Leydens Wholesalers & Distributors Dublin, No. 158A

Infrastructure Design Report

210178-DBFL-Z0-XX-RP-C-0001

INFRASTRUCTURE

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DBFL CONSULTING ENGINEERS

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1 INTRODUCTION

1.1 Background

DBFL Consulting Engineers were commissioned to provide engineering services to accompany a planning submission for a proposed mixed-use development at Leydens Wholesalers & Distributors Dublin, No. 158A, Dublin 3, with Dublin City Council.

1.2 Objectives

This report addresses the main infrastructure elements including;

- Site access;
- Proposed roads;
- Management of surface water runoff (Surface Water Management Plan);
- Foul drainage strategy;
- Water supply;

1.3 Development Proposals

Malkey Limited intend to apply for permission for development (Large-scale Residential Development (LRD)) at this c. 0.55 hectare site at the former Leydens Wholesalers & Distributors, No. 158A Richmond Road, Dublin 3, D03 YK12. The site is bounded to the north-east by Richmond Road, to the west/south-west by No. 146A and Nos. 148-148A Richmond Road (pending application ABP Reg. Ref. TA29N.312352), to the south/south-west by a residential and commercial development (Distillery Lofts) and to the east/south-east by the Former Distillery Warehouse (derelict brick and stone building). Improvement works to Richmond Road are also proposed including carriageway widening up to c. 6 metres in width, the addition of a c. 1.5 metre wide one-way cycle track/lane in both directions, the widening of the northern footpath on Richmond Road to a minimum of c. 1.8 metres and the widening of the southern footpath along the site frontage which varies from c. 2.2 metres to c. 7.87 metres, in addition to a new signal controlled pedestrian crossing facility, all on an area of c. 0.28 hectares. The development site area and road works area will provide a total application site area of c. 0.83 hectares.

The proposed development will principally consist of: a Large-scale Residential Development (LRD) comprising the demolition of existing industrial structures on site (c. 3,359 sq m) and the construction of a mixed-use development including artist studios (c. 749 sq m), a creche (c. 156 sq m), a retail unit (c. 335 sq m), and a gym (c. 262 sq m), and 133 No. residential units (65 No. one bed apartments and 68 No. two bed apartments). The development will be provided in 3 No. blocks ranging in height from part 1 No. to part 10 No. storeys as follows: Block A will be part 1 No. storey to part 4 No. storeys in height, Block B will be part 1 No. storeys to part 10 No. storeys in height (including podium) and Block C will be part 1 No. storeys to part 9 No. storeys in height (including podium). The proposed development has a gross floor area of c. 14,590 sq m and a gross floor space of c. 13,715 sq m.

The development also proposes the construction of: a new c. 204 No. metre long flood wall along the western, southern and south-eastern boundaries of the proposed development with a top of wall level of c. 6.4 metres AOD to c. 7.15 metres AOD (typically c. 1.25 metres to c. 2.3 metres in height) if required; and new telecommunications infrastructure at roof level of Block B including shrouds, antennas and microwave link dishes (18 No. antennas enclosed in 9 No. shrouds and 6 No. transmission dishes, together with all associated equipment) if required. A flood wall and telecommunications infrastructure are also proposed in the adjoining Strategic Housing Development (SHD) application (pending decision ABP Reg. Ref. TA29N.312352) under the control of the Applicant. If that SHD application is granted and first implemented, no flood wall or telecommunications infrastructure will be required under this application for LRD permission (with soft landscaping provided instead of the flood wall). If the SHD application is refused permission or not first implemented, the proposed flood wall and telecommunications infrastructure in the LRD application will be constructed.

The proposed development also provides ancillary residential amenities and facilities; 25 No. car parking spaces including 13 No. electric vehicle parking spaces, 2 No. mobility impaired spaces and 3 No. car share spaces; 2 No. loading bays; bicycle parking spaces; motorcycle parking spaces; electric scooter storage; balconies and terraces facing all directions; public and communal open space; hard and soft landscaping; roof gardens; green roofs; boundary treatments; lighting; ESB substation; switchroom; meter room; comms rooms; generator; stores; plant; lift overruns; and all associated works above and below ground.

1.4 Site Location and Topography and Characteristics

The site has an area of circa 0.55ha, excluding the Richmond Road upgrade works and is accessed from Richmond Road. The subject brownfield site, previously occupied by Leydens Wholesalers & Distributors Dublin, is bound to the west and southwest by a site upon which a recently submitted SHD application has been made to An Bord Pleanála (ABP). To the north lies the Richmond Road corridor. The subject site is bound to the south-east by Distillery Lofts commercial premises whilst to the east lies the remains of a previous commercial building which is in a state of disrepair. The site location is shown in *Figure 1-1* below.

A section of Richmond Road, which provides access to the subject site, is proposed to be upgraded as part of the development and includes cycle tracks/lanes and footpaths on both sides of the road.

The site is generally flat, with a fall from Richmond Road at the north-west to the south-east, at an average gradient of 1/130. The industrial site is fully paved with concrete and asphalt surfacing.

Figure 1-1 Site Location Map [Google Maps]

The site is within the jurisdiction of the Dublin City Development Plan, 2022-2028. Based on the information provided on the Map E, “Use Zonings Objectives” map, the subject site is zoned Z10 in the 2022 – 2028 Dublin City Development Plan *“to consolidate and facilitate the development of inner city and inner suburban sites for mixed-uses”.*

2 ROADS AND ACCESS

2.1 Vehicular Access

The subject development will benefit from direct vehicular access onto Richmond Road as presented in Figure 2-1. The proposed site access will be located to the west of the Lofts and the Stables Apartment complex access. The access will take the form of a priority-controlled junction and access is proposed to be secured by a proposed gate to restrict access to permitted residents / visitors only. The design of the new access junction, in addition to the internal road, has been actively influenced by and subsequently complies with DMURS.

Figure 2-1 Site access arrangement

Further details of the site access arrangements has been illustrated in DBFL Drawing No. 210178-DBFL-TR-SP-DR-C-1102. Access arrangements are shown for the proposed development after the road upgrade works have been completed, tying into the existing Richmond Road alignment as well as the proposed road upgrade tying into the post DCC Richmond Road enhancement corridor objective works have been complete. This approach would ensure the proposed Richmond Road upgrade works aligns with the future DCC plans to upgrade the Richmond Road corridor on either side of the proposed works.

2.2 Richmond Road Works

The scheme also includes for enhancements of approx. 204m of the Richmond Road corridor comprising improved footways and the introduction of dedicated cycle infrastructure. The provision of dedicated high-quality pedestrian footways (1.8m to 2.0m wide) and cycle tracks/lanes

(1.5m wide) which will be provided as part of the Richmond Road upgrades proposed as part of the subject application. A signalised pedestrian crossing is proposed approx. 40m north-west of Block A. It is noted that these upgrades were initially incorporated within the adjoining SHD development (ABP Pl. Ref. 312352) but has now been included within the subject application in order that these road upgrades are independent of the SHD development (i.e., will be delivered regardless of the SHD development' planning application outcome). The proposed Richmond Road works ties into the existing road with gradual tapers. The north-west tie-in is proposed as a temporary tie-in until the roadworks are extended north at a later stage. Refer to Figure 2-2 for the extent of the proposed Richmond Road works.

