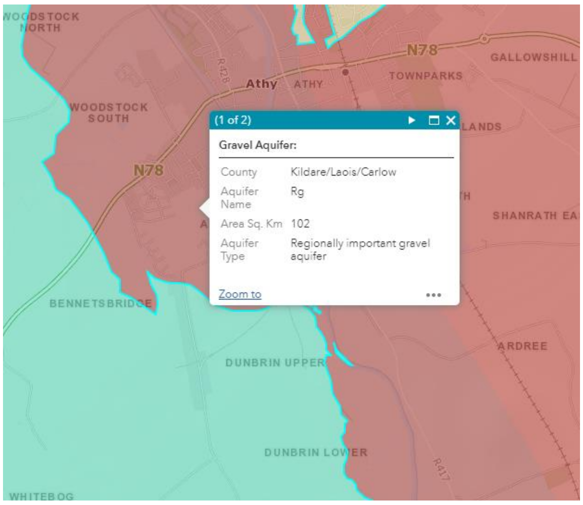
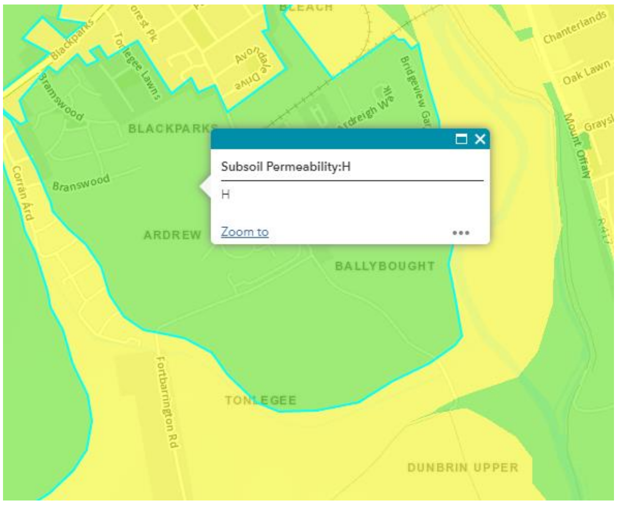


Figure 3-3 Aquifer Classification - Gravel Aquifer

Figure 3-4 - GSI Soil Classification



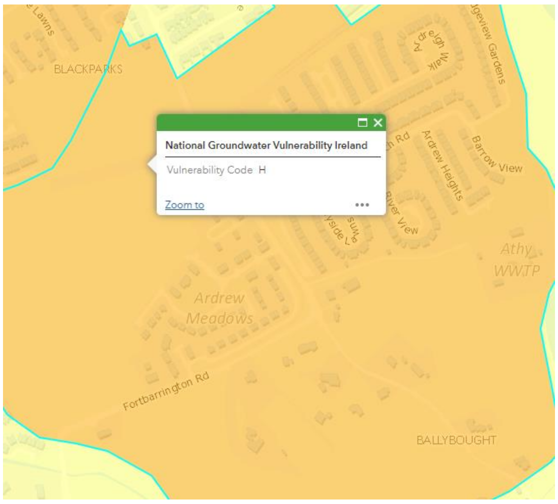


Figure 3-5 - GSI Subsoil Permeability

Figure 3-6 GSI Groundwater Vulnerability

From the vulnerability rating and aquifer classifications table below (Groundwater Protection Response Matrix) of the TII document shows a resource protection rating of R2(2) for the site. This rating stipulates that certain conditions must be met to allow infiltration to be incorporated into the design. These are shown in extracts below.

Table 3-2 Extract from TII Publication – DN-DNG-03065

Vulnerability rating	Source protection area	Resource protection area (aquifer category)							
		Regionally Important Aquifer			Locally Important Aquifer			Poor aquifer	
		Rk*	Rf	Rg	Lg	Lm	Ll	Pl	Pu
Extreme: Rock near Surface or karst (X)	R4	R4	R4	R3(2)	R3(2)	R3(1)	R3(1)	R3(1)	R3(1)
Extreme (E)	R4	R2 (3)	R2 (2)	R3(2)	R3(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
High (H)	R3(2)	R2 (2)	R2 (2)	R2(2)	R2(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
Moderate (M)	R3(1)	R2 (1)	R2 (1)			R2 (1)	R2 (1)	R1	R1
Low (L)	R3(1)	R1	R1			R1	R1	R1	R1

* A small proportion of the country (~0.6%) is underlain by locally important karstic aquifers (Lk); in these areas, the groundwater protection responses for the Rk groundwater protection zone shall apply.

A rating of R2(2) requires the design to meet the minimum standard of R2(2). As the subsoil is classified as a gravelly Silt and is underlain by Limestone and shales, Table R2(2) of the TII document requires that a minimum of 1m unsaturated subsoil is required beneath the invert level of the drainage system.

R1	Acceptable subject to minimum design standards in the NRA DMRB and Notes 1 and 2.
R2	
R2(1)	Acceptable subject to minimum design standards in the NRA DMRB and to meeting the following requirements : 1. There is a consistent minimum thickness of 1 m unsaturated subsoil, or 2 m in areas of karstified rock (Rk & Lk), beneath the invert level of the drainage system (Note 1). 2. During all stages of design particular attention must be paid to the presence of karst features and additional assessments undertaken if required. If karst features are identified response R2 (3) must be applied as a minimum. 3. During all stages of design particular attention must be paid to receptors (such as; public wells, group schemes, industrial water supply sources and springs) and additional assessments undertaken if required.

R2(2) Acceptable subject to minimum design standards in the NRA DMRB, meeting requirements 1, 2 and 3 of above and the following additional requirements:

4. Where the subsoil is classed using BS5930 as; SAND, GRAVEL or SILT (in circumstances where the clay content is <10%) AND/OR is underlain by limestone bedrock, there is a consistent minimum thickness of 2 m unsaturated subsoil beneath the invert level of the drainage system.

OR

There is a minimum consistent unsaturated thickness 1m of "appropriate material" (Note 3) either natural or man-made beneath the invert level of the point of discharge.

Figure 3-7 - Extract from TII Document DN-DNG-03065

It is the conclusion of the investigation that infiltration to ground is suitable in this location if the minimum requirements as set out above are met.

Furthermore, a site investigation was carried out across the development area in to confirm the conceptual design assumption that there were gravelly silt beneath the area that would be suitable for infiltration. The investigation included infiltration tests that followed the guidance in BRE 365. The tests were carried out in locations identified as potential infiltration areas within the proposed site. The tests were carried out at a depth similar to the anticipated design layout of the proposed infiltration area. The infiltration rate determined on site at the Infiltration locations was sufficient to allow for a Infiltration design.

Site investigation infiltration testing results at the location of the proposed infiltration tank show an infiltration rate of 0.063m/hr. The infiltration rate of 0.063 m/hr was applied for the sides of the infiltration tank. A conservative approach was taken for the base of the infiltration tank, an infiltration rate of 0.0315 m/hr was adopted to simulate 50% blockage by silt.

In addition, a factor of safety was then applied to the infiltration rate to account for possible long-term reductions in performance. A Factor of Safety of 2 is applied for the area drained. The design infiltration coefficient is factored within the Microdrainage programme to allow for the appropriate factor of safety. Noting that no ground water encountered during the site investigations.

The infiltration systems are designed to cater for the 1 in 100-year return period storms with an additional allowance of 20% for climate change, this in accordance with the GDSDS. Using a proprietary infiltration system, with a nominal void ratio of 95%.The typical layout is shown in Drawing **SHB3-ATY-CS-RPS-DR-DA002 in Appendix A** with a typical crate system shown in **Appendix G**. A plan area of 625m^2 (0.81m deep providing a storage capacity of 480m^3) will be required and will be located within the Public Open Space in the middle of the housing development.

There will be sufficient storage capacity available in the infiltration systems to store water from the critical 100-year storm (plus 20% for climate change) prior to infiltration to ground. The maintenance of the infiltration system should be carried out as per the manufacturer's recommendations. Infiltration design calculations can be found in **Appendix C.**

4 WATER SUPPLY / IW PRE CONNECTION ENQUIRY

RPS completed a Pre-connection enquiry form and submitted this to Irish Water on the 23rd March 2021. RPS received feedback from Irish Water on the 30th April 2021 via a standard confirmation of feasibility, attached in **Appendix E.**

IW database shows a 200mm cast iron watermain on the Fortbarrington Road. NCW topographical survey has captured the location of the watermain. It is proposed to tie into this watermain to provide a watermain feed to the proposed buildings. A sluice valve and water meter will be provided prior to connection to the new building as indicated in drawings in **Appendix A**. The water main layout and details including valves, hydrants, metering etc. will be in accordance with Irish Water's Code of Practice and Standard Details for water infrastructure

A looped watermain will service the site with hydrants used to provide hydrant fire cover. This new watermain will be 150mm diameter PE100 HDPE pipe. Individual houses will have their own connections to the looped watermain via service connections and boundary boxes. Individual service boundary boxes will be of the type to suit Irish Water and to facilitate domestic meter installation. Hydrants are provided for firefighting at locations to ensure that each dwelling is within the required Building Regulations distance of a hydrant.

An underground storage tank for firefighting requirements is proposed for the site. This storage tank will be connected to the watermain and will incorporate an automated level control system. The access requirements for fire fighters will be fully agreed with the Local Area Fire Officer prior to construction. The required supply for firefighting purposes comes from the Water UK document "National guidance document on the provision of water for firefighting" which calls for 35 litres/second for a site with an area of between one and two hectares.

A hydrant survey was competed in August 2021 by SES Water Management which established a flow rate of 996 l/min. the flow rate is the average maximum sustainable flow based on the 5-minute flow test. A flow rate of 996 l/min equates to a rate of approx.16.6 l/s. An additional firefighting flow rate of approx. 19 l/s is required to meet the requirements of the above regulations. See **Appendix F** for hydrant testing results.

The maximum tank volume will be **72m^3** (20 l/s for a period of 1 hour) this caters fully for the requirements of the above regulations. The proposed water main layout and water storage tank location is shown on drawing No. **SHB3-ATY-CS-RPS-DR-DA001 in Appendix A.**

5 FLOODING

A Site-Specific Flood Risk Assessment has been prepared and is submitted under separate cover with this application.

This flood risk assessment has been undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floodmaps.ie) and the Eastern CFRAM Study and has been carried out in accordance with the OPW's Guidelines for Planning Authorities – The Planning System and Flood Risk Management (November 2009)

Appendix A

Drainage Layout, Detailed Drawings

- **SHB3-ATY-CS-RPS-DR-DA001 – Watermain Layout**
- **SHB3-ATY-CS-RPS-DR-DA002 – Storm and Foul Water Networks**

LEGEND

SITE BOUNDARY	(red line)
EXISTING 250mm uPVC WATER MAIN	(green line)
PROPOSED 150mm WATERMAIN (STD-W-13)	(blue dashed line)
PROPOSED SERVICE CONNECTION 25mm HDPE (STD-W-03)	(cyan dashed line)
PROPOSED SERVICE CONNECTION 80mm HDPE (STD-W-03)	(orange dashed line)
PROPOSED SLUICE VALVE (STD-W-07)	SV
PROPOSED HYDRANT (STD-W-18 / STD-W-19)	H
PROPOSED AIR VALVE (STD-W-22 / STD-W-23)	AV
PROPOSED SCOUR VALVE (STD-W-30)	ScV
PROPOSED BULK FLOW METER AND ASSOCIATED TELEMETRY SYSTEM (STD-W-26)	M
PROPOSED BOUNDARY BOX (STD-W-03)	
PROPOSED THRUST BLOCK	

0.00m 20m 40m 60m 80m 100m
Scale Bar

MINIMUM 20l/s FLOW REQUIRED FROM HYDRANTS FOR FIRE FIGHTING PURPOSES AT MULTI-OCCUPIED HOUSING DEVELOPMENTS AS PER "NATIONAL GUIDANCE DOCUMENT FOR THE PROVISION OF WATER FOR FIRE FIGHTING - WATER UK 3rd EDITION". HYDRANTS TO BE TESTED ON COMPLETION OF WATERMAIN. TANK TO BE SIZED BASED ON WATER PRESSURE WITHIN THE NEW NETWORK. IF 20l/S IS ACHIEVED, STATIC WATER MAY NOT BE REQUIRED SUBJECT TO AGREEMENT WITH THE LOCAL AUTHORITY.

72m3 STATIC STORAGE TANK WILL PROVIDE A FLOW OF 20l/s FOR 1 HOUR

NOTE:
FOR APARTMENT BUILDINGS A BOOSTED WATER SUPPLY SYSTEM IS TO BE PROVIDED USING A CONNECTION VIA AN UNRESTRICTED AIR-GAP DEVICE (AA TYPE DEVICE, IS EN 1717) IN ACCORDANCE WITH SECTION 3.13 OF THE WATER CODE OF PRACTICE. METER IS TO BE SELECTED, SUPPLIED AND FITTED BY IW

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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.
(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Foul Sewer Notes:

1. All foul sewer works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
3. Foul sewer service connections and inspection chambers to each dwelling shall be in accordance with Irish Water standard detail STD-WW-02.
4. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
5. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
6. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-WW-05.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-WW-06 & 06A.

Storm Sewer Notes:

1. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
2. All manhole chambers shall be in accordance with Irish Water standard detail STD-WW-10.
3. Trench backfill and bedding shall be in accordance with Irish Water standard detail STD-WW-07.
4. Concrete bed, haunch and surround shall be in accordance with Irish Water standard detail STD-WW-08.

Watermain Notes:

1. All watermain works shall be carried out in accordance with Irish Water Standard Details and Code of Practice for Water Infrastructure Document CDS-5020-03.
2. All pipe materials shall be in compliance with Section 3.9 of Irish Water Code of Practice Document-CDS-5020-03.
3. Individual water service connections and boundary boxes to each dwelling shall be in compliance with Irish Water standard detail STD-W-02.
4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-W-11.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-W-12 & 12A.
6. On line and off-line air valve details shall be in accordance with Irish Water standard detail STD-W-22 & STD-W-23 respectively.
7. Sluice valve details shall be in accordance with Irish Water standard detail STD-W-15.
8. On line and off-line hydrant details shall be in accordance with Irish Water standard detail STD-W-18 & STD-W-19 respectively.
9. Scour valve and chamber details shall be in accordance with Irish Water standard detail STD-W-30.