Figure 2-2 Richmond Road Upgrade Proposed Works

Refer to Figure 2-3 for the Richmond Road works when the road upgrade is extended north at a later stage.

Figure 2-3 Development Frontage Arrangements Post DCC Richmond Road Corridor Enhancement Objective

The proposed cross-section for Richmond Road is shown on the enclosed drawing 210178-DBFL-RD-SP-DR-C-5202 and the road long sections on drawings 210178-DBFL-RD-SP-DR-C-3201 to 3203. The proposed Richmond Road works tie in at existing levels north of Richmond Road (across the road from the proposed development) to ensure minimal change to the exiting levels at property accesses.

On the northern side of Richmond Road, a 60mm kerb is proposed between the road and the off-road cycle track and a 60mm kerb between the cycle track and the footpaths.

On the southern side (Development side) of Richmond Road, a 100mm kerb is proposed between the road and the off-road cycle track and a 50mm kerb between the cycle track and the footpaths.

The existing alignment is to be kept as far as possible with minimal changes to existing vertical alignment proposed at centreline.

A Traffic & Transportation Assessment (TTA), prepared by DBFL Consulting Engineers, is included as a standalone document and addresses car parking, cycle parking facilities and access to public transport.

The development is designed in accordance with DMURS (*Design Manual Urban Roads and Streets*) and a DMURS Compliance Statement is included in the separate TTA report included in this submission.

2.3 Vehicle Tracking

DBFL Drawing No. 210178-DBFL-TR-SP-DR-C-1103 indicates all vehicle tracking for a refuse vehicle, delivery goods vehicle and fire tender. Appropriate vehicle sizes are used for the tracking as indicated on drawing number 210178-DBFL-TR-SP-DR-C-1103. Designated on-site areas have been provided for the refuse vehicle and delivery vehicle at the south-east corner of the site as indicated in Figure 2-4 below.

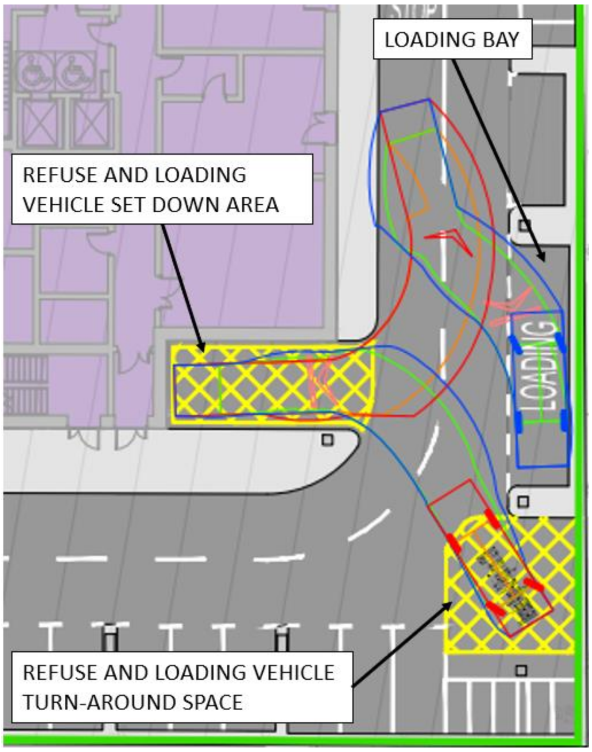


Figure 2-4 Refuse/delivery vehicle set down area

A fire tender route has been provided between Blocks A & B as indicated in Figure 2-5 below.

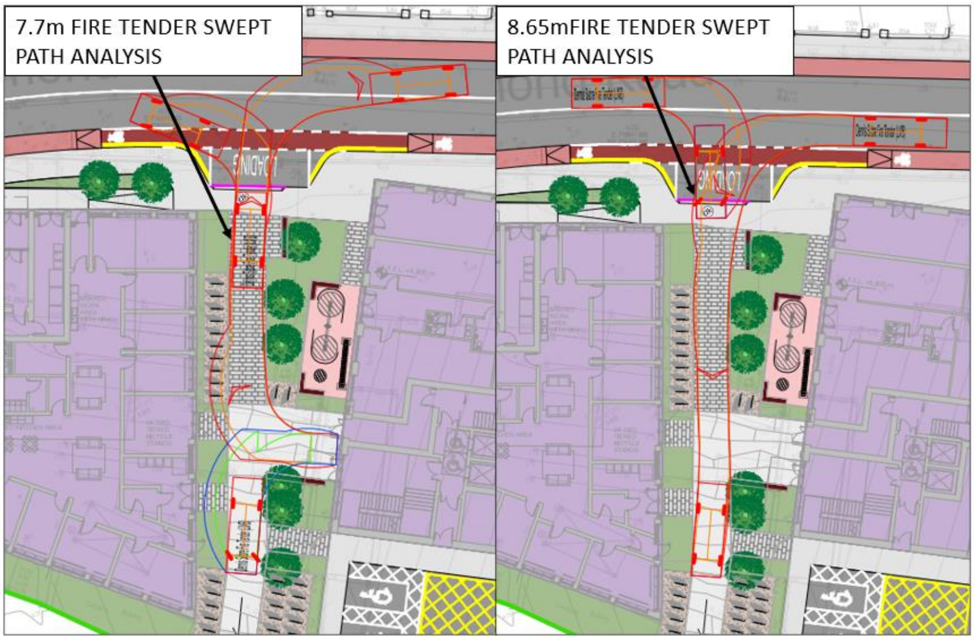


Figure 2-5 Fire tender access route

Further details on the site access is included in the separate TTA document and the enclosed drawing 210178-DBFL-TR-SP-DR-C-1103.

2.4 Available Sightlines

Sightlines at the entrance to the proposed development in accordance with the recommendations of DMURS are included on DBFL drawing no. 210178-DBFL-RD-SP-DR-C-1200.

2.5 Vehicle and Cycle Parking

An appropriate amount of vehicle and cycle parking has been provided as set out in the separate TTA document.

3 EXISTING UTILITIES

Existing utilities within the site and in the immediate vicinity of the site was determined by as-built records from utility companies and a GPR Utility Survey completed by Murphy Geospatial.

Existing utilities as identified by the GPR Survey include:

- ESB (Electrical) - ESB records show electrical connections to Ebox offsite. None found on site;
- Public lighting - Connections to the lamp poles were identified on site. Two lamp posts were reported as being disused – please refer to the attached Murphy Geospatial Survey attached as **Appendix I;**
- EIR – None identified on site;
- UPC - – None identified on site;
- ENET - – None identified on site;
- GNI (Gas) – Partially located on site. Refer to drawings in report;

Refer to Murphy Geospatial Utility Survey included in **Appendix I** for further details.

4 SITE INVESTIGATION

A preliminary site investigation was conducted as attached in **Appendix J** and includes the following tests:

- 3 x Trial pits up to 1.5m depth
- 2 x infiltration tests

The ground investigation revealed that the site is surfaced with 10mm layer of asphalt. Below the surfacing, two distinctive soil layers have been identified:

Made Ground: Greyish brown sandy clayey angular fine to coarse GRAVEL BACKFILL. Sand is fine to coarse.

In-situ Material: Light brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.

5 SURFACE WATER MANAGEMENT PLAN

5.1 Existing Surface Water Drainage

Local Authority record drawings indicate a large diameter surface water sewer in the vicinity of the site. There is a 1350mm diameter surface water sewer at the proposed entrance to the subject development under Richmond Road. Refer to *Figure 5-1* below.