Rev	Date	Drn / Chk	Amendment / Issue	App
P07	24.11.21	PMGB / PMGB	ISSUE FOR PLANNING	DK
P06	19.11.21	PMGB / PMGB	ISSUE FOR LA REVIEW	DK

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Project
SHB 3
ATHY, CO. KILDARE

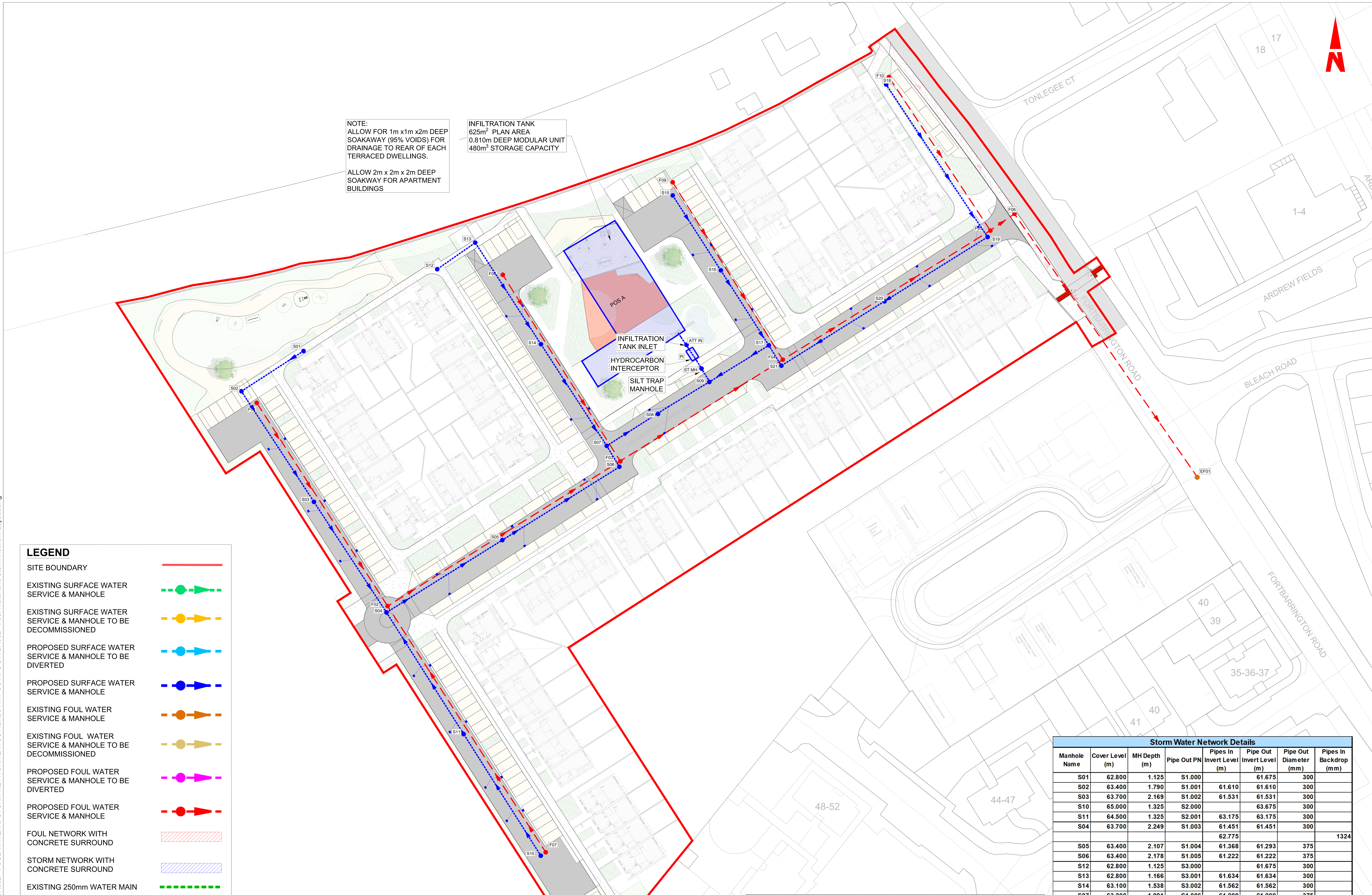
Title
WATERMAIN LAYOUT

Model File Identifier
SHB3-ATY-CS-RPS-DR-DA001

File Identifier
SHB3-ATY-CS-RPS-DR-DA001-01

Created on	Sheets	
APRIL 2021	01 OF 01	
Scale	**Status**	**Rev**
1:500 @ A1 1:1000 @ A3	S4	P07

S:\MGC0712 - NDFA SHB3\MGC0712-04 - Athy\8.0 Drawings\DA\DA001 - WATERMAIN LAYOUT\SHB3-ATY-CS-RPS-DR-DA001 - Watermain Layout.dwg



LEGEND

- SITE BOUNDARY
- EXISTING SURFACE WATER SERVICE & MANHOLE
- EXISTING SURFACE WATER SERVICE & MANHOLE TO BE DECOMMISSIONED
- PROPOSED SURFACE WATER SERVICE & MANHOLE TO BE DIVERTED
- PROPOSED SURFACE WATER SERVICE & MANHOLE
- EXISTING FOUL WATER SERVICE & MANHOLE
- EXISTING FOUL WATER SERVICE & MANHOLE TO BE DECOMMISSIONED
- PROPOSED FOUL WATER SERVICE & MANHOLE TO BE DIVERTED
- PROPOSED FOUL WATER SERVICE & MANHOLE
- FOUL NETWORK WITH CONCRETE SURROUND
- STORM NETWORK WITH CONCRETE SURROUND
- EXISTING 250mm WATER MAIN
- PROPOSED 150mm WATERMAIN
- PROPOSED GULLY
- PROPOSED SLUICE VALVE — SV
- PROPOSED AIR VALVE — AV
- PROPOSED BULK FLOW METER — M
- NON RETURN VALVE — NRV
- HYDRANT — H
- PROPOSED THRUST BLOCK

0.00m 20m 40m 60m 80m 100m
Scale Bar

Foul Water Network Details

Manhole Name	Cover Level (m)	MH Depth (m)	Pipe Out PN	Pipes In Invert Level (m)	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In Backdrop (mm)
F01	63.400	0.725	F1.000		62.675	225	
F07	64.000	1.125	F2.000		62.875	225	
F02	63.400	0.994	F1.001	62.406	62.406	225	
				62.546			140
F08	62.800	0.825	F3.000		61.975	225	
F03	64.625	2.916	F1.002	62.099	61.709	225	390
				61.709			
F09	62.000	1.285	F4.000		60.715	225	
F04	62.600	2.105	F1.003	61.494	60.495	225	999
				60.495			
F10	61.825	1.125	F5.000		60.700	225	
F05	61.925	1.701	F1.004	60.224	60.224	225	
				60.484			260
F06	61.925	1.736	F1.005	60.189	60.189	225	
FOutfall	61.260	1.310		59.950	OUTFALL		

Storm Water Network Details

Manhole Name	Cover Level (m)	MH Depth (m)	Pipe Out PN	Pipes In Invert Level (m)	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In Backdrop (mm)
S01	62.800	1.125	S1.000		61.675	300	
S02	63.400	1.790	S1.001	61.610	61.610	300	
S03	63.700	2.169	S1.002	61.531	61.531	300	
S10	65.000	1.325	S2.000		63.675	300	
S11	64.500	1.325	S2.001	63.175	63.175	300	
S04	63.700	2.249	S1.003	61.451	61.451	300	
				62.775			1324
S05	63.400	2.107	S1.004	61.368	61.293	375	
S06	63.400	2.178	S1.005	61.222	61.222	375	
S12	62.800	1.125	S3.000		61.675	300	
S13	62.800	1.166	S3.001	61.634	61.634	300	
S14	63.100	1.538	S3.002	61.562	61.562	300	
S07	63.200	1.991	S1.006	61.209	61.209	375	
				61.489			205
S08	62.800	1.697	S1.007	61.178	61.103	450	
S15	62.000	1.125	S4.000		60.875	225	
S16	62.300	1.578	S4.001	60.797	60.722	300	
S18	61.825	0.985	S5.000		60.840	450	
S19	61.925	1.401	S5.001	60.524	60.524	450	
S20	62.260	1.799	S5.002	60.461	60.461	450	
S21	62.600	2.202	S5.003	60.398	60.398	450	
S17	62.600	2.215	S4.002	60.584	60.385	450	48
				60.385			
S09	62.785	2.436	S1.008	61.072	60.349	450	722
				60.349			
STMH	62.785	2.446	S1.009	60.339	60.339	450	
PI	62.785	2.553	S1.010	60.332	60.232	450	100mm accounts for PI
ATT/INF	62.785	2.578	S1.011	59.407	60.207	450	800mm drop into infiltration

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4. Separation distances from other services, boundary walls etc. shall be in accordance with Irish Water standard detail STD-WW-05.
5. Separation distances from trees, shrubs etc. shall be in accordance with Irish Water standard detail STD-WW-06 & 06A.

Storm Sewer Notes:

1. All pipe materials shall comply with Section 3.13 of the Irish Water Code of Practice for Wastewater Infrastructure Document CDS-5030-03.
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8. On line and off-line hydrant details shall be in accordance with Irish Water standard detail STD-W-18 & STD-W-19 respectively.
9. Scour valve and chamber details shall be in accordance with Irish Water standard detail STD-W-30.

Rev	Date	Drn / Chk	Amendment / Issue	App
P06	19.11.21	FMGB / DK	ISSUE FOR LA REVIEW	DK

Client

Kildare County Council
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Project
SHB 3
ATHY, CO. KILDARE

Title
Foul and Storm Sewer Layout

Model File Identifier
SHB3-ATY-CS-RPS-DR-DR002

File Identifier
SHB3-ATY-CS-RPS-DR-DR002-01

Created on: April 2021
Sheets: 01 OF 01
Scale: 1:500 @ A1, 1:1000 @ A3
Status: S3
Rev: P06

Appendix B

Design Calculations

- **SHB3-ATY-CS-RPS-CA-0001 – Foul Water Design Calcultions**
- **SHB3-ATY-CS-RPS-CA-0001 – Storm Water Design Calcultions**

Foul Water Design Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Domestic (l/s/ha)	0.00	Maximum Backdrop Height (m)	2.000
Industrial Peak Flow Factor	0.00	Domestic Peak Flow Factor	6.00	Min Design Depth for Optimisation (m)	0.900
Flow Per Person (l/per/day)	150.00	Add Flow / Climate Change (%)	0	Min Vel for Auto Design only (m/s)	0.75
Persons per House	2.70	Minimum Backdrop Height (m)	0.100	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	62.221	0.269	231.3	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F2.000	75.721	0.329	230.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F1.001	71.001	0.307	231.0	0.000	10	0.0	1.500	o	225	Pipe/Conduit	
F3.000	61.450	0.266	231.0	0.000	6	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	62.675	0.000	0.0	11	0.0	17	0.24	0.75	29.9	0.3
F2.000	62.875	0.000	0.0	11	0.0	16	0.24	0.76	30.0	0.3
F1.001	62.406	0.000	0.0	32	0.0	27	0.33	0.75	30.0	0.9
F3.000	61.975	0.000	0.0	6	0.0	12	0.19	0.75	30.0	0.2

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.002	49.579	0.215	231.0	0.000	7	0.0	1.500	o	225	Pipe/Conduit	
F4.000	50.713	0.220	230.5	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F1.003	62.611	0.271	231.0	0.000	11	0.0	1.500	o	225	Pipe/Conduit	
F5.000	47.566	0.216	220.2	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F1.004	8.105	0.035	231.6	0.000	6	0.0	1.500	o	225	Pipe/Conduit	
F1.005	55.126	0.239	231.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.002	61.709	0.000	0.0	45	0.0	32	0.37	0.75	30.0	1.3
F4.000	60.715	0.000	0.0	6	0.0	12	0.19	0.75	30.0	0.2
F1.003	60.495	0.000	0.0	62	0.0	37	0.41	0.75	30.0	1.7
F5.000	60.700	0.000	0.0	6	0.0	12	0.20	0.77	30.7	0.2
F1.004	60.224	0.000	0.0	74	0.0	40	0.43	0.75	29.9	2.1
F1.005	60.189	0.000	0.0	74	0.0	40	0.43	0.75	30.0	2.1

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F01	63.400	0.725	Open Manhole	1200	F1.000	62.675	225				
F07	64.000	1.125	Open Manhole	1200	F2.000	62.875	225				
F02	63.400	0.994	Open Manhole	1200	F1.001	62.406	225	F1.000	62.406	225	
								F2.000	62.546	225	140
F08	62.800	0.825	Open Manhole	1200	F3.000	61.975	225				
F03	64.625	2.916	Open Manhole	1200	F1.002	61.709	225	F1.001	62.099	225	390
								F3.000	61.709	225	
F09	62.000	1.285	Open Manhole	1200	F4.000	60.715	225				
F04	62.600	2.105	Open Manhole	1200	F1.003	60.495	225	F1.002	61.494	225	999
								F4.000	60.495	225	
F10	61.825	1.125	Open Manhole	1200	F5.000	60.700	225				
F05	61.925	1.701	Open Manhole	1200	F1.004	60.224	225	F1.003	60.224	225	
								F5.000	60.484	225	260
F06	61.925	1.736	Open Manhole	1200	F1.005	60.189	225	F1.004	60.189	225	
FOutfall	61.260	1.310	Open Manhole	225		OUTFALL		F1.005	59.950	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F01	667583.349	692948.695	667583.349	692948.695	Required	
F07	667657.999	692832.698	667657.999	692832.698	Required	

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Mervue
Galway, Ireland

Date 19/11/2021 17:33 | Designed by PMGB
File SHB3-BLN-CS-RPS-CA-0001 - Athy.MDX | Checked by DK
Innovyze | Network 2020.1

Manhole Schedules for Foul - Main

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F02	667617.017	692896.370	667617.017	692896.370	Required	
F08	667644.420	692985.866	667644.420	692985.866	Required	
F03	667677.268	692933.932	667677.268	692933.932	Required	
F09	667692.486	693003.165	667692.486	693003.165	Required	
F04	667719.348	692960.150	667719.348	692960.150	Required	
F10	667746.705	693033.189	667746.705	693033.189	Required	
F05	667772.507	692993.229	667772.507	692993.229	Required	
F06	667779.190	692997.814	667779.190	692997.814	Required	
FOutfall	667810.608	692952.517			No Entry	

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.005	FOutfall	61.260	59.950	59.950	225	0

REPORT

Storm Water Design Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	3.000
M5-60 (mm)	18.100	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	0.900
Ratio R	0.302	PIMP (%)	100	Min Vel for Auto Design only (m/s)	0.75
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	20	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.100		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.330	4-8	0.476	8-12	0.017

Total Area Contributing (ha) = 0.824

Total Pipe Volume (m³) = 57.136

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	19.147	0.065	294.6	0.017	5.00	0.0	0.600	o	300	Pipe/Conduit	
S1.001	34.217	0.079	431.3	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.002	34.217	0.079	431.3	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.000	37.248	0.500	74.5	0.077	5.00	0.0	0.600	o	300	Pipe/Conduit	
S2.001	37.248	0.400	93.1	0.076	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	35.336	0.083	425.9	0.049	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	35.729	0.071	500.0	0.077	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.005	6.326	0.013	500.0	0.057	0.00	0.0	0.600	o	375	Pipe/Conduit	
S3.000	11.999	0.041	292.7	0.007	5.00	0.0	0.600	o	300	Pipe/Conduit	
S3.001	31.293	0.072	431.9	0.032	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.002	31.293	0.072	431.9	0.041	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.35	61.675	0.017	0.0	0.0	0.4	0.91	64.4	2.7
S1.001	50.00	6.11	61.610	0.042	0.0	0.0	1.1	0.75	53.1	6.9
S1.002	50.00	6.87	61.531	0.103	0.0	0.0	2.8	0.75	53.1	16.7
S2.000	50.00	5.34	63.675	0.077	0.0	0.0	2.1	1.82	128.9	12.6
S2.001	50.00	5.72	63.175	0.154	0.0	0.0	4.2	1.63	115.2	25.0
S1.003	50.00	7.65	61.451	0.305	0.0	0.0	8.3	0.76	53.4	49.6
S1.004	50.00	8.39	61.293	0.382	0.0	0.0	10.4	0.80	88.7	62.1
S1.005	50.00	8.52	61.222	0.439	0.0	0.0	11.9	0.80	88.7	71.4
S3.000	50.00	5.22	61.675	0.007	0.0	0.0	0.2	0.91	64.6	1.1
S3.001	50.00	5.91	61.634	0.038	0.0	0.0	1.0	0.75	53.0	6.2
S3.002	50.00	6.61	61.562	0.080	0.0	0.0	2.2	0.75	53.0	12.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.006	15.634	0.031	500.0	0.018	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.007	15.634	0.031	500.0	0.044	0.00	0.0	0.600	o	450	Pipe/Conduit	
S4.000	23.020	0.078	294.4	0.044	5.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	23.020	0.138	166.8	0.023	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	47.393	0.316	150.0	0.019	5.00	0.0	0.600	o	450	Pipe/Conduit	
S5.001	31.437	0.063	500.0	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.002	31.437	0.063	500.0	0.072	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.003	6.195	0.012	500.0	0.037	0.00	0.0	0.600	o	450	Pipe/Conduit	
S4.002	18.070	0.036	500.0	0.008	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	8.85	61.209	0.537	0.0	0.0	14.5	0.80	88.7	87.2
S1.007	50.00	9.13	61.103	0.581	0.0	0.0	15.7	0.90	143.5	94.4
S4.000	50.00	5.51	60.875	0.044	0.0	0.0	1.2	0.76	30.1	7.1
S4.001	50.00	5.82	60.722	0.067	0.0	0.0	1.8	1.21	85.8	10.9
S5.000	50.00	5.48	60.840	0.019	0.0	0.0	0.5	1.66	263.7	3.1
S5.001	50.00	6.06	60.524	0.059	0.0	0.0	1.6	0.90	143.5	9.6
S5.002	50.00	6.64	60.461	0.131	0.0	0.0	3.5	0.90	143.5	21.3
S5.003	50.00	6.75	60.398	0.168	0.0	0.0	4.6	0.90	143.5	27.3
S4.002	50.00	7.09	60.385	0.243	0.0	0.0	6.6	0.90	143.5	39.5

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.008	5.052	0.010	500.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.009	3.669	0.007	524.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.010	12.698	0.025	507.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.011	10.730	0.021	511.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.008	50.00	9.23	60.349	0.824	0.0	0.0	22.3	0.90	143.5	133.8
S1.009	50.00	9.30	60.339	0.824	0.0	0.0	22.3	0.88	140.1	133.8
S1.010	50.00	9.53	60.232	0.824	0.0	0.0	22.3	0.90	142.4	133.8
S1.011	50.00	9.73	60.207	0.824	0.0	0.0	22.3	0.89	142.0	133.8

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S01	62.800	1.125	Open Manhole	1200	S1.000	61.675	300				
S02	63.400	1.790	Open Manhole	1200	S1.001	61.610	300	S1.000	61.610	300	
S03	63.700	2.169	Open Manhole	1200	S1.002	61.531	300	S1.001	61.531	300	
S10	65.000	1.325	Open Manhole	1200	S2.000	63.675	300				
S11	64.500	1.325	Open Manhole	1200	S2.001	63.175	300	S2.000	63.175	300	
S04	63.700	2.249	Open Manhole	1200	S1.003	61.451	300	S1.002	61.451	300	
								S2.001	62.775	300	1324
S05	63.400	2.107	Open Manhole	1350	S1.004	61.293	375	S1.003	61.368	300	
S06	63.400	2.178	Open Manhole	1350	S1.005	61.222	375	S1.004	61.222	375	
S12	62.800	1.125	Open Manhole	1200	S3.000	61.675	300				
S13	62.800	1.166	Open Manhole	1200	S3.001	61.634	300	S3.000	61.634	300	
S14	63.100	1.538	Open Manhole	1200	S3.002	61.562	300	S3.001	61.562	300	
S07	63.200	1.991	Open Manhole	1350	S1.006	61.209	375	S1.005	61.209	375	
								S3.002	61.489	300	205
S08	62.800	1.697	Open Manhole	1350	S1.007	61.103	450	S1.006	61.178	375	
S15	62.000	1.125	Open Manhole	1200	S4.000	60.875	225				
S16	62.300	1.578	Open Manhole	1200	S4.001	60.722	300	S4.000	60.797	225	
S18	61.825	0.985	Open Manhole	1350	S5.000	60.840	450				
S19	61.925	1.401	Open Manhole	1350	S5.001	60.524	450	S5.000	60.524	450	
S20	62.260	1.799	Open Manhole	1350	S5.002	60.461	450	S5.001	60.461	450	
S21	62.600	2.202	Open Manhole	1350	S5.003	60.398	450	S5.002	60.398	450	
S17	62.600	2.215	Open Manhole	1350	S4.002	60.385	450	S4.001	60.584	300	48
								S5.003	60.385	450	
S09	62.785	2.436	Open Manhole	1350	S1.008	60.349	450	S1.007	61.072	450	722
								S4.002	60.349	450	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
STMH	62.785	2.446	Open Manhole	1350	S1.009	60.339	450	S1.008	60.339	450	
PI	62.785	2.553	Open Manhole	1350	S1.010	60.232	450	S1.009	60.332	450	100
ATT/INF	62.785	2.578	Open Manhole	1350	S1.011	60.207	450	S1.010	60.207	450	
	62.785	2.599	Open Manhole	0		OUTFALL		S1.011	60.186	450	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S01	667595.272	692962.339	667595.272	692962.339	Required	
S02	667579.204	692951.927	667579.204	692951.927	Required	
S03	667597.972	692923.317	667597.972	692923.317	Required	
S10	667656.658	692831.808	667656.658	692831.808	Required	
S11	667636.699	692863.257	667636.699	692863.257	Required	
S04	667616.740	692894.706	667616.740	692894.706	Required	
S05	667646.706	692913.432	667646.706	692913.432	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S06	667676.983	692932.403	667676.983	692932.403	Required	
S12	667629.864	692983.483	667629.864	692983.483	Required	
S13	667639.700	692990.354	667639.700	692990.354	Required	
S14	667656.702	692964.084	667656.702	692964.084	Required	
S07	667673.705	692937.813	667673.705	692937.813	Required	
S08	667686.980	692946.070	667686.980	692946.070	Required	
S15	667690.784	693002.565	667690.784	693002.565	Required	
S16	667703.211	692983.187	667703.211	692983.187	Required	
S18	667745.982	693031.274	667745.982	693031.274	Required	
S19	667772.240	692991.819	667772.240	692991.819	Required	
S20	667745.568	692975.180	667745.568	692975.180	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S21	667718.896	692958.540	667718.896	692958.540	Required	
S17	667715.638	692963.810	667715.638	692963.810	Required	
S09	667700.256	692954.328	667700.256	692954.328	Required	
STMH	667697.490	692958.555	667697.490	692958.555	Required	
PI	667695.466	692961.615	667695.466	692961.615	Required	
ATT/INF	667688.859	692972.459	667688.859	692972.459	Required	
	667679.639	692977.949			No Entry	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	Classification	Pitched Roof	90	0.007	0.007	0.007
	Classification	Pitched Roof	90	0.011	0.010	0.017
1.001	Classification	pavement	75	0.023	0.018	0.018
	Classification	Permeable Pavement	60	0.014	0.008	0.026
1.002	Classification	Pitched Roof	90	0.024	0.022	0.022
	Classification	Permeable Pavement	60	0.011	0.006	0.028
	Classification	Permeable Pavement	60	0.014	0.008	0.036
	Classification	Permeable Pavement	60	0.007	0.004	0.041
	Classification	Permeable Pavement	60	0.009	0.005	0.046
	Classification	pavement	75	0.020	0.015	0.060
2.000	Classification	Pitched Roof	90	0.028	0.025	0.025
	Classification	Permeable Pavement	60	0.007	0.004	0.029
	Classification	Permeable Pavement	60	0.005	0.003	0.032
	Classification	pavement	75	0.018	0.014	0.046
	Classification	Permeable Pavement	60	0.021	0.013	0.058
	Classification	pavement	75	0.025	0.019	0.077
2.001	Classification	Pitched Roof	90	0.036	0.033	0.033
	Classification	Permeable Pavement	60	0.007	0.004	0.037
	Classification	Permeable Pavement	60	0.007	0.004	0.041
	Classification	Permeable Pavement	60	0.007	0.004	0.046
	Classification	Permeable Pavement	60	0.019	0.012	0.057
	Classification	pavement	75	0.025	0.019	0.076
1.003	Classification	Pitched Roof	90	0.007	0.007	0.007
	Classification	Pitched Roof	90	0.007	0.007	0.013
	Classification	Permeable Pavement	60	0.007	0.004	0.017
	Classification	Permeable Pavement	60	0.013	0.008	0.025
	Classification	pavement	75	0.032	0.024	0.049
1.004	Classification	Pitched Roof	90	0.011	0.010	0.010
	Classification	Pitched Roof	90	0.013	0.012	0.022
	Classification	Permeable Pavement	60	0.005	0.003	0.024
	Classification	Permeable Pavement	60	0.019	0.012	0.036
	Classification	Permeable Pavement	60	0.004	0.003	0.038
	Classification	Permeable Pavement	60	0.012	0.007	0.046
	Classification	Permeable Pavement	60	0.017	0.010	0.056
	Classification	pavement	75	0.028	0.021	0.077

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.005	Classification	Pitched Roof	90	0.009	0.008	0.008
	Classification	Pitched Roof	90	0.016	0.014	0.022
	Classification	Permeable Pavement	60	0.005	0.003	0.024
	Classification	Permeable Pavement	60	0.022	0.013	0.037
	Classification	Permeable Pavement	60	0.009	0.006	0.043
	Classification	pavement	75	0.019	0.014	0.057
3.000	Classification	Pitched Roof	90	0.007	0.007	0.007
3.001	Classification	Permeable Pavement	60	0.011	0.006	0.006
	Classification	pavement	75	0.028	0.021	0.027
	Classification	Permeable Pavement	60	0.008	0.005	0.032
3.002	Classification	Pitched Roof	90	0.012	0.011	0.011
	Classification	Permeable Pavement	60	0.008	0.005	0.015
	Classification	Permeable Pavement	60	0.011	0.007	0.022
	Classification	Permeable Pavement	60	0.017	0.010	0.032
	Classification	pavement	75	0.012	0.009	0.041
1.006	Classification	Pitched Roof	90	0.007	0.007	0.007
	Classification	Permeable Pavement	60	0.007	0.004	0.011
	Classification	pavement	75	0.009	0.007	0.018
1.007	Classification	Permeable Pavement	60	0.007	0.004	0.004
	Classification	Permeable Pavement	60	0.024	0.015	0.019
	Classification	pavement	75	0.027	0.020	0.039
	Classification	Permeable Pavement	60	0.009	0.005	0.044
4.000	Classification	Pitched Roof	90	0.013	0.011	0.011
	Classification	Permeable Pavement	60	0.007	0.004	0.016
	Classification	Permeable Pavement	60	0.005	0.003	0.019
	Classification	Permeable Pavement	60	0.015	0.009	0.028
	Classification	pavement	75	0.021	0.016	0.044
4.001	Classification	Pitched Roof	90	0.009	0.008	0.008
	Classification	Permeable Pavement	60	0.006	0.004	0.012
	Classification	Permeable Pavement	60	0.009	0.005	0.017
	Classification	pavement	75	0.008	0.006	0.023
5.000	Classification	Pitched Roof	90	0.012	0.011	0.011
	Classification	Permeable Pavement	60	0.007	0.004	0.015
	Classification	Permeable Pavement	60	0.008	0.005	0.019
5.001	Classification	Pitched Roof	90	0.007	0.006	0.006

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	Classification	Pitched Roof	90	0.012	0.011	0.018
	Classification	pavement	75	0.016	0.012	0.029
	Classification	pavement	75	0.014	0.011	0.040
5.002	Classification	Pitched Roof	90	0.010	0.009	0.009
	Classification	Pitched Roof	90	0.008	0.007	0.017
	Classification	Permeable Pavement	60	0.004	0.003	0.019
	Classification	Permeable Pavement	60	0.017	0.010	0.029
	Classification	Permeable Pavement	60	0.005	0.003	0.032
	Classification	Permeable Pavement	60	0.010	0.006	0.038
	Classification	Permeable Pavement	60	0.021	0.013	0.051
	Classification	pavement	75	0.028	0.021	0.072
5.003	Classification	Pitched Roof	90	0.009	0.008	0.008
	Classification	Permeable Pavement	60	0.015	0.009	0.017
	Classification	Permeable Pavement	60	0.003	0.002	0.019
	Classification	pavement	75	0.024	0.018	0.037
4.002	Classification	Permeable Pavement	60	0.013	0.008	0.008
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.140	0.824	0.824

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.011		62.785	60.186	60.285	0	0

Storage Structures for Storm

Infiltration Basin Manhole: ATT/INF, DS/PN: S1.011

Invert Level (m) 59.407 Infiltration Coefficient Side (m/hr) 0.06300 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.03150 Safety Factor 2.0

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	626.5	0.800	626.5	0.801	0.0

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.100 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.302 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 20

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S01	15 minute 100 year Winter I+20%		62.800	62.602	0.627	0.000	0.15	1.043	3.426		8.3	FLOOD RISK
S1.001	S02	15 minute 100 year Winter I+20%		63.400	62.598	0.688	0.000	0.35	2.380	8.755		17.1	SURCHARGED
S1.002	S03	15 minute 100 year Winter I+20%		63.700	62.582	0.751	0.000	0.67	3.517	21.285		32.6	SURCHARGED
S2.000	S10	15 minute 100 year Winter I+20%		65.000	63.785	-0.190	0.000	0.28	0.119	16.015		33.7	OK
S2.001	S11	15 minute 100 year Winter I+20%		64.500	63.354	-0.121	0.000	0.64	0.447	31.831		68.5	OK
S1.003	S04	15 minute 100 year Winter I+20%		63.700	62.542	0.791	0.000	2.17	3.562	63.244		106.5	SURCHARGED
S1.004	S05	15 minute 100 year Winter I+20%		63.400	62.140	0.471	0.000	1.61	3.612	79.186		128.4	SURCHARGED
S1.005	S06	15 minute 100 year Winter I+20%		63.400	61.940	0.343	0.000	2.04	4.818	90.982		145.2	SURCHARGED
S3.000	S12	15 minute 100 year Winter I+20%		62.800	61.845	-0.130	0.000	0.05	0.187	1.352		2.6	OK
S3.001	S13	15 minute 100 year Winter I+20%		62.800	61.843	-0.091	0.000	0.33	0.689	7.947		16.1	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	First (Y) Flood	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S3.002	S14	15 minute 100 year Winter I+20%		63.100	61.830	-0.032	0.000	0.62	1.975	16.472		30.0	OK
S1.006	S07	15 minute 100 year Winter I+20%		63.200	61.802	0.217	0.000	3.03	3.353	111.087		171.2	SURCHARGED
S1.007	S08	15 minute 100 year Winter I+20%		62.800	61.607	0.054	0.000	2.08	2.283	120.242		182.6	SURCHARGED
S4.000	S15	15 minute 100 year Winter I+20%		62.000	61.156	0.056	0.000	0.68	0.312	9.071		18.7	SURCHARGED
S4.001	S16	15 minute 100 year Winter I+20%		62.300	61.130	0.108	0.000	0.32	1.324	13.887		24.7	SURCHARGED
S5.000	S18	15 minute 100 year Winter I+20%		61.825	61.135	-0.154	0.000	0.03	0.416	3.986		7.9	OK
S5.001	S19	15 minute 100 year Winter I+20%		61.925	61.133	0.159	0.000	0.22	7.674	12.209		27.9	SURCHARGED
S5.002	S20	15 minute 100 year Winter I+20%		62.260	61.127	0.217	0.000	0.31	5.732	27.163		38.1	SURCHARGED
S5.003	S21	15 minute 100 year Winter I+20%		62.600	61.117	0.269	0.000	0.42	5.807	34.851		45.8	SURCHARGED
S4.002	S17	15 minute 100 year Winter I+20%		62.600	61.112	0.277	0.000	0.65	3.341	50.320		63.3	SURCHARGED
S1.008	S09	15 minute 100 year Winter I+20%		62.785	61.096	0.297	0.000	1.92	3.759	170.568		221.0	SURCHARGED
S1.009	STMH	15 minute 100 year Winter I+20%		62.785	60.942	0.153	0.000	1.83	1.445	170.577		220.3	SURCHARGED
S1.010	PI	15 minute 100 year Winter I+20%		62.785	60.788	0.106	0.000	2.73	1.128	170.587		220.5	SURCHARGED
S1.011	ATT/INF	720 minute 100 year Winter I+20%		62.785	60.207	-0.450	0.000	0.00	477.395	0.000	1296	0.0	OK