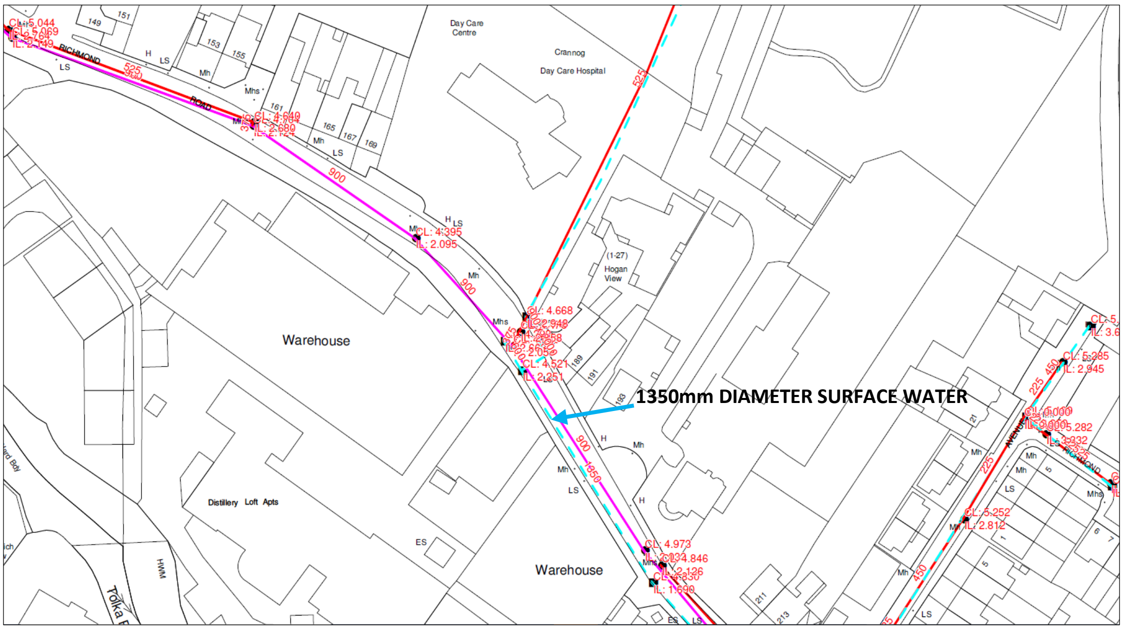


Figure 5-1 Extract of Local Authority Record Drawings

Within the site, the existing surface water network comprises of a combination of gullies, concrete channels, 100mm - 225mm diameter uPVC surface water pipes, which collects surface water runoff from the existing site, and discharges unattenuated runoff to the public surface water sewer in Richmond Road near the current entrance of the site.

5.2 General Surface Water Management Policy

Dublin City Council is within the Greater Dublin Area (GDA) as identified in the Greater Dublin Strategic Drainage Study (GDSDS). The GDSDS outlines regional drainage policies to address the drainage needs of the GDA. These policies address surface water management from development sites, from the point of view of water quality, quantity, risk of flooding and compliance with relevant environmental legislation. As outlined in the GDSDS, proposed developments must be drained on separate foul and surface water drainage systems and must incorporate Sustainable Urban Drainage Systems (SuDS) for the management of surface water runoff. The SuDS strategy follows CIRIA SuDS Guidelines.

The guidelines require the following 4 main criteria to be provided by the design;

- Criterion 1: River Water Quality Protection – River Water Quality Protection – Satisfied by providing interception storage and treatment of surface water run-off by SUDS features such as permeable paving, tree pits, green/blue roof/podium & filter layers under attenuation.

- Criterion 2: River Regime Protection – Satisfied by attenuating surface water run-off in association with flow control devices prior to discharge off site at greenfield runoff rate within the green/blue roof and cellular below ground storage.

- Criterion 3: Level of Service (flooding) for the site – satisfied by the development's surface water drainage design, planned flood routing and on-site storage. Also refer to DBFL Site Specific Flood Risk Assessment.

- Criterion 4: River flood protection – Satisfied by attenuating surface water discharge to greenfield runoff rates, addressing pluvial flood risk associated with the 1 in 100 year storm and avoiding development the addition of a flood wall in the proposals to protect the development from river flooding.

5.3 Management of Surface Water Runoff

To manage surface water runoff from the development, it is proposed to discharge attenuated runoff from the development to the existing public surface water sewer at the south east corner of the site in Richmond Road. Surface water storage will be provided within the site to accommodate runoff from a 1% AEP event plus 20% climate change. A combination of SuDS (sustainable urban drainage) features and traditional drainage, such as gullies and pipes will be utilised to manage runoff from the site.

Two separate surface water management systems have been identified as part of the proposed works to include:

1. The proposed development
2. The area of proposed Richmond Road works which would provide access to the proposed development.

5.4 Surface Water management - Proposed development (Excluding the Richmond Road works)

To control the quality and quantity of runoff from the site it is proposed to incorporate significant SuDS measures within the scheme, including a green/blue roof system for the terrace and building roofs and permeable paving for hard surfaces where possible.

Surface water runoff not absorbed by SuDS features will be attenuated to Q_{bar} (Greenfield Runoff) with runoff exceeding this stored on site for up to a 1% AEP (Annual Exceedance Probability), in accordance with the requirements of the GDSDS (Greater Dublin Strategic Drainage Study). Surface water runoff from the building roofs is contained within the green/blue roof system within an underground cellular storage located in the south-east corner of the site, under the proposed road. Further ground level storage is also provided in the form of permeable paving, designed with enough storage to contain the 1% AEP storm event for the area between blocks A and B. Any incidental surface water build-up in this area would drain north to Richmond Road or into the proposed surface water sewer via the linear drains at the entrances to the buildings.

For severe (>1%AEP) storm events, an overland surface water strategy has been developed to ensure buildings are not flooded in the case of these storm events and appropriate freeboard has been allowed for. It is intended that all surface water collected will pass through an appropriate petrol interceptor and grease trap.

5.4.1 Surface Water Attenuation

Surface water runoff from the development is designed to be attenuated to greenfield runoff (Q_{bar}), in accordance with the recommendations of the GDSDS. Surface water run-off from the surface water catchment will be controlled using a vortex flow control device (Hydrobrake or equivalent) on the surface water outlet from the catchment area. Q_{bar} has been calculated based on the effective drainage area for the scheme, which is calculated as circa 0.471ha (effective catchment area). Refer to dr. 210178-DBFL-CS-SP-DR-C-1310 and Figure 5-2 for the extent of the effective drainage area.