Appendix C

Surface Water Infiltration Design Output and Sizing

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 693 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m^3)	Status
15 min Summer	59.658	0.251	2.9	149.3	O K
30 min Summer	59.744	0.337	3.0	200.5	O K
60 min Summer	59.831	0.424	3.1	252.1	O K
120 min Summer	59.921	0.514	3.1	305.8	O K
180 min Summer	59.974	0.567	3.2	337.2	O K
240 min Summer	60.010	0.603	3.2	358.7	O K
360 min Summer	60.057	0.650	3.2	386.6	O K
480 min Summer	60.085	0.678	3.3	403.4	O K
600 min Summer	60.102	0.695	3.3	413.7	O K
720 min Summer	60.112	0.705	3.3	419.8	O K
960 min Summer	60.119	0.712	3.3	423.7	O K
1440 min Summer	60.115	0.708	3.3	421.3	O K
2160 min Summer	60.098	0.691	3.3	411.3	O K
2880 min Summer	60.077	0.670	3.3	398.8	O K
4320 min Summer	60.030	0.623	3.2	371.0	O K
5760 min Summer	59.981	0.574	3.2	341.9	O K
7200 min Summer	59.932	0.525	3.1	312.8	O K
8640 min Summer	59.885	0.478	3.1	284.7	O K
10080 min Summer	59.840	0.433	3.1	257.7	O K
15 min Winter	59.688	0.281	3.0	167.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Time-Peak (mins)
15 min Summer	98.585	0.0	23
30 min Summer	66.565	0.0	38
60 min Summer	42.383	0.0	68
120 min Summer	26.312	0.0	126
180 min Summer	19.760	0.0	186
240 min Summer	16.091	0.0	246
360 min Summer	12.019	0.0	364
480 min Summer	9.760	0.0	484
600 min Summer	8.300	0.0	602
720 min Summer	7.269	0.0	722
960 min Summer	5.894	0.0	954
1440 min Summer	4.386	0.0	1184
2160 min Summer	3.261	0.0	1564
2880 min Summer	2.640	0.0	1984
4320 min Summer	1.958	0.0	2812
5760 min Summer	1.583	0.0	3632
7200 min Summer	1.342	0.0	4400
8640 min Summer	1.172	0.0	5192
10080 min Summer	1.045	0.0	5960
15 min Winter	98.585	0.0	23

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	59.785	0.378	3.0	225.1	O K
60 min Winter	59.883	0.476	3.1	283.5	O K
120 min Winter	59.986	0.579	3.2	344.8	O K
180 min Winter	60.047	0.640	3.2	381.1	O K
240 min Winter	60.090	0.683	3.3	406.4	O K
360 min Winter	60.146	0.739	3.3	440.1	O K
480 min Winter	60.182	0.775	3.3	461.3	O K
600 min Winter	60.206	0.799	3.4	475.3	O K
720 min Winter	60.208	0.801	8.5	476.4	O K
960 min Winter	60.207	0.800	5.8	476.4	O K
1440 min Winter	60.208	0.801	8.5	476.4	O K
2160 min Winter	60.207	0.800	5.8	476.1	O K
2880 min Winter	60.180	0.773	3.3	460.2	O K
4320 min Winter	60.106	0.699	3.3	416.0	O K
5760 min Winter	60.027	0.620	3.2	369.3	O K
7200 min Winter	59.951	0.544	3.2	323.5	O K
8640 min Winter	59.877	0.470	3.1	279.8	O K
10080 min Winter	59.809	0.402	3.1	239.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	66.565	0.0	37
60 min Winter	42.383	0.0	66
120 min Winter	26.312	0.0	124
180 min Winter	19.760	0.0	184
240 min Winter	16.091	0.0	242
360 min Winter	12.019	0.0	358
480 min Winter	9.760	0.0	474
600 min Winter	8.300	0.0	588
720 min Winter	7.269	0.0	650
960 min Winter	5.894	0.0	758
1440 min Winter	4.386	0.0	1068
2160 min Winter	3.261	0.0	1608
2880 min Winter	2.640	0.0	2140
4320 min Winter	1.958	0.0	3068
5760 min Winter	1.583	0.0	3920
7200 min Winter	1.342	0.0	4760
8640 min Winter	1.172	0.0	5616
10080 min Winter	1.045	0.0	6360

Model Details

Storage is Online Cover Level (m) 62.307

Infiltration Basin Structure

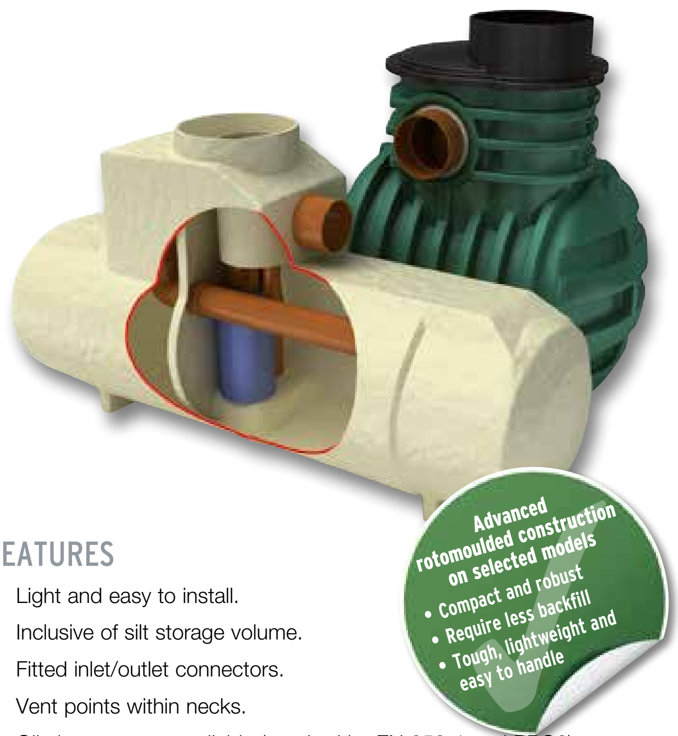
Invert Level (m) 59.407 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.03150 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.06300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	626.5	0.800	626.5	0.801	0.0

Appendix D

Hydrocarbon Interceptor – Brochure

Bypass NSB RANGE



APPLICATION

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occurring at the same time is small, e.g.

- Surface car parks.
- Roadways.
- Lightly contaminated commercial areas.

PERFORMANCE

Klargester were one of the first UK manufacturers to have separators tested to EN 858-1. Klargester have now added the NSB bypass range to their portfolio of certified and tested models. The NSB number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Kingspan Klargester Bypass separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity.
- Silt storage capacity.
- Oil storage volume.
- Coalescer.

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSB = 0.0018A(m2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

FEATURES

- Light and easy to install.
- Inclusive of silt storage volume.
- Fitted inlet/outlet connectors.
- Vent points within necks.
- Oil alarm system available (required by EN 858-1 and PPG3).
- Extension access shafts for deep inverts.
- Maintenance from ground level.
- GRP or rotomoulded construction (subject to model).

To specify a nominal size bypass separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped.
- The drain invert inlet depth.
- Pipework type, size and orientation.

SIZES AND SPECIFICATIONS

UNIT NOMINAL SIZE	FLOW (l/s)	PEAK FLOW RATE (l/s)	DRAINAGE AREA (m²)	STORAGE CAPACITY (litres) SILT	OIL	UNIT LENGTH (mm)	UNIT DIA. (mm)	ACCESS SHAFT DIA. (mm)	BASE TO INLET INVERT (mm)	BASE TO OUTLET INVERT	STANDARD FALL ACROSS (mm)	MIN. INLET INVERT (mm)	STANDARD PIPEWORK DIA.
NSBP003	3	30	1670	300	45	1700	1350	600	1420	1320	100	500	160
NSBP004	4.5	45	2500	450	60	1700	1350	600	1420	1320	100	500	160
NSBP006	6	60	3335	600	90	1700	1350	600	1420	1320	100	500	160
NSBE010	10	100	5560	1000	150	2069	1220	750	1450	1350	100	700	315
NSBE015	15	150	8335	1500	225	2947	1220	750	1450	1350	100	700	315
NSBE020	20	200	11111	2000	300	3893	1220	750	1450	1350	100	700	375
NSBE025	25	250	13890	2500	375	3575	1420	750	1680	1580	100	700	375
NSBE030	30	300	16670	3000	450	4265	1420	750	1680	1580	100	700	450
NSBE040	40	400	22222	4000	600	3230	1920	600	2185	2035	150	1000	500
NSBE050	50	500	27778	5000	750	3960	1920	600	2185	2035	150	1000	600
NSBE075	75	750	41667	7500	1125	5841	1920	600	2235	2035	200	950	675
NSBE100	100	1000	55556	10000	1500	7661	1920	600	2235	2035	200	950	750
NSBE125	125	1250	69444	12500	1875	9548	1920	600	2235	2035	200	950	750

Rotomoulded chamber construction   GRP chamber construction   * Some units have more than one access shaft – diameter of largest shown.

Appendix E

Confirmation of Feasibility – Irish Water

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City Delivery Office,
Cork City.

www.water.ie

Padraig Mac Giolla Bhride

Lyrr 2
IDA Bus & Technology Park
Mervue
Galway

30 April 2021

Re: CDS21001934 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 74 unit(s) at Ardew, Athy, Co. Kildare

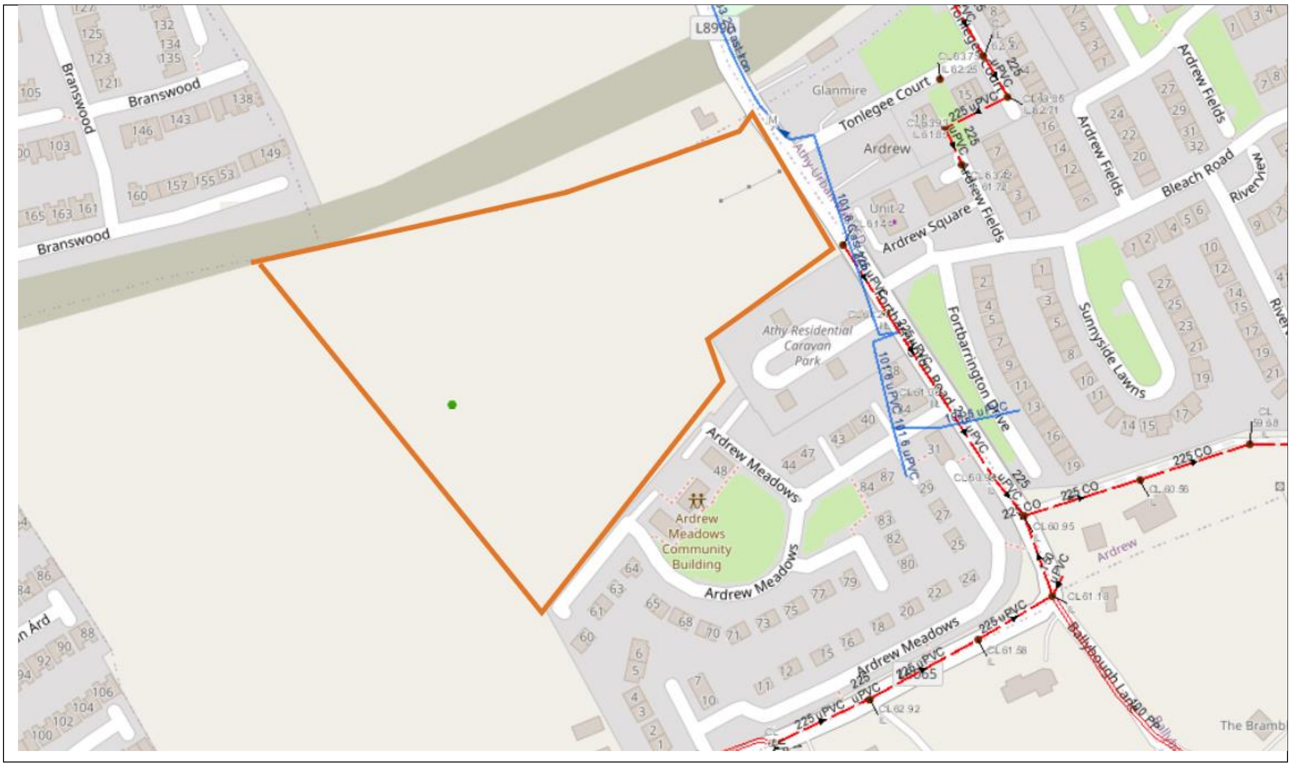
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Ardew, Athy, Co. Kildare (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible Subject to upgrades
SITE SPECIFIC COMMENTS	
Water Connection	The connection point for the proposed development should be made to the existing 200mm cast Iron watermain in Fortbarrington Road. Please note that this Confirmation of Feasibility to connect to the Irish Water infrastructure also does not extend to your fire flow requirements. Please note that Irish Water cannot guarantee a flow rate to meet fire flow requirements and in order to guarantee a flow to meet the Fire Authority requirements, you should provide adequate fire storage capacity within your development.
Wastewater Connection	Where the applicant proposed to connect, upgrade works are required to extend the length of the network by approximately 50 m. Irish Water currently does not have any plans to extend its network in this area. Should you wish to progress with the connection you will be required to fund this network extension.

The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.

The map included below outlines the current Irish Water infrastructure adjacent to your site:



Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.

3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Lara Nagle from the design team on email mkomso@water.ie. For further information, visit www.water.ie/connections.

Yours sincerely,

Yvonne Harris

Yvonne Harris

Head of Customer Operations

Appendix F

Hydrant Testing Results – SES Water Management

Hydrant Testing Report

Social Housing Bundle 3 Lot 1, Athy, Co. Kildare

Client:	RPS
Site Contact:	Desmond Keane
Project:	Hydrant Testing Social Housing Bundle 3 Lot 1, Athy, Co. Kildare
Engineer:	Conor Malone
Technician:	John McCourt
Start/Finish of Survey	August 2021

Contents

1 Scope of Works

SES Water Management was requested by RPS Consulting Engineers to carryout flow and pressure testing on hydrants for the Social Housing Bundle 3 Lot 1 project location in Athy, Co. Kildare.

Pressure logging of the hydrants was carried out over a 7-day period. Flow testing was then carried out using a digital flow meter with static and residual pressures also being recorded.

2 Hydrant Specifications & Flow Requirements

2.1 Guidelines for Fire Flow Requirement

Housing Developments
Housing Developments with units of detached or semi-detached houses of not more than two floors should have a supply capable of delivering a minimum of 8 l/s (480 l/min) OR multi occupied developments with units of more than 2 floors should have a water supply capable of delivering a minimum of 20 to 35 l/s (1,200 to 2,100 Litres/minute).

Village Hall or the like
Should have a water supply capable of delivering 15 Litres per second (900 Litres/minute) through any single hydrant on the development.

Primary School and/or Single Story Health Centre or the like should have a water supply capable of delivering 20 Litres per second (1,200 Litres/minute) through any single hydrant on the development.

Secondary Schools, Colleges, Large Health & Community Facilities or the like
Should have a water supply capable of delivering 35 Litres per second (2,100 Litres/minute) through any single hydrant on the development.

Industry
Up to one hectare, facility should have 20 Litres per second (1,200 Litres/minute)
Between one and two hectares, facility should have 35 Litres per second (2,100 Litres/minute)

2.2 Key Aspects of Fire Hydrant Specification

SURFACE:
Hydrants should be located in the footpath or grass margin adjoining the roadway. Where it is located in the grass, the periphery of the box should be concreted.
The surface box and concrete surround should be kept over the level of the adjoining surface to prevent polluted water from entering the hydrant pit.

FRAME:
Hydrant chambers should have a cast iron surface box. The surface box should be bedded in mortar on the chamber walls, and if the hydrants are located other than on a footway or roadway, they should be surrounded by 150mm concrete of 100mm in depth.

COVER:
The hydrant cover should provide a 375mm x 225mm clear opening and should be placed centrally over the hydrant to permit freedom of affixing stand-pipe and valve key.

PIT:
The hydrant pit / chamber should provide not less than 75mm clearance around the hydrant body. Hydrant pits should be constructed to be self-draining. The pit should be clean and free of all debris.

OUTLET DEPTH:
The depth of the hydrant outlet should not exceed 350mm below finished ground level, with the top of the spindle being 75mm minimum to 225mm maximum below finished surface to footpath.

MARKER:
A hydrant indicator plate should be fitted on a wall or marker post at 450mm over ground level. They should show the diameter of the water main and the distance in metres of the hydrant from the marker.

TESTING:
Fire hydrants should be tested on an annual basis. The Fire Hydrant condition should be assessed to ensure it meets the required criteria. The flow and pressure should be recorded and reported in writing. Calibration certificates must be available for all test Equipment used.

3 Fire Hyrdant Condition Survery

The hydrants were reviewed to assess that they meet the standards in accordance with the BS5360 / BS9990.

Appendix A provides full details of the condition survey which was completed on site.

The items below are the main findings of the fire hydrant condition survey;

- The Fire hydrants are accessible and have spindles in place.
- Fire Hydrant FH1 is missing a marker plate or post to identify hydrant location/details.
- Fire Hydrant FH1 is London Round Thread connection, FH2 is a bayonet LUG connection
- Fire Hydrant FH2 exceeds the recommended depth but could be easily accessed.
- The Fire hydrants are missing outlet caps
- Both Fire Hydrants are missing canary yellow paint on the covers.

FH1

FH1

FH2

FH2

Figure 1: Condition Photos

4 Fire Hydrant Flow & Pressure Testing

4.1 7-Day Pressure Logging

A pressure logger was deployed on Fire Hydrant FH1 on 16th August 2021 to record pressure over a 7-day logging period. The graph below shows the pressure logging results which show the day night variation in pressure.

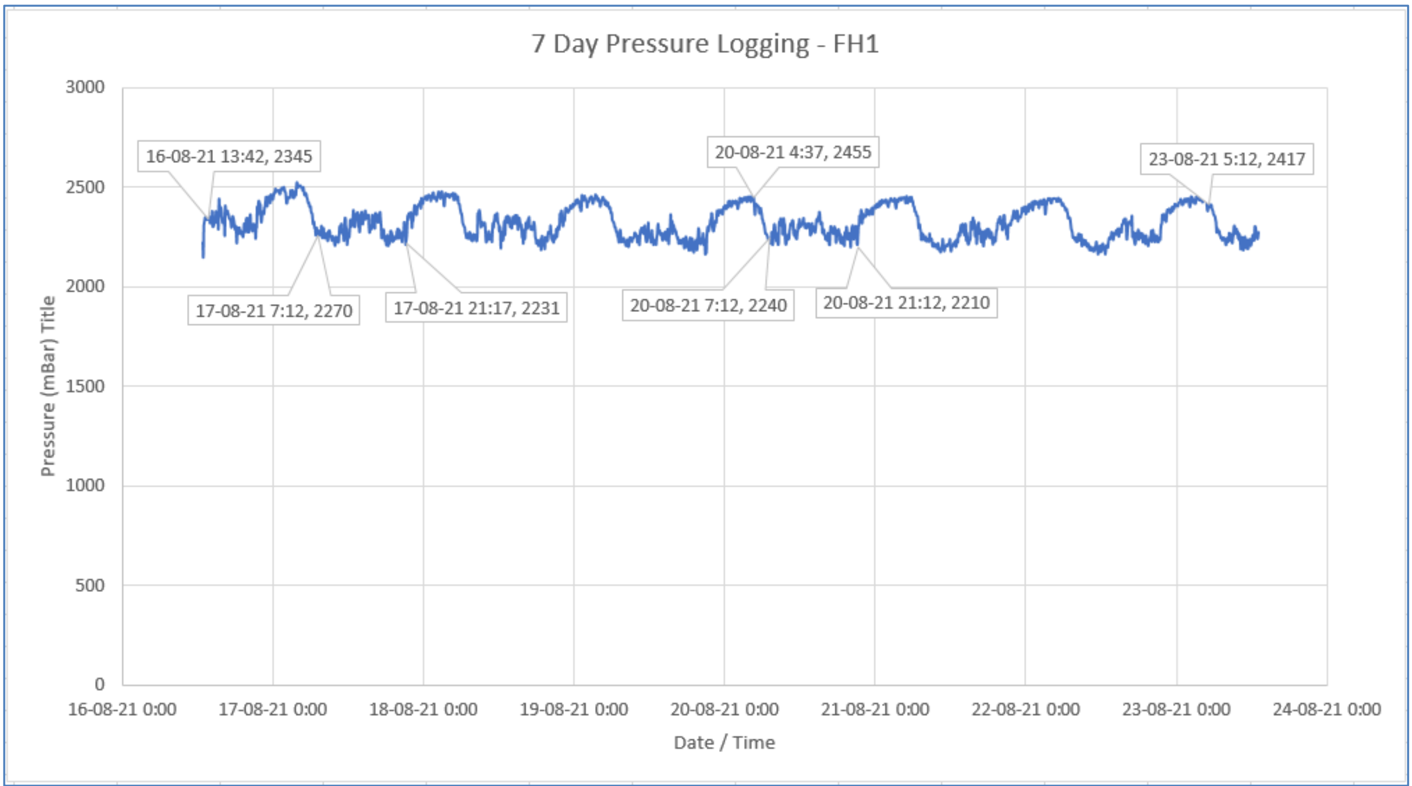


Figure 2: 7-Day Static Pressure Logging Results

Based on the downloaded pressure data, the static pressure varies from 2.5 bar at night to 2.2 bar during the day. For the purposes of hydrant testing, the time/duration of the minimum static pressure is between 07:00hrs to 18:00hrs.

4.2 Fire Hydrant Flow & Pressure Testing

Flow testing includes measuring the static pressure at the test hydrant before the flow testing is carried out. A digital hydrant flow meter is then connected to the hydrant to record flow rates in litres per minute over a 5-minute period. The flow rates detailed below, is the average maximum sustainable flow based on the 5-minute flow test.

Flow testing was carried out on 23rd August 2021 at 10:15am and the results are detailed below.

FH No.	Flow Rate L/Min	Static Pressure (bar)	Residual Pressure (bar)
FH1	996	2.2	1.1 At FH2

Table 1: Fire Hydrant Flow & Pressure Test Results

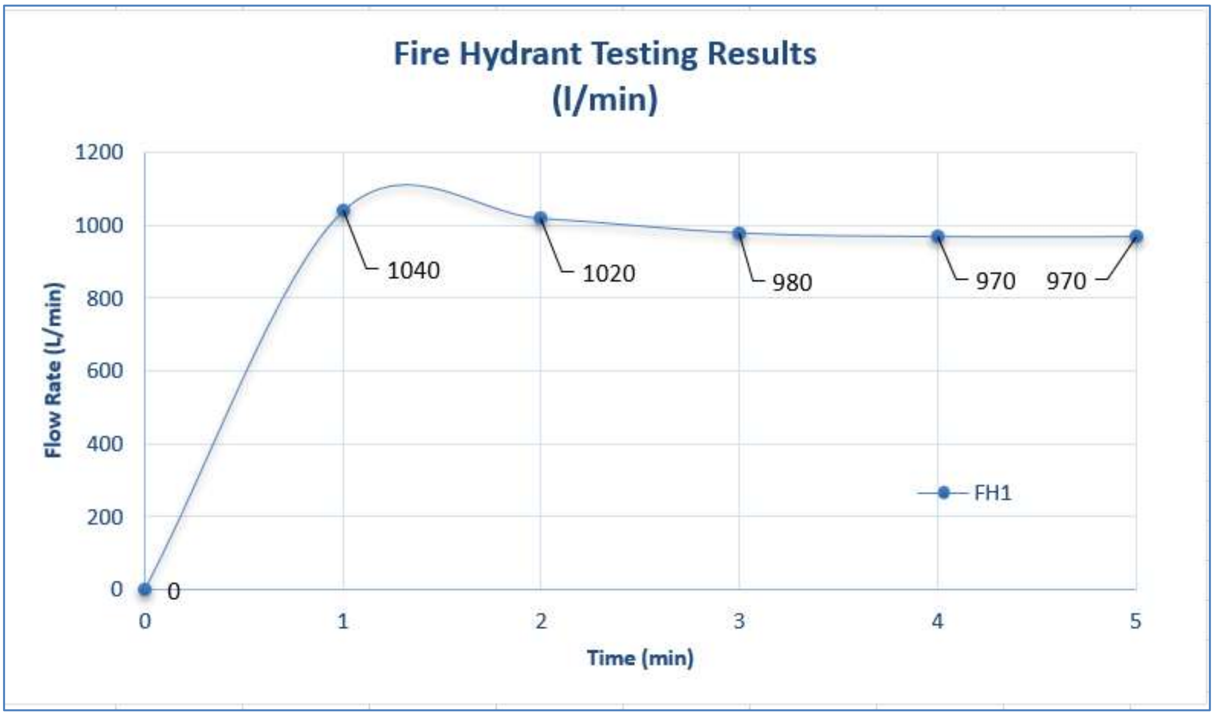


Figure 3: Fire Hydrant Flow Test Results

As can be seen from the results the hydrants have a flow rate from 1040 l/min to 970 l/min.

5 Fire Hydrant Location Plan

Appendices

Appendix A - Fire Hydrant Condition Survey

FH No.	Surface	Cover/ Frame	Pit	Type	Depth (mm)	Marker/ Plate	Canary Yellow	Spindle	Operating	Comment
1	Concrete	Good	Good	LRT	700	No	No	Good	Yes	
2	Concrete	Good	Poor	LRT	600	Yes	No	Good	Yes	

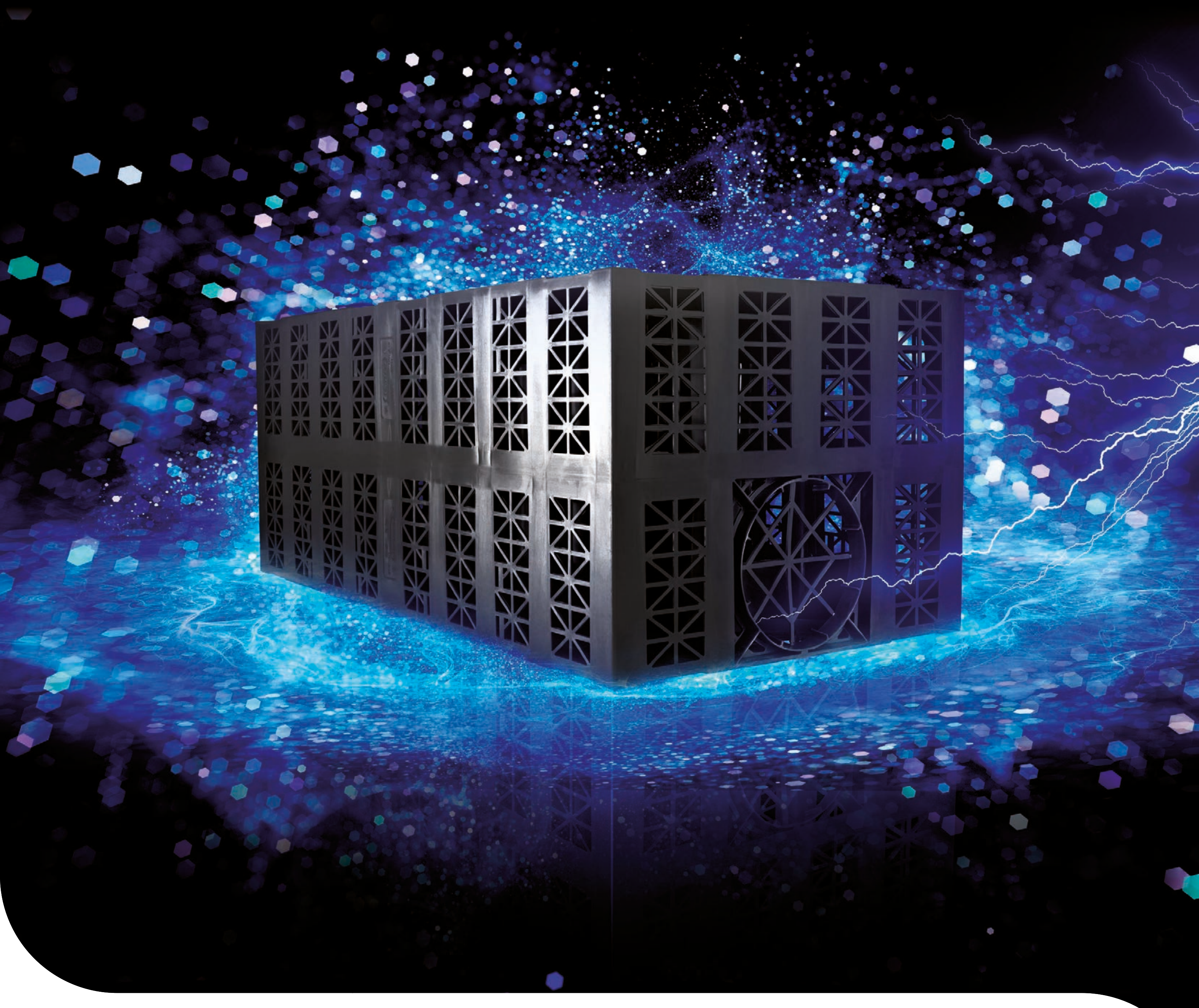
Appendix G

Aquacell – Cellular Storage System

WATER MANAGEMENT

AquaCell systems

Product and installation manual



Introduction to SuDS

Continuing urban development, a changing climate and the consequences of increased rainfall are all increasingly prominent issues on the political and environmental agenda and all drive the need to actively manage excessive rainfall across new and existing developments through the use of Sustainable Drainage Systems (SuDS).
Designed correctly drainage systems can assist in delivering sustainable development whilst improving the spaces where we live, work and play.
The SuDS approach to managing water takes account not just of how water quantity is managed but also considers how improvements to water quality can be delivered as well as the creation of habitats promoting biodiversity and amenity for the community.
Good SuDS aim to mimic nature and manage rainfall close to where it falls. They are designed to move and attenuate water within the development before it is released into water courses. Water is stored within the development where is allowed to infiltrate into the ground or is released at a controlled rate to prevent issues downstream.
The CIRIA SuDS Manual gives guidance on all areas of SuDS and focuses on the cost-effective planning, design, construction, operation and maintenance of SuDS.