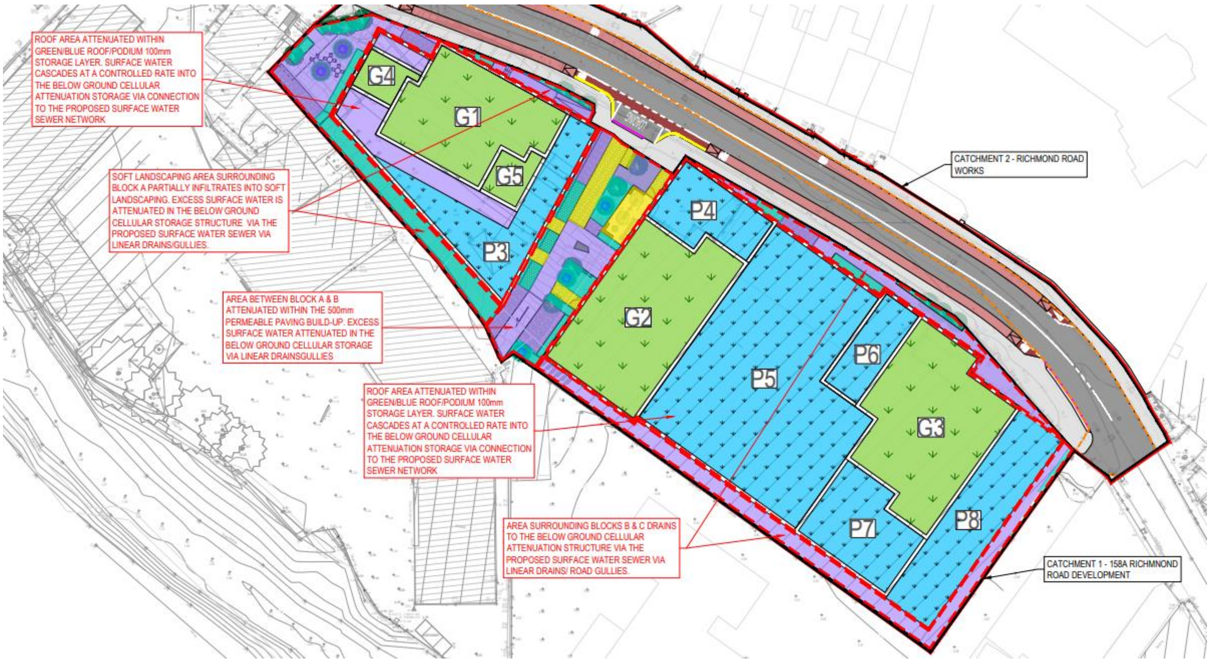


Figure 5-2 Proposed development catchment area

Q_{bar} is calculated using the *Institute of Hydrology* equation, as recommended in the Greater Dublin Strategic Drainage Study (GDSDS), as follows:

$$Q_{bar\ [rural]} = 0.00108\ x\ AREA^{0.89} x\ SAAR^{1.17} x\ Soil^{2.17}$$

Where:

- $Q_{bar[rural]}$ is the mean catchment annual flow from a rural catchment in m^3/s;
- AREA is the area of the catchment in km^2. For a catchment area less than 50ha, calculate Q_{bar} for 50 ha and pro rata it. Area = 50ha or $0.5km^2$
- SAAR is the standard average annual rainfall = 729mm.
- SOIL is the soil index, with 5 soil types used and SPR values (standard percentage runoff) applied to each soil type.

  The SPR values for the 5 soil types are as follows:

  Soil 1 = 0.1; Soil 2 = 0.3; Soil 3 = 0.37; Soil 4 = 0.47; Soil 5 = 0.53;

A soil value of 0.37 (**Soil Type 3**) is applied for the subject site as derived from the preliminary site investigation infiltration results. The infiltration coefficient derived from the infiltration tests and used the calculate the appropriate storage volumes for SuDS elements such as permeable paving is 0.169m/h.

$$Q_{bar\ [rural]} = 0.00108\ x\ (0.050\ x\ 0.01)^{0.89} x\ 729^{1.17} x\ 0.37^{2.17} * 1000/50$$

$$= 3.0 l/s/ha$$

= 1.6 l/s for the gross catchment Area of 0.536 ha

Refer to **Appendix A** for the applicable Met Eireann Rainfall data.

AS RECOMMENDED IN THE GDSDS, TO REDUCE THE RISK OF BLOCKAGES IN THE ORIFICE, THE ALLOWABLE OUTFLOW FROM THE SITE WILL BE LIMITED TO 2.0l/s.

5.4.2 Surface Water Storage

The overall required storage volumes for the catchment area has been calculated by modelling how the surface water cascades from the roof level storage to the cellular underground storage tank at a controlled rate (0.2l/s), and is then discharged into the public surface water sewer at another controlled flow rate (Qbar = 2l/s). Permeable paving at ground level also acts as off line storage for surface water at ground level to reduce surface water entering the proposed surface water sewer system by encouraging infiltrating into the ground. The *Micro Drainage Source Control Cascade* module was used to model this process and calculations are attached in **Appendix B.** Figure 5-3 below depicts the cascading of surface water from one storage structure to the next before being discharged into the public surface water sewer in Richmond Road at a controlled rate.

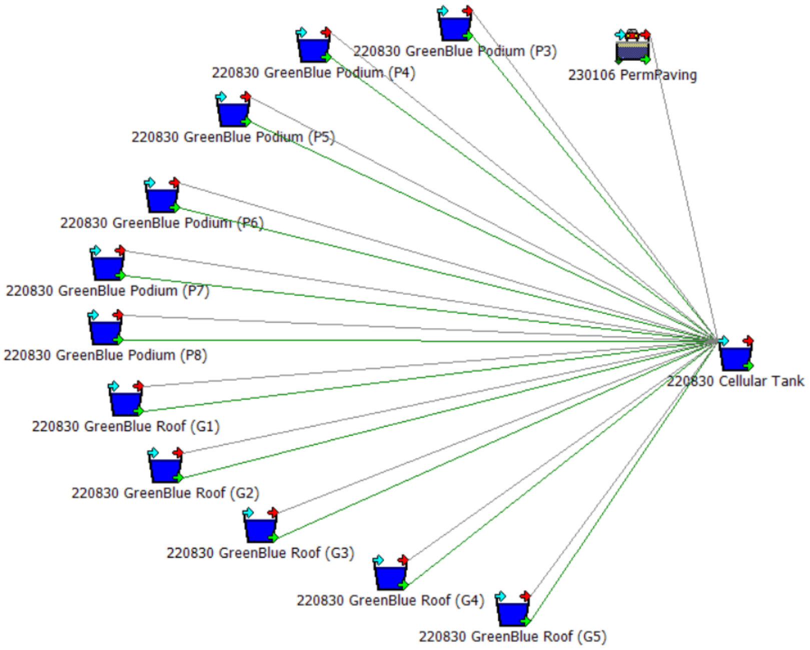


Figure 5-3 Surface Water Storage Cascade

Roof Level Storage

The ABG Green/Blueroof System D108mm or similar approved is proposed for the roofs and terraces. A storage layer in the build-up will accommodate runoff from roofs and terraces. The storage provided in each green/blue roof and terrace is indicated Table 5-1. The green/blue roofs and terraces have been modelled to release attenuated surface water at a rate of 0.2l/s. Surface water would then cascade to the downstream cellular attenuation tank. An overflow structure would be installed in the outlet of the green/blue roofs and terraces in case of a roof outlet control blockage. Refer to **Appendix H** for ABG blue roof brochure.

Ground Level Storage

At ground level, surface water is attenuated in the proposed 100m^2 permeable paving build-up and in an underground cellular attenuation system. Storage is provided for runoff volumes for rainfall events up to a 1% AEP (Annual Exceedance Probability) plus 20% climate change. Surface water runoff at ground level between blocks A and B is stored off line within the permeable paving build-up and is sized to store the 1% AEP storm event of the catchment area between blocks A and B (0.048ha). Refer to Appendix B for the Micro Drainage Source Control calculations used to confirm the storage capacity of the permeable paving. 120m^2 Of permeable paving provides 18m^3 of storage, assuming 30% porosity as per the CIRIA, document No. C521.