Which SuDS components are best?

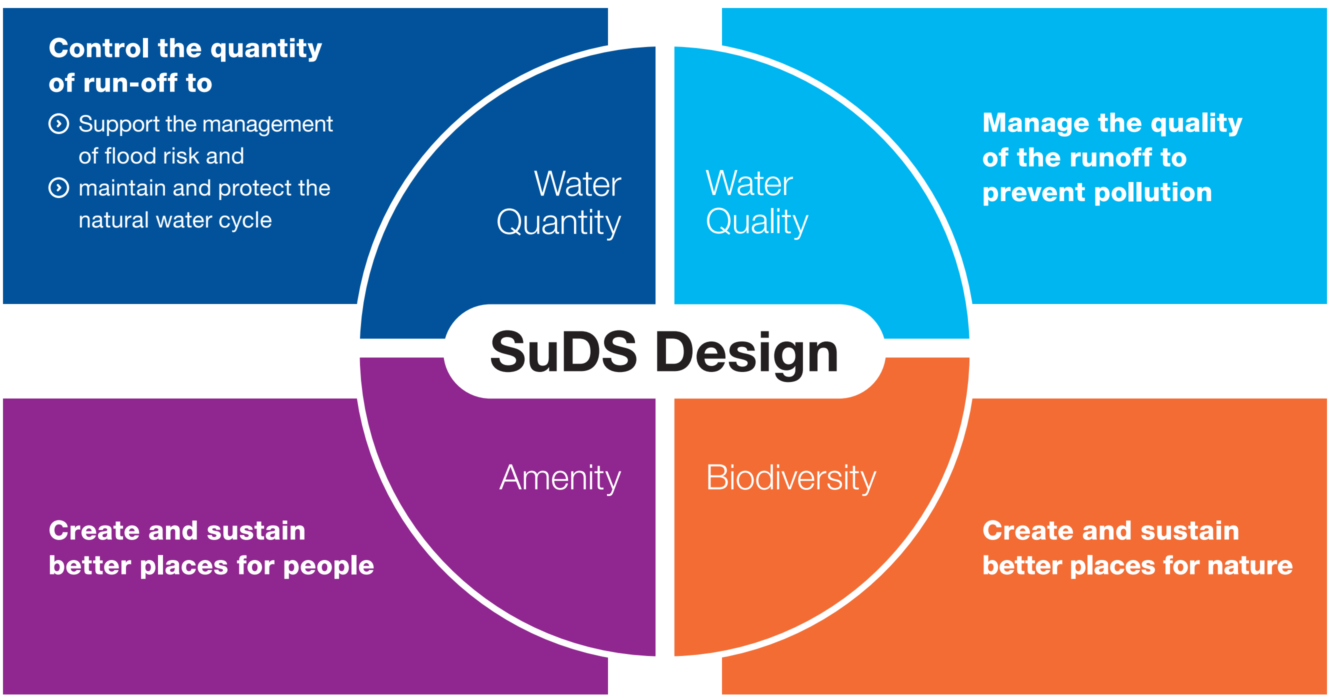
SuDS should help maximise amenity and biodiversity, whilst also delivering key objectives to manage flood risk and water quality For any given site, SuDS should be considered as sequence of components designed to efficiently drain surface water whilst minimising pollution.
Selection of which SuDS components is best for each development is dependent on the site specific requirements.

How can Wavin help with SuDS projects?

Wavin is well qualified to advise on how to comply with current and emerging regulation. We can aid specifiers, developers and contractors in responding to legislative demands as they pertain to flooding, sewage, urban drainage and sustainable resources use.
In particular, the proven qualities and performance of AquaCell systems not only support the achievement of SuDS, they can also help reinforce and enhance planning applications and enable development to proceed.

CIRIA SuDS Design

Source: The SuDS Manual (CIRIA)



Keeping you on top of legislation

Flood and Water Management Act 2010

The Flood and Water Management Act was designed to reduce the risk of flooding and its consequences by providing for better, more comprehensive and co-ordinated water management, embracing groundwater, surface water and coastal erosion risk. Schedule 3 of the act gives DEFRA responsibility for establishing national standards for sustainable drainage and empowers local authorities to manage local flood risk by adopting and maintaining sustainable drainage schemes. In January 2019 Schedule 3 was implemented by the Welsh Government. This legislation effectively makes the use of SuDS mandatory on new developments with the aim of reducing flood risk and improving water quality. The new standards for Wales support the 'four pillars' of SuDS.

Sewers for Adoption

In England the framework for the delivery of SuDS in the absence of Schedule 3 is through a revision to Sewers for Adoption to include some SuDS components as adoptable by the Water and Sewage Companies. The document, currently with Ofwat for approval, is expected to be introduced early 2020. When it comes into force it will be the only guide to the standards that sewers must meet if they are to be adoptable by WaSCs in England. The new document will, for the first time, offer guidance on SuDS components (although not all) that can be adopted by Water and Sewerage Companies with standards on the flood risk performance that is expected.

The Water Environment and Water Services (WEWS) (Scotland) Act 2003

In Scotland WEWS makes Scottish Water responsible for SuDS that deal with the run-off from roofs and any paved ground surface within the property boundary. In order to deliver this SuDS need to be designed to Scottish Water's specifications as set out in their manual, Sewers for Scotland v4.0. In addition, the law makes the use of SuDS obligatory when dealing with surface water drainage from all new developments.

The EU Water Framework Directive

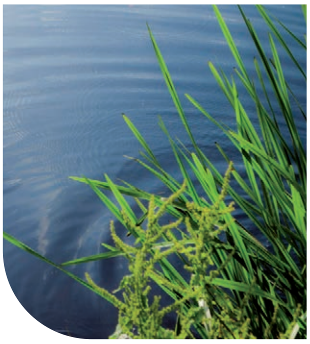
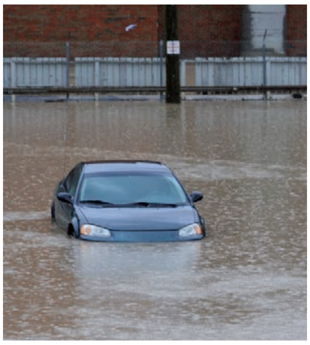
Nearly half the EU population lives in 'water-stressed' countries, caused by high extraction from freshwater sources, and demand is growing all the time. The EU Water Framework Directive introduces a new legislative approach designed to better manage and protect water resources, based not on national orpolitical boundaries but on the natural catchment of river basins.

Building Regulation Part H (Drainage and Waste Disposal)

Building Regulation Part H embraces the guidelines for drainage and waste disposal that must be met in the UK. Although Part H extends to rainwater drainage and solid waste storage, waste drainage issues are to the fore. The Building Regulations are designed to ensure that all foul water is properly disposed of to maintain a decent level of sanitation, promoting both personal and environmental health. The regulations also highlight the importance of pollution prevention, working sewage infrastructure and sewage maintenance. With regards to stormwater, Building Regulations Approved Document H3 stipulates that adequate provision should be made for rainwater to be carried from the roof of a building to either a soakaway, water course or sewer.

National Planning Policy Framework

Section 14 of the National Planning Policy Framework sets out policy to ensure that flood risk is taken into account at all stages of the planning process and that inappropriate development in areas at risk of flooding is avoided. The policy directs development away from areas of highest risk and where new development is, exceptionally necessary in such areas, aims to make it safe without creating an increase in flood risk elsewhere and, where possible, reduce flood risk overall. It also states developments should only be allowed in an area of flood risk if it incorporates sustainable drainage systems, unless there is clear evidence that these would be inappropriate.

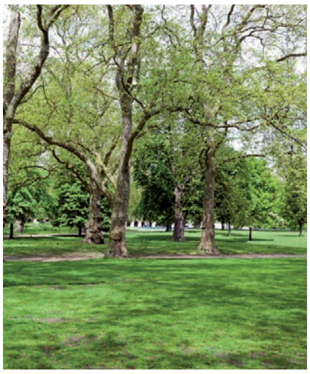
Overview

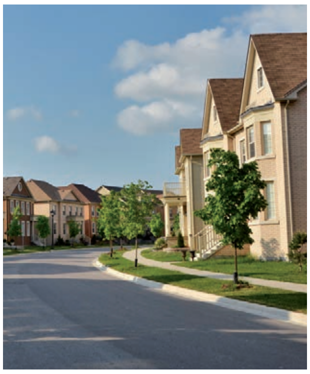
The AquaCell range of geocellular systems are a fully tried and tested, BBA approved, modular technique for managing excessive rainfall.

Applications

The AquaCell range can be used as either a temporary storage tank or as a soakaway, and is suitable for applications including:

- Landscaped areas
- Parks
- Domestic gardens
- Residential developments
- Car parks & roads
- Industrial/commercial areas



The AquaCell range

There are three types of AquaCell unit. Each can be used as a standalone system or different unit types can be mixed and matched together in layers to value engineer the most cost effective solution.

All AquaCell units have identical dimensions (1m x 0.5m x 0.4m), but they are manufactured to perform differently. The type of unit, or combination of units required will depend on factors such as the load application, overall installation depth and site conditions.

Features and benefits

The following are applicable to all AquaCell units:

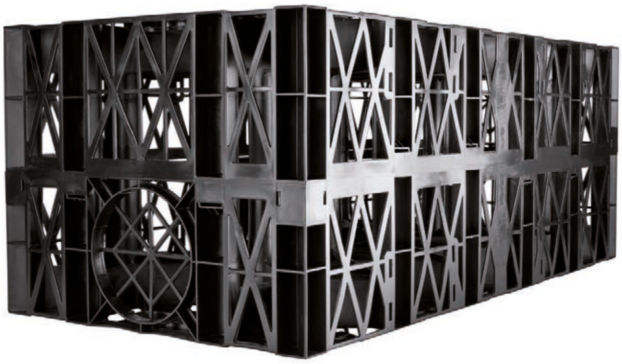
- BBA Approved – certificate No. 03/4018
- Modular, lightweight and versatile
- Easy to handle and quick to install
- Proven clip and peg connection system
- 95% void (each unit holds 190 litres of water)
- Can be brick-bonded for extra stability
- Units can be mixed and matched together for optimum performance
- Full range of ancillaries
- Can be used as integral part of a SuDS scheme

Environmental benefits

In addition, the AquaCell range can also offer the following environmental benefits:

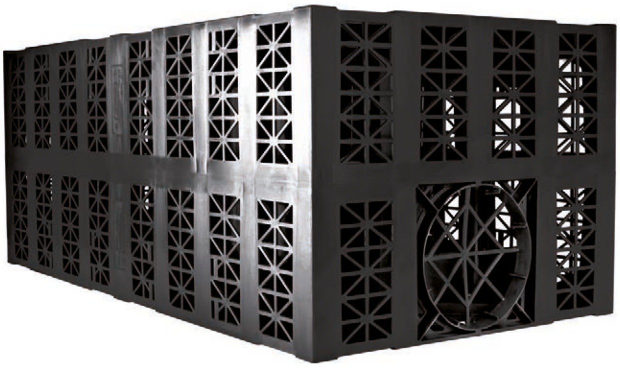
- Reduced flooding risk
- Controlled release of stormwater into watercourses or, where permitted, existing sewer systems
- Recharging of local groundwater (if infiltration/soakaway application)
- Aerobic purification to improve water run-off quality
- Sustainable, cost effective management of the water environment

Eco



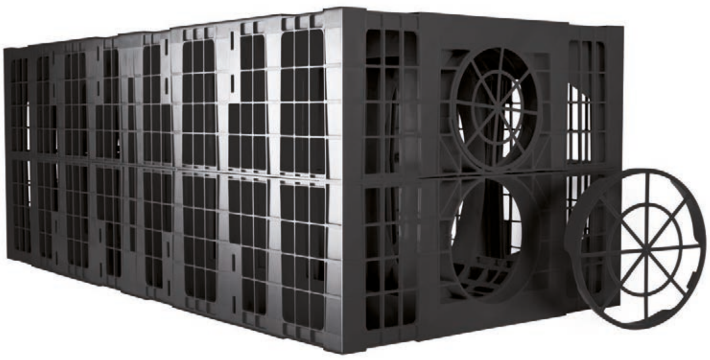
Eco is manufactured from specially reformulated, recycled material and has been designed for shallow, non-trafficked, landscape applications.

Core-R



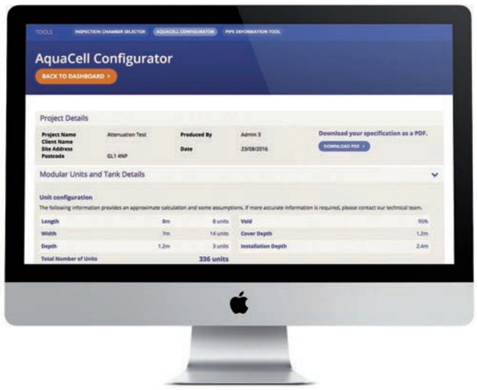
Core-R has been designed for use in deep applications, subject to both regular and heavy traffic loadings, such as cars and HGV's.

Plus-R



Plus-R has been designed primarily for use in applications where inspectability is required, and is suitable for use in all applications from landscaped areas to heavily trafficked areas including HGV.

AquaCell Configurator Tool



Optimise tank and soakaway designs with the AquaCell Configurator Tool

The AquaCell Configurator tool aids and speeds the efficient design of stormwater tank or soakaway solutions. The tool guides users through a step-by-step specification process and, based on responses, will recommend the optimum design, based on the loadings, depths and site conditions of each project.

The tool generates a PDF of the design for easy download and can store the data online for future reference. To start using the tool or to learn more visit: **myportal.wavin.co.uk/tools**

AquaCell Eco

Application

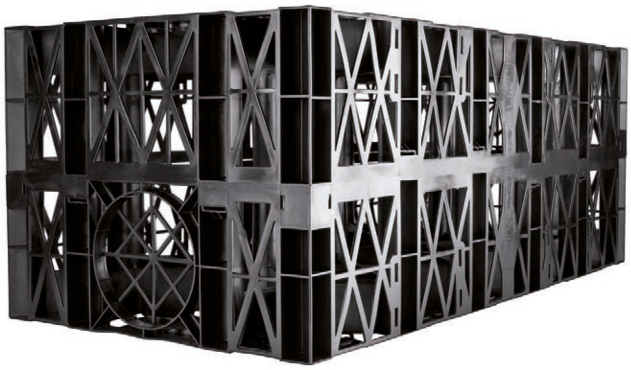
AquaCell Eco is manufactured from specially reformulated, recycled material and has been specifically designed for shallow, non-trafficked, landscaped applications. AquaCell Eco is **NOT** suitable for locations subject to high water tables.

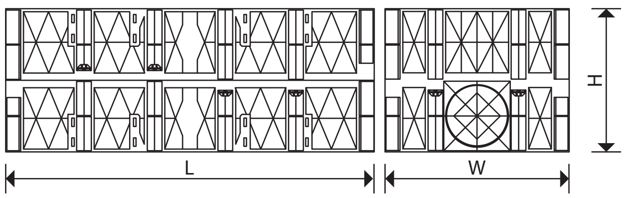
AquaCell Eco is typically suitable for installations to a maximum depth of 2.68 metres, to the base of the units from ground level, with a minimum cover depth of 0.3 metres, (CIRIA's recommendation, is to allow a cover depth of 0.5 metres in applications where a ride on mower may be used).

Any installation using AquaCell Eco must **NOT** be subjected to additional loading at any time. Trafficking by construction plant on site, including mechanical equipment, must be avoided.

If trafficking of the buried tank by construction plant or, other vehicles is unavoidable, the installation should be constructed using AquaCell Core-R units (see page 9).

The width of an AquaCell Eco installation should not exceed 12 metres to allow for mechanical backfilling without loading. There is no limit to the length of the installation.



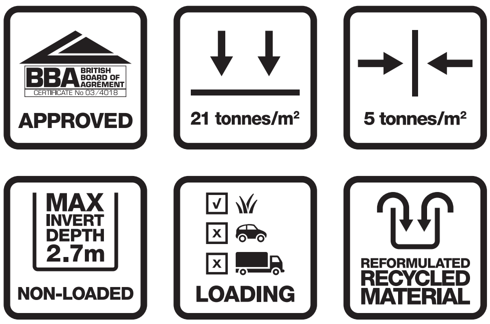


Material: Reformulated polypropylene

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB025	500	400	1000

Features and benefits

- Manufactured from specially reformulated, recycled material
- Suitable for both soakaway and attenuation applications
- Proven vertical loading capacity of: 21.3 tonnes/m² (213kN/m²)
- Proven lateral loading capacity of: 5.2 tonnes/m² (52kN/m²)
- Integral "hand holds" for ease of carrying/handling
- BBA approved – Certificate No 03/4018



Maximum installation depths – to base of units (m)[1]

Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas
Over-consolidated stiff clay	20	24	1.53
Silty sandy clay	19	26	1.68
Loose sand and gravel	18	30	2.08
Medium dense sand and gravel	19	34	2.35
Dense sand and gravel	20	38	2.68

(1) These values relate to installations where the groundwater is a minimum of one metre below the base of the excavation.
(2) AquaCell Eco units should not be used where groundwater is present.
(3) 0.5m cover is required where a ride-on mower may be used.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

Source: BBA

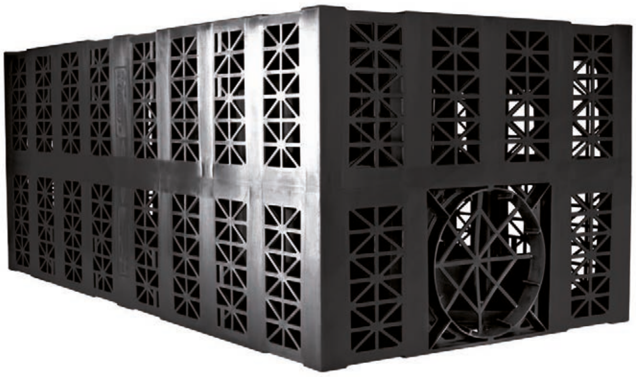
AquaCell Core-R

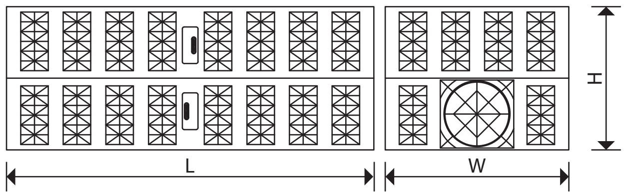
Application

AquaCell Core-R has been designed for use in deep applications, subject to regular and heavy traffic loadings, e.g. cars and HGV's. AquaCell Core-R can also be used for deep soakaways and landscaped applications.

Typically for use down to depths of 6.68m in landscaped areas (6.43m trafficked by cars) to the base of the units from ground level, in best soil conditions.

Trafficking by heavy construction plant on site, including mechanical equipment, must be avoided until the minimum cover depth of 1.11 metres is in place.





Features and benefits

- Suitable for regular and heavy traffic loadings
- Proven vertical loading capacity of: 66.9 tonnes/m² (669 kN/m²)
- Proven lateral loading capacity of: 12.3 tonnes/m² (123kN/m²)
- BBA approved – Certificate No 03/4018
- Ideal for all types of shallow and deep projects including major attenuation and infiltration schemes

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB150	500	400	1000

Maximum installation depths – to base of units (m)[1]

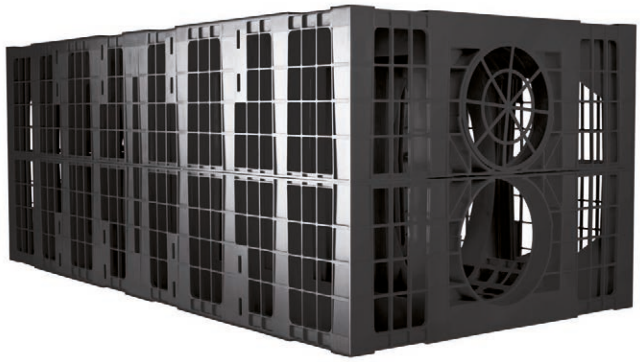
Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas	Vehicle mass <9 tonnes[4, 5]	Vehicle mass <44 tonnes
Over-consolidated stiff clay	20	24	3.85	3.61	3.36
Silty sandy clay	19	26	4.35	4.09	3.83
Loose sand and gravel	18	30	5.34	5.06	4.78
Medium dense sand and gravel	19	34	5.94	5.68	5.41
Dense sand and gravel	20	38	6.68	6.43	6.18

(1) Without groundwater present below base of units – AquaCell Core-R may be used where groundwater is present, contact Wavin for technical advice.
(2) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of φ.
(3) The design is very sensitive to small changes in the assumed value of φ, therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
(4) Applicable for car parks or other areas trafficked only by cars or occasional refuse collection trucks or similar vehicles (typically one per week).
(5) This category should be used when considering landscaped areas that may be trafficked by ride on mowers.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

Source: BBA

AquaCell Plus-R

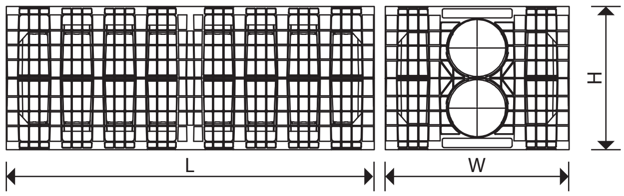


Application

AquaCell Plus-R has been designed primarily for use in applications where inspection is required. It is suitable for use in all applications from landscaped areas to heavily trafficked areas (for vehicles up to 44 tonnes). The units can be used in combination with AquaCell Core-R (and Eco if there is at least one layer of Core-R in between the Plus-R and Eco layer).

Extra lateral loading capacity allows installation at greater depths. Integral inspection channels in each unit combine to create viewing channels for the full length of the installed structure.

Typically for use down to depths of 7.82m in landscaped areas (7.57m trafficked by cars and 7.3m trafficked by HGV's) to the base of the units from ground level, in best soil conditions. Trafficking by heavy construction plant on site, including mechanical equipment, must be avoided until the minimum cover depth of 1.30 metres is in place.

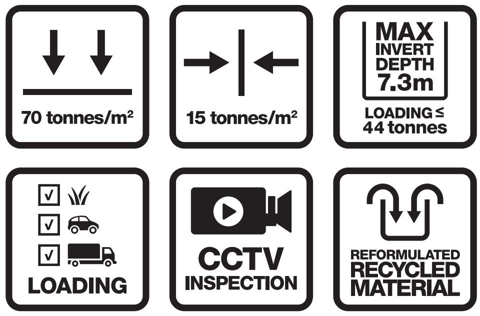


Material: Polypropylene

Nominal size (mm)	Part number	Dimensions (mm)		
		W	H	L
160	6LB200	500	400	1000

Features and benefits

- Suitable for extra deep installations
- Inspectable (supplied with end cap for use when an inspection channel is not required)
- Proven vertical loading capacity of: 70.2 tonnes/m² (702 kN/m²)
- Proven lateral loading capacity of: 15.1 tonnes/m² (151 kN/m²)



Maximum installation depths – to base of units (m)[1]

Typical soil type	Soil weight kN/m³	Angle of internal friction φ (degrees)[2, 3]	Landscaped areas	Vehicle mass <9 tonnes[4, 5]	Vehicle mass <44 tonnes
Over-consolidated stiff clay	20	24	4.67	4.42	4.17
Silty sandy clay	19	26	5.03	4.78	4.53
Loose sand and gravel	18	30	5.86	5.61	5.36
Medium dense sand and gravel	19	34	6.87	6.62	6.37
Dense sand and gravel	20	38	7.82	7.57	7.30

(1) Without groundwater present below base of units – AquaCell Plus-R may be used where groundwater is present, contact Wavin for technical advice.
(2) Loosening of dense sand or softening of clay by water can occur during installation. The designer should allow for any such likely effects when choosing an appropriate value of φ.
(3) The design is very sensitive to small changes in the assumed value of φ, therefore, it should be confirmed by a chartered geotechnical engineer. In clay soils, it may be possible to utilise cohesion in some cases.
(4) Applicable for car parks or other areas trafficked only by cars or occasional refuse collection trucks or similar vehicles (typically one per week).
(5) This category should be used when considering landscaped areas that may be trafficked by ride on mowers.

Assumptions made:
- Ground surface is horizontal
- Shear planes or other weaknesses are not present within the structure of the soil.

AquaCell Plus-R: for inspectability

By aligning AquaCell Plus-R units end-to-end, full length viewing channels can be created – allowing for CCTV inspection if required. These are created in the bottom layer of an AquaCell tank installation.

The units can be used in combination with AquaCell Core-R (and with Eco if there is at least one layer of AquaCell Core-R in between the Plus-R and Eco layer).

NOTE: For any AquaCell Plus-R units on the perimeter of a structure that are NOT required for inspection access, the open ends of the integral inspection tunnels should be fitted with the end caps provided.

Inspection chambers

An inspection chamber should precede the inlet pipework for the AquaCell structure.

A silt trap or hydro-dynamic separator prior to the inspection chamber is also recommended.

For on-line installations the following Chambers are recommended:

— Down to 3m Wavin Non-Entry Inspection Chambers
— Down to 5m Wavin Range 600 Inspection Chambers, or a traditional manhole*

**where inlet pipework is replaced by AquaCell units acting as flow conduit.*

For off-line installations:

— Manhole with in-built flow control

Recommendation: If installing any Wavin Non-Entry Inspection Chamber, deeper than 1.2 metres, ensure that the cover and frame includes a 350mm restrictor to prevent man entry.

Inspection and maintenance

CCTV inspection at every inspection point is recommended:

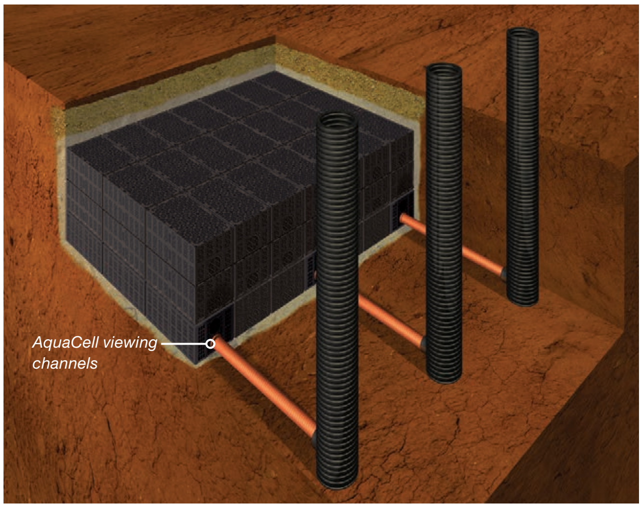
— after every major storm
— at regular intervals according to the specific maintenance plan for the site

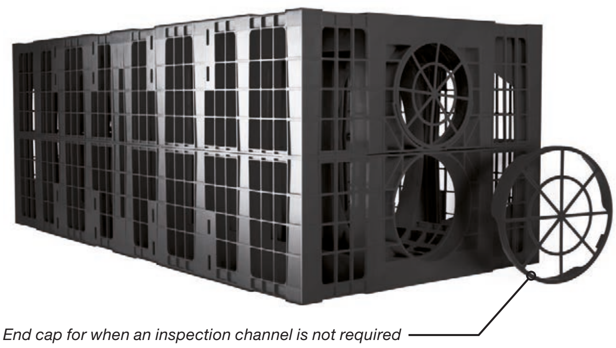
Silt traps prior to inlet pipework should be routinely inspected and cleaned out to minimise debris reaching the tank.
It is important to prevent construction silt from entering the AquaCell structure.

Inspectability scenarios

AquaCell Plus-R viewing channel

Trafficked tank installation with inspection chambers





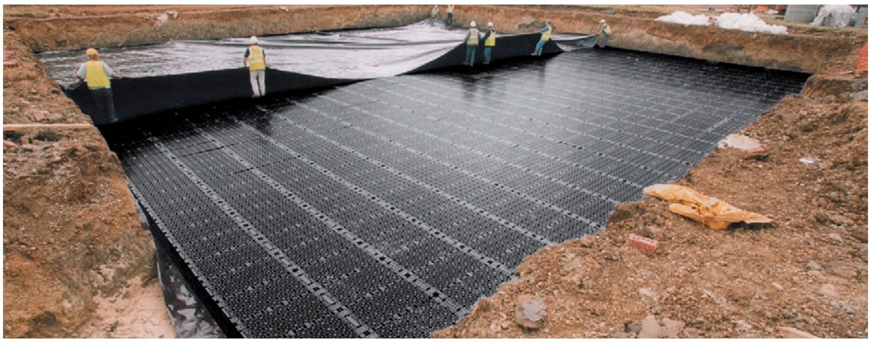
Design guidance

Infiltration or attenuation?