Additional storage of 114m^3 is provided in an underground cellular attenuation system to attenuate surface water runoff from the entire site and would be the last storage structure within the attenuation train before surface water is released to the public surface water sewer at a controlled rate. The underground cellular storage tank is proposed at the south-east corner of the site under the proposed road, with attenuated flows discharging to existing public 1350mm surface water pipe in Richmond Road at the proposed entrance to the development. Refer to **Appendix G** for the proposed Stormbloc Brochure and Maintenance Procedures.

Table 5-1 Required and Provided Surface Water Storage

Total Surface Water Storage Provision			
Surface Type	**Volume Required (m^3)**	**Storage Surface Area Provided (m^2)**	**Storage Volume Provided (m^3)**
(P3) Green/Blue Podium	11.3	248.0	24
(P4) Green/Blue Podium	2.8	147.0	14
(P5) Green/Blue Podium	75.5	972.0	94
(P6) Green/Blue Podium	3.7	111.0	11
(P7) Green/Blue Podium	8.8	208.0	20
(P8) Green/Blue Podium	17.9	350.0	34
(G1) Green/Blue Roof	17.9	357.0	35
(G2) Green/Blue Roof	27.8	479.0	47
(G3) Green/Blue Roof	28.7	493.0	48
(G4) Green/Blue Roof	0.9	41.0	4
(G5) Green/Blue Roof	1.2	44.0	4
Roof Storage Sub-Total			**327**
Cellular Below Ground Attenuation Tank	68.7	179.0	114
Permeable Paving/Surfacing	4.3	120.0	18
Underground Storage Sub-Total			**132**
Total	**270**		**459**

5.4.3 SuDS

The document 'Sustainable Urban Drainage Systems' (SuDS) published by CIRIA, document No. C521, was utilised for the surface water design strategy for the proposed development. The document encourages the use of a variety of alternative measures in the design of sustainable drainage systems, which take account of quality, quantity and amenity. These measures protect or enhance water quality, are sympathetic to the environment, provide a habitat for wildlife and encourage natural ground water recharge. They provide storage that not only attenuates the flow but also permits settlement of coarse silts. Runoff would also be treated by absorption of particles by aquatic vegetation or by soil, and by biological activity.

The SuDS features incorporated into the drainage design for the scheme include the following:

- Green/Blue Terrace;
- Green/Blue Roof;
- Permeable paving;
- Soft Landscaping
- SuDS Tree Pits

5.4.3.1 Green/Blue Roofs & Terraces

A typical extensive green roof build-up is included in Figure 5-4 below.

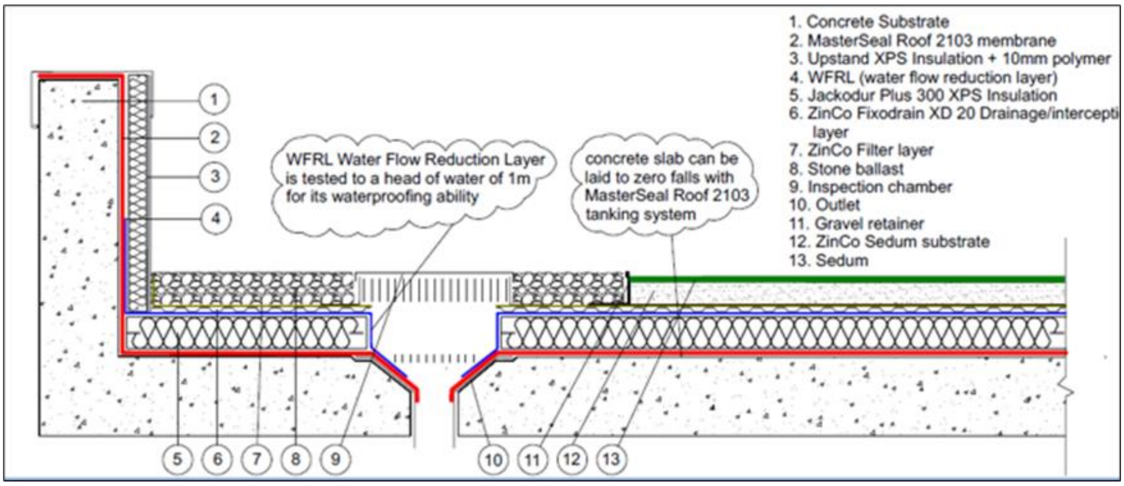


Figure 5-4 Typical Extensive Green Roof Detail

The proposed ABG D108 green/blue roof system build-up for the roofs and terraces is illustrated in Figure 5-5 below. The finishing no top of the blue roof storage layer would vary, depending on the final landscape layout and would be a mixture of soft and permeable hard surfaces, both contributing to surface water interception.

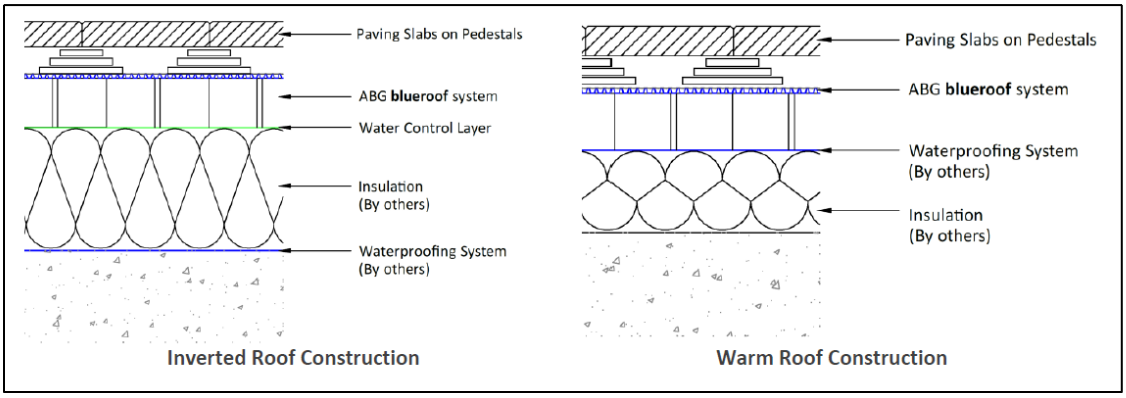


Figure 5-5 Blue Roof Detail – D108mm

The surface water drainage layout for the scheme is detailed in DBFL drawings no. 210178-DBFL-CS-SP-DR-C-1300 (Site Services) and 210178-DBFL-CS-SP-DR-C-1310 (Surface Water Catchment Plan).

5.4.3.2 Permeable Paving

The proposed design includes permeable paving finishes as indicated on drawings 210178-DBFL-CS-SP-DR-C-1310. Surface water runoff from the paved areas is intercepted by the permeable build-up of the paved areas where it is intended to naturally infiltrate into the ground. If the porous build-up of the paving and the in-situ material beneath becomes saturated, surface water would drain to the surface water pipe network through gullies and linear drains as indicated on drawing 210178-DBFL-CS-SP-DR-C-1300.

Permeable paving reduces pollutants such as petrol and diesel as it contributes to its biodegrading process. It also assists in filtering solid particles out of surface water runoff, providing filtration before discharging into the surface water pipe network and ultimately the receiving watercourse.

5.4.3.3 SuDS Tree Pits

Tree Pits are proposed to intercept excess surface water runoff from soft landscaping areas between buildings within the development. SuDS tree pit details as proposed are shown on drawing 210178-DBFL-CS-SP-DR-C-5303. Tree pits are slightly lowered below surrounding surface area to allow surface water to be directly intercepted at the base of the tree pit and infiltrate down to the tree root system. Once the tree pit is saturated, water would be routed to the surface water pipe network through an overflow as detailed on drawing 210178-DBFL-CS-SP-DR-C-5303.

5.4.4 Surface Water Drainage Design Standards

Surface water drainage for the proposed development is designed using the recommendations of the GDSDS, EN752 and BS8301:1985, with the following parameters applied:

• Return period for pipe network	2 years,
○ check 30-year 15 minute, no flooding;	
○ check 100-year flooding in designated areas;	
• Time of entry	4 minutes
• Pipe Friction (Ks) (concrete)	0.6 mm
• Minimum Velocity	1.0 m/s
• Standard Average Annual Rainfall	729mm
• M5-60	16.1mm
• Ratio r (M5-60/M5-2D)	0.278
• Storage System Storm Return Event	GDSDS Volume 2, p61, Criterion 3
○ 10-year no flooding on site;	
○ 30-year no flooding on site;	

- 100-year check no internal property flooding. Flood routing plan. FFL + 500mm freeboard above 100-year flood level. No flooding to adjacent areas.

Climate Change	20% for rainfall intensities.
C_v winter	0.84
C_v summer	0.75

(Note on C_v Factors; The DOE "Recommendations for Site Development Works" & BS8301:1985 note that the volumetric runoff coefficient Cv should be set at 0.6 for rapidly draining soils and 0.9 for heavy soils. Applying a Cv rate of 0.84 for Winter and 0.75 for Summer is standard practice and is appropriate for this site.

The *Network Module* of *Microdrainage* has been used to assess the performance of the proposed surface water network, attenuation structures and controlled discharge into the existing public surface water network in Richmond Road. This analysis indicated that the pipe sizes and grades are adequate for storm events up to the 1% AEP and that the underground cellular storage volume of 114m^3 cellular storage at ground level satisfies attenuation requirements along with the storage provided in the green/blue roofs and terraces.

Refer to **Appendix C** for *Microdrainage Network Module* calculations.

A breakdown of the impermeable areas contributing to the surface water drainage network is included in *Table 5-2* below;

Table 5-2 Impermeable Areas

Catchment 1 - 158A Richmond Road Development			
Surface Type	**Gross Area (ha)**	**Runoff Coefficient**	**Total Impermeable**
Green/Blue Roof	0.141	0.9	0.127
Green/Blue Podium	0.141	0.9	0.126
Footpaths on Green/Blue Podium	0.063	0.9	0.057
Roof Area (Traditional)	0.056	1.0	0.056
Permeable Paving	0.012	0.8	0.010
Soft Landscaped Areas	0.040	0.3	0.012
Hard Landscaping Areas	0.083	1.0	0.083
Total	**0.536**		**0.471**

The green/blue roof area and the green/blue terrace areas make up a total of **70%** of the total roof/terrace area as calculated in Table 5-3 below (0.141+0.141)/(0.40)*100 = 70%, satisfying the minimum 70% required by DCC for extensive green/blue roofs stipulated in the Green & Blue Roof Guide, 2021 and section 15.6.3 of the DCC Development Plan 2022 – 2028..

Table 5-3 Roof/Terrace Areas

Roof Area Breakdown	
Surface Type	**Gross Area (ha)**
Green/Blue Roof	0.141
Green/Blue Terrace	0.141
Footpaths on Green/Blue Terrace	0.063
Roof Area (Traditional)	0.056
Total	**0.40**

5.4.5 Interception and Treatment Storage

To prevent pollutants or sediments discharging into water courses the GDSDS requires “interception storage” to be incorporated into the development.

The volume of interception required is based on 5mm of rainfall depth from 80% of the runoff from impermeable areas as defined in GDSDS. The interception volume attributable to each SuDS feature consists of the volume of water that can infiltrate to the ground, evaporate into the atmosphere or can transpire through plants and vegetation. Additionally, there will be some losses of water due to absorption, wetting of stone and soil media.

Interception is provided as follows:

- Green/blue roof runoff is intercepted in the green roof build-up.
- Green/Blue terrace runoff is intercepted in the build-up of the green areas on the terrace and stone build-up of the hard terrace areas.
- Footpath runoff in landscaped areas at ground level are intercepted by the specified permeable paving or adjacent soft landscaping where impermeable paving is used.

All surfaced water collected from roads will pass through an appropriate petrol interceptor and grease trap, complying with the provision of 2 treatment stages mentioned within requirements of the CIRIA document C697.

5.5 Surface Water Management – Richmond Road Works

Surface water run-off from Richmond Road currently drains along the road in a south easterly direction as shown in Figure 5-6, where it drains into existing gullies connected to the existing 1350mm surface water sewer at the south eastern corner of the proposed development.

Figure 5-6 Richmond Road Works Surface Water Management

A new surface water sewer is proposed for the section of Richmond Road to be upgraded as indicated on drawing 210178-DBFL-CS-SP-DR-C-1300. The proposed 300mm surface water sewer would drain runoff from the road, footpaths and cycle tracks/lanes through road gullies and tie in at the same proposed manhole where the proposed development's surface water is proposed to discharge. All rainfall parameters for the Richmond Road works match the parameters for the internal surface water sewer network as listed in section 4.4.4.

Surface water network calculations for the Richmond Road surface water sewer network generated with the Micro-Drainage Network module are included in **Appendix C**.

5.6 Flood Risk

A separate '*Site Specific flood Risk Assessment*' (SSFRA) by DBFL Consulting Engineers, is included under separate cover, and addresses the flood protection measures for the proposed development.

5.7 DCC Surface Water Management Policies

The Surface Water Management Plan as detailed in this chapter satisfied the relevant surface water management policies as stipulated in *Chapter 9: Sustainable Environmental Infrastructure and Flood Risk* of the DCC Development Plan 2022 – 2028.

The relevant DCC surface water management policies are listed below:

SI7 Water Quality Status – Water quality enhanced by nature based drainage features

SI8 Physical Condition of Waterbodies - N/A

SI9 Groundwater Pollution – Groundwater pollution reduced through SuDS features

SI10 Managing Development Within and Adjacent to River Corridors – N/A

SI11 Managing Development Within and Adjacent to Camac River Corridor – N/A

SI12 River Restoration in Strategic Development and Regeneration Areas - N/A

SI13 Minimising Flood Risk – Addressed in the SSFRA

SI14 Strategic Flood Risk Assessment – Addressed in the SSFRA

SI15 Site-Specific Flood Risk Assessment – SSFRA as per the DCC 2022-2028 SFRA enclosed

SI16 Site-Specific Flood Risk Assessment– N/A

SI17 Catchment-Based Flood Risk Management Plans – Catchment plan drawing enclosed dr 210178-DBFL-SW-SP-DR-C-1310

SI18 Protection of Flood Alleviation Infrastructure

SI19 Provision and Upgrading of Flood Alleviation Assets – Flood wall provided as per dr 210178-DBFL-RD-SP-DR-C-5211

SI20 Basement Flood Risk Management – No Basement/ N/A

SI21 Managing Surface Water Flood Risk - SUDS and nature based solutions included as per section 5.4.3 of the Infrastructure Design Report

SI22 Sustainable Drainage Systems – included in design as per section 5.4.3 of the Infrastructure Design Report

SI23 Green Blue Roofs – Included in design as per section 5.4.3 of the Infrastructure Design Report

SI24 Control of Paving of Private Driveways / Vehicular Entrances / Grassed Areas

SI25 Surface Water Management – Included as part of this report

SI26 Taking in Charge of Private Drainage Infrastructure – Public Road drainage and connections will be to DCC standard. The Development will be private building drainage – it is assumed that building drainage does not need to be constructed to DCC standard (e.g. Ajs, Inspection chambers, attenuation storage etc)

6 FOUL DRAINAGE

There is an existing 900mm concrete foul sewer in Richmond Road. It is proposed to discharge foul flows from the development to the existing 900mm located on Richmond Road at the proposed site entrance at the existing manhole indicated in *Figure 6-1* below.

A pre-connection enquiry form for the subject site was issued to Irish Water and a copy of the Confirmation of Feasibility (COF) from Irish Water is included in **Appendix E.**

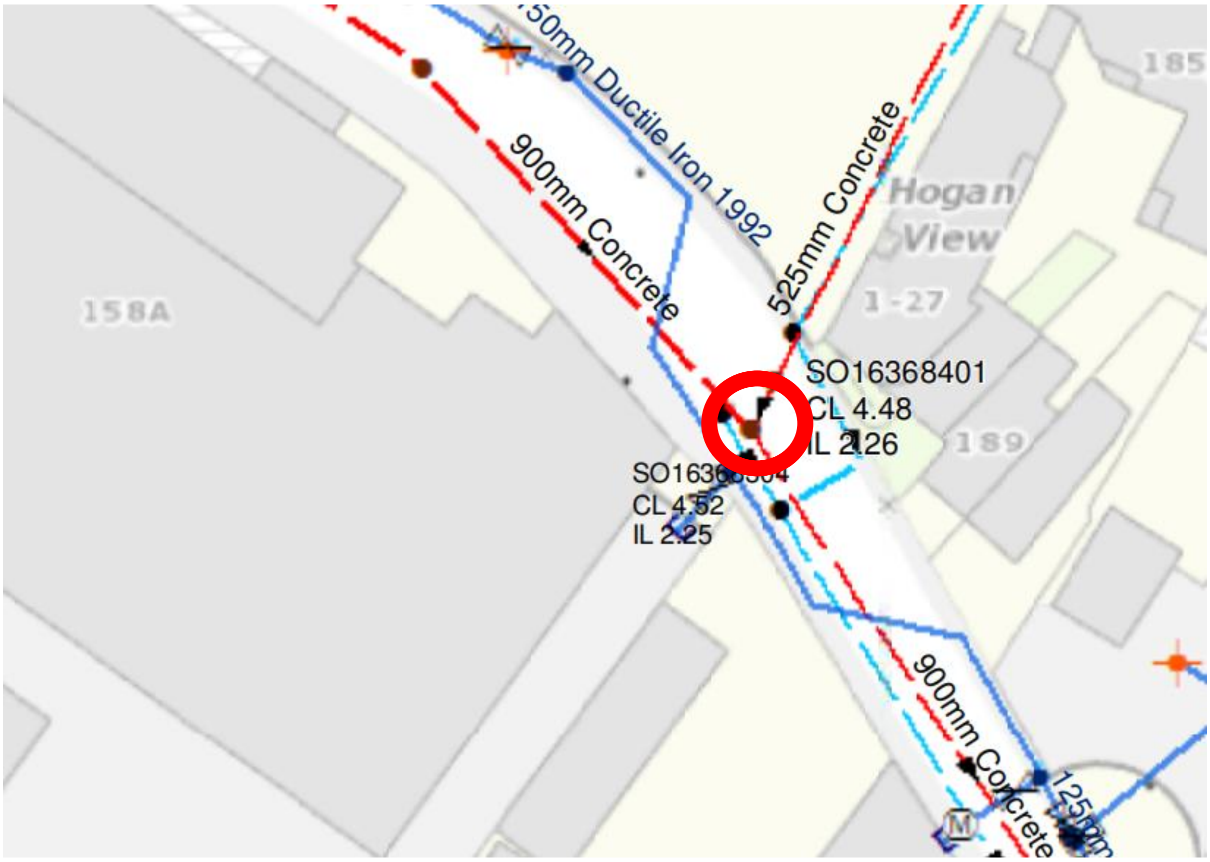


Figure 6-1 Extract of Irish Water Records (Foul connection)

In accordance with the conditions set by Irish Water within the confirmation of feasibility, foul and surface water flows from the development will be conveyed in separate networks.

The design of the foul water network was issued to Irish Water and the letter with the Statement of Design Acceptance from Irish Water is included in **Appendix F.**

Foul sewers have been designed in accordance with the Building Regulations and specifically in accordance with the principles and methods set out in the DOE "Recommendations for Site

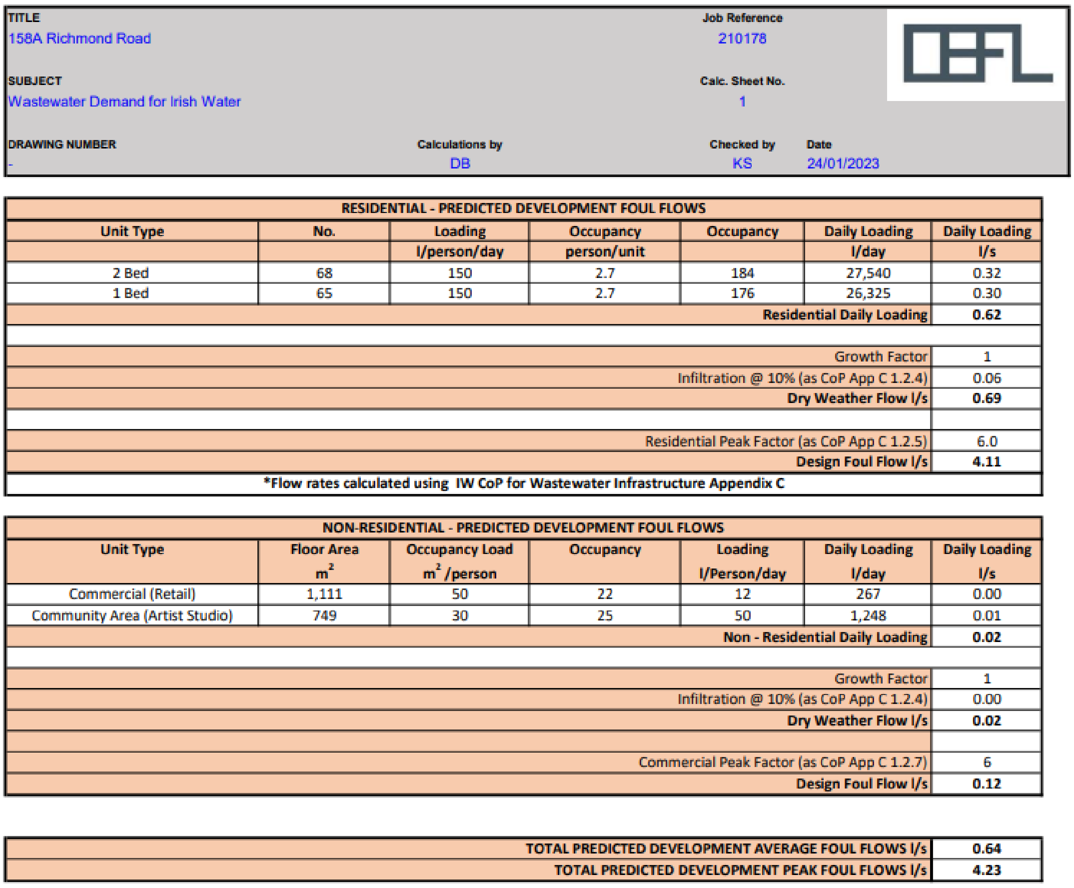
Development Works for Housing Areas", IS EN752 (2008), BS8301: 1985, IS EN12056: Part 2 (2000) and the recommendations of the 'Greater Dublin Strategic Drainage Study', (GDSDS).

The following criteria have been applied:

Demand	446l/house/day (Irish Water Code of Practice)
Discharge units	14 units per house (BS8301:1985)
Pipe Friction (Ks)	1.5 mm (concrete)
Pipe Friction (Ks)	0.15 mm (uPVC)
Minimum Velocity	0.75 m/s (self-cleansing velocity)
Maximum Velocity	3.0 m/s (1:20 maximum pipe gradient)
Frequency Factor	0.5 for domestic use

Estimated foul loading generated by the development are included in Table 6-1 below:

Table 6-1 Foul Loading Demand



TITLE
158A Richmond Road

SUBJECT
Wastewater Demand for Irish Water

DRAWING NUMBER
-

Job Reference 210178

Calc. Sheet No. 1

Calculations by DB

Checked by KS

Date 24/01/2023

RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Unit Type	**No.**	**Loading l/person/day**	**Occupancy person/unit**	**Occupancy**	**Daily Loading l/day**	**Daily Loading l/s**
2 Bed	68	150	2.7	184	27,540	0.32
1 Bed	65	150	2.7	176	26,325	0.30
					Residential Daily Loading	**0.62**
					Growth Factor	1
					Infiltration @ 10% (as CoP App C 1.2.4)	0.06
					Dry Weather Flow l/s	**0.69**
					Residential Peak Factor (as CoP App C 1.2.5)	6.0
					Design Foul Flow l/s	**4.11**
***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix C**						

NON-RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Unit Type	**Floor Area m^2**	**Occupancy Load m^2 /person**	**Occupancy**	**Loading l/Person/day**	**Daily Loading l/day**	**Daily Loading l/s**
Commercial (Retail)	1,111	50	22	12	267	0.00
Community Area (Artist Studio)	749	30	25	50	1,248	0.01
					Non - Residential Daily Loading	**0.02**
					Growth Factor	1
					Infiltration @ 10% (as CoP App C 1.2.4)	0.00
					Dry Weather Flow l/s	**0.02**
					Commercial Peak Factor (as CoP App C 1.2.7)	6
					Design Foul Flow l/s	**0.12**

TOTAL PREDICTED DEVELOPMENT AVERAGE FOUL FLOWS l/s	**0.64**
TOTAL PREDICTED DEVELOPMENT PEAK FOUL FLOWS l/s	**4.23**

Refer to **Appendix D** for the Micro Drainage Foul Drainage Network calculations.

7 WATER SUPPLY AND DISTRIBUTION

The water main distribution system for the development will connect to the existing 150mm diameter water main located in Richmond Road as shown in Figure 7-1. A pre-connection enquiry form for the subject site was issued to Irish Water and a copy of the Confirmation of Feasibility (COF) from Irish Water is included in **Appendix E**.

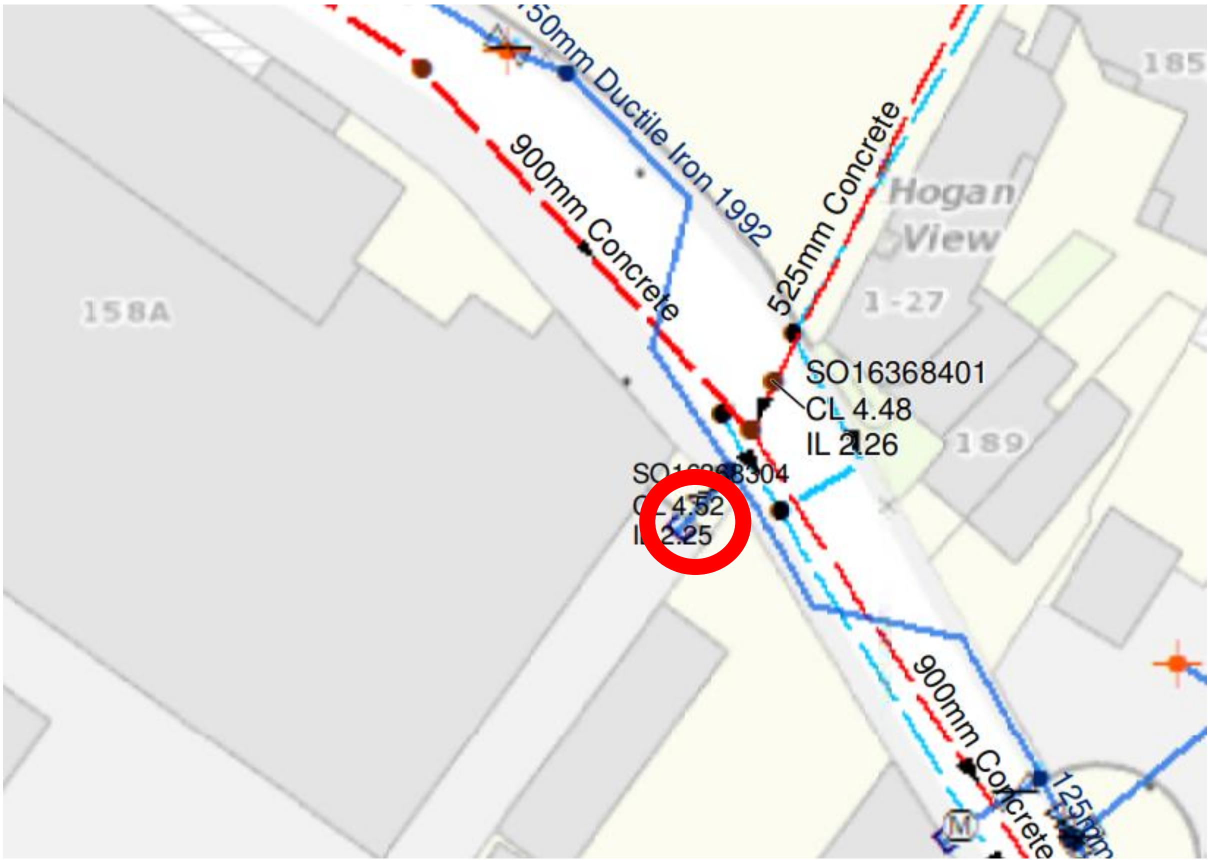