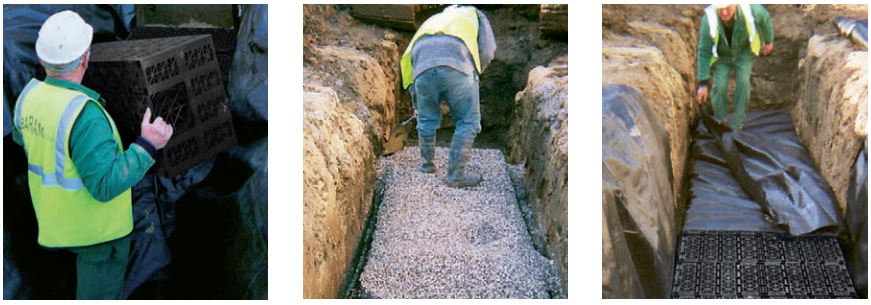
The AquaCell range can be used either as:

- A soakaway whereby the units will be installed in suitable pervious soils so the units can be wrapped in a geotextile to allow infiltration of the stormwater into the surrounding ground, or
- As an attenuation tank in impervious ground (e.g. clay) where infiltration is not possible, here the units are encapsulated in a geomembrane (which is in turn wrapped in a protective geotextile layer) so that the structure can hold the stormwater temporarily until local drainage flows can accept it for normal disposal at a permissible outflow rate.

Large scale AquaCell Core-R storage tank



Domestic AquaCell Core-R soakaway



Site assessment

Ground conditions may be established as part of a geotechnical assessment. This may include tests for infiltration and ground water level.

If there is no confirmation that such assessments have been conducted, or resulting conclusions are unavailable, a trial pit will be required in accordance with BRE 365.

For further information and guidance, please contact the Wavin Technical Design Team.

Infiltration (soakaways)

According to the principals of SuDS, wherever possible stormwater should be drained back into the ground via a soakaway as the first priority. A site must meet BOTH of the following criteria for infiltration to be possible:

- The underlying soil surrounding the proposed installation is sufficiently permeable
- The seasonally high water table is a minimum of 1 metre below the base of the proposed installation

If either of these criteria is not met, or cannot be confirmed for any reason, a soakaway system may not be suitable for the application, in which case a storage tank must be used.

Attenuation (storage tanks)

A storage tank may be designed to be online or offline (see pages 26-31 for typical details). However, if the site is subject to groundwater or a high water table, it is important to ensure that the tank is not vulnerable to flotation. Sufficient weight from soil, or other covering placed over the AquaCell units, must be sufficient to counter any buoyancy uplift force from the rising groundwater level.

Important design considerations for geocellular structures

Rising rainfall levels and increased focus on SuDS compliance, have led to an increase in the use of modular units to create underground structures for infiltration or the temporary storage of stormwater.

However, not all currently available systems have the proven performance characteristics necessary to meet the wide range of complex underground geocellular applications.

The Wavin range of AquaCell units provide assured performance, since all strength and hydraulic capabilities have been verified by independent testing and all units are fully BBA approved.

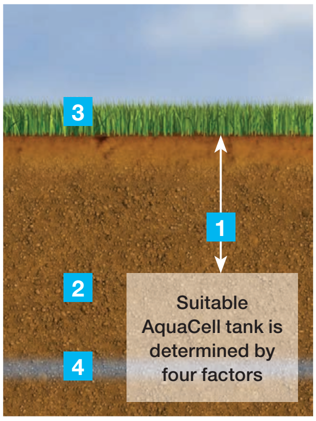
To guarantee the structural integrity of an engineered drainage system, any underground structure must be strong enough to support the loads to which it will be subjected without any unacceptable deflection.

The correct choice of geocellular unit must have appropriate proven top (vertical) and side (lateral) load bearing capacity and deflection characteristics to suit site conditions.

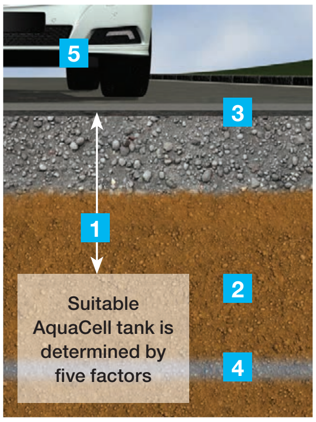
The five key site considerations to be noted when designing a geocellular structure are:

1. Depth of cover (See page 14)
2. Soil type
3. Surface finishing
4. Presence of groundwater
5. Type of traffic/loading

A: Non-trafficked



B: Trafficked



The combination of these 5 factors effectively means that the required characteristics of a geocellular structure to be installed under a trafficked location (for example) will be very different from that under a landscaped/low-loaded location.

Two typical examples are given below.

Example A: Landscaped/non-trafficked location and 0.3m cover depth. Typically requires minimum vertical strength of 17.5 tonnes/m²

Example B: Car park with occasional light delivery traffic and between 0.5 – 0.7m cover depth. Typically requires minimum vertical strength of 40 tonnes/m²

Design guidance

Hydraulic design

All AquaCell units have identical dimensions: 1m x 0.4m x 0.5m, have a nominal void ratio of 95% and each holds 190 litres of water. Hydraulic calculations are accordingly the same for AquaCell Eco, Core-R and Plus-R.

Structural design however, requires careful consideration of loading factors specific to each location – see CIRIA C680 or CIRIA C737 for further guidance (we recommend using the BPF Guide Designing Geocellular Drainage Systems to CIRIA Report C737 alongside.)

Structural design – installation and cover depths

Each AquaCell unit has been designed to have specific loading capacities (see pages 8-10) that define the maximum depth parameters for which they are suitable.

Minimum depth of cover varies according to whether or not the installation will be subject to trafficking by cars/HGVs.

However, in some situations, installations may have to be located with greater cover depths. Reasons may include:

- Deep-running drainage network
- Other buried services running above tank location
- Installation into banked/ sloping ground
- Upper layer of clay preventing infiltration

The table shows a summary of typical cover depths and installation depths as a guide.

Typical minimum cover depths and maximum installation depths

Location type	Minimum cover depths (m)		
	AquaCell Eco	**AquaCell Core-R**	**AquaCell Plus-R**
Landscaped/non-trafficked areas[2]	0.30	0.30	0.30
Car parks, vehicle mass up to 9 tonnes[1]	n/a	0.60	0.69
HA/HGV loading up to 60 tonnes	n/a	1.11	1.30
	Maximum installation depths (m)[3]		
Maximum depth to base of unit (Landscaped)	2.68	6.68	7.82
Maximum depth to base of unit – vehicle mass up to 9 tonnes	n/a	6.43	7.57
Maximum depth to base of unit – vehicle mass up to 44 tonnes	n/a	6.18	7.30

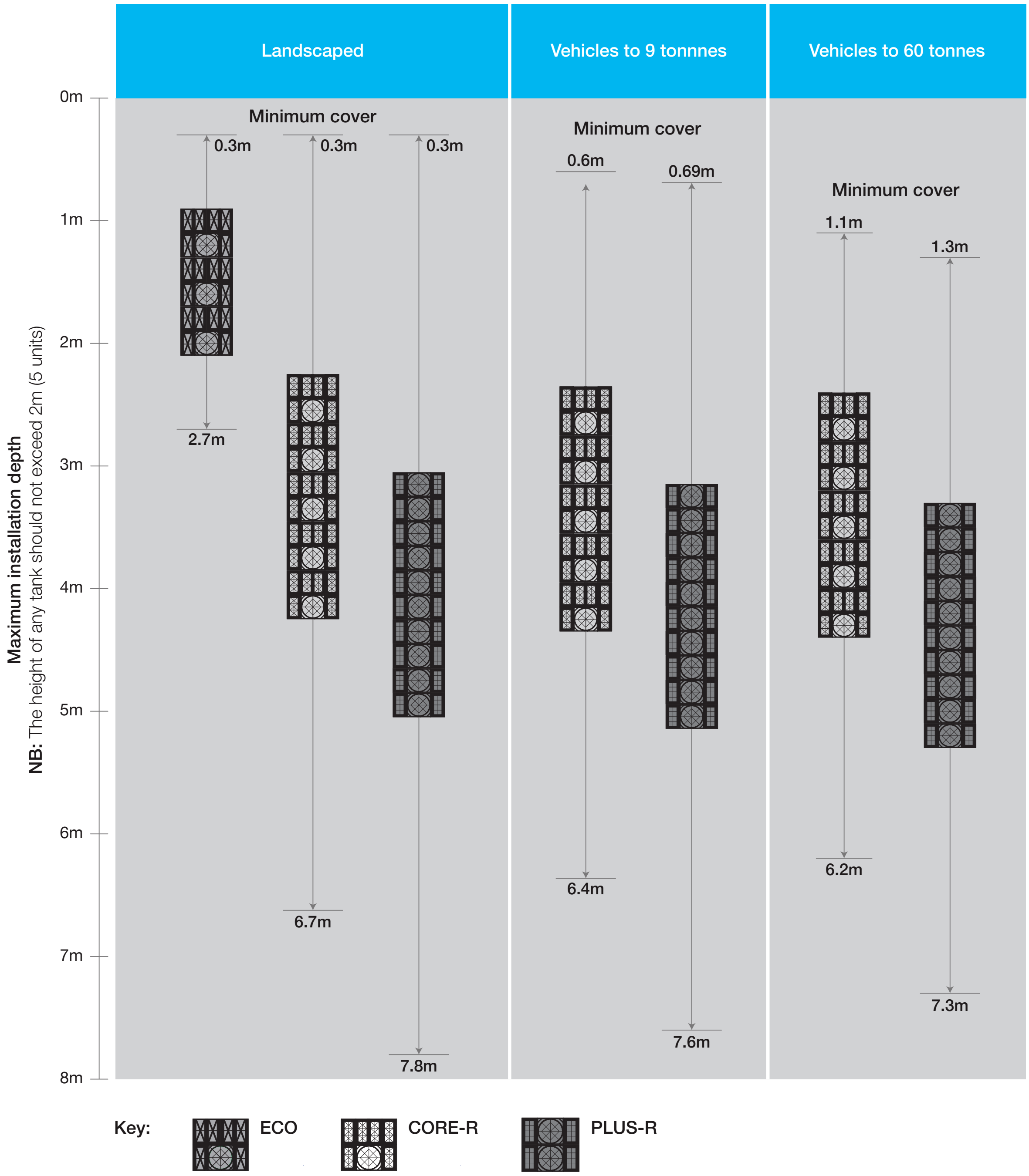
(1) For specific advice on cover depths for heavier loadings/HGV applications, contact Wavin Technical Design on 0844 856 5165.
(2) 0.30m is minimum depth for AquaCell in landscaped applications. 0.5m cover is recommended in applications where ride-on mowers may be used. If construction plant is to be used on site, extra protection may be needed.
(3) Allowable maximum depth to base of bottom layer of units is dependent on soil type, angle of shearing resistance, loadings, and groundwater level. The above depths are based on 38° angle of shearing resistance and no groundwater.

In trafficked applications it is recommended that the height of any tank should not exceed 2m (5 units). If you require a tank that exceeds this, please contact Wavin Technical Design for guidance:

T: 0844 856 5165 E: technical.design@wavin.co.uk

Minimum cover and maximum installation depths to base of units from ground level, in best soil conditions

This chart shows how deep each unit can be used for different applications in best soil conditions.



Note: The AquaCell units can also be used in combination with each other, see page 16 for details.

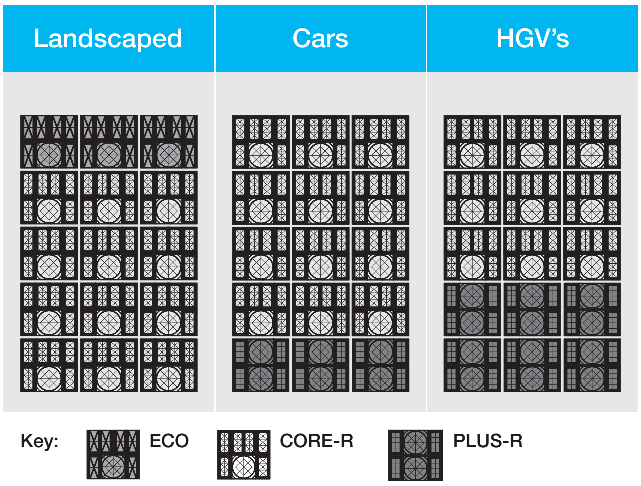
Design guidance

Mix and match

Although all AquaCell units have identical dimensions, and a high nominal void ratio of 95%, they are manufactured to perform at a range of depths, dependent on soil type, angle of shearing resistance, loading and ground water levels. For optimum performance the units can be mixed and matched (in layers) to value engineer the most effective design (in cost and performance terms) for each installation. For example, in a landscaped application if you needed to install a tank or soakaway that is deeper than 2.7m, you could install layers of AquaCell Core-R underneath the AquaCell Eco. See below illustrations showing examples of how the AquaCell units can be mix and matched together. For advice on how to optimise a tank or soakaway design using more than one type of AquaCell please contact Wavin Technical Design.

Note: AquaCell Eco cannot be used directly with AquaCell Plus-R therefore there must be a layer of AquaCell Core-R between them.

Typical examples of mix and match with AquaCell



Brick bonding – for extra stability

When assembling a geocellular structure that comprises two or more layers, it is recommended that AquaCell units are placed in a 'brick-bonded' configuration for extra stability.

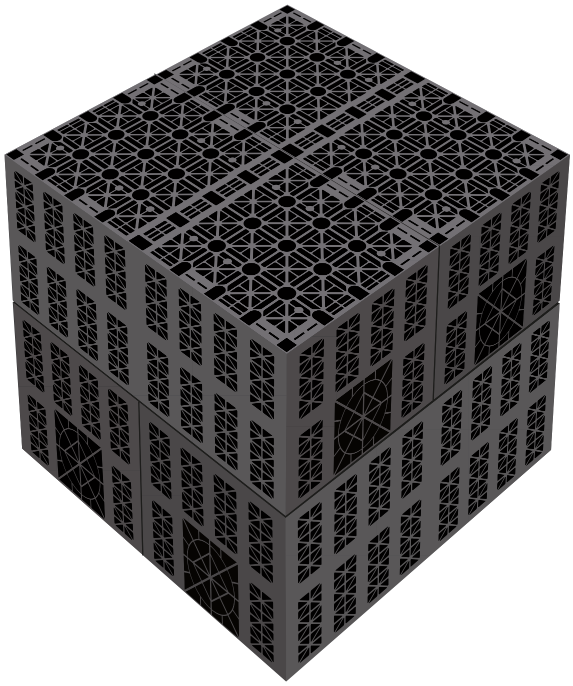
This helps minimise continuous vertical joints in the assembly, and gives the structure extra stability.

A significant advantage of AquaCell unit design is that brick bonding placement does not require extra connectors.

All three AquaCell units may be placed in this way, unless inspection channels and cleaning access are required using AquaCell Plus-R.

AquaCell Plus-R units incorporate integral inspection channels. These are designed for combined alignment to create viewing tunnels at the base of an assembled structure (see page 11).

Example of AquaCell being brick bonded



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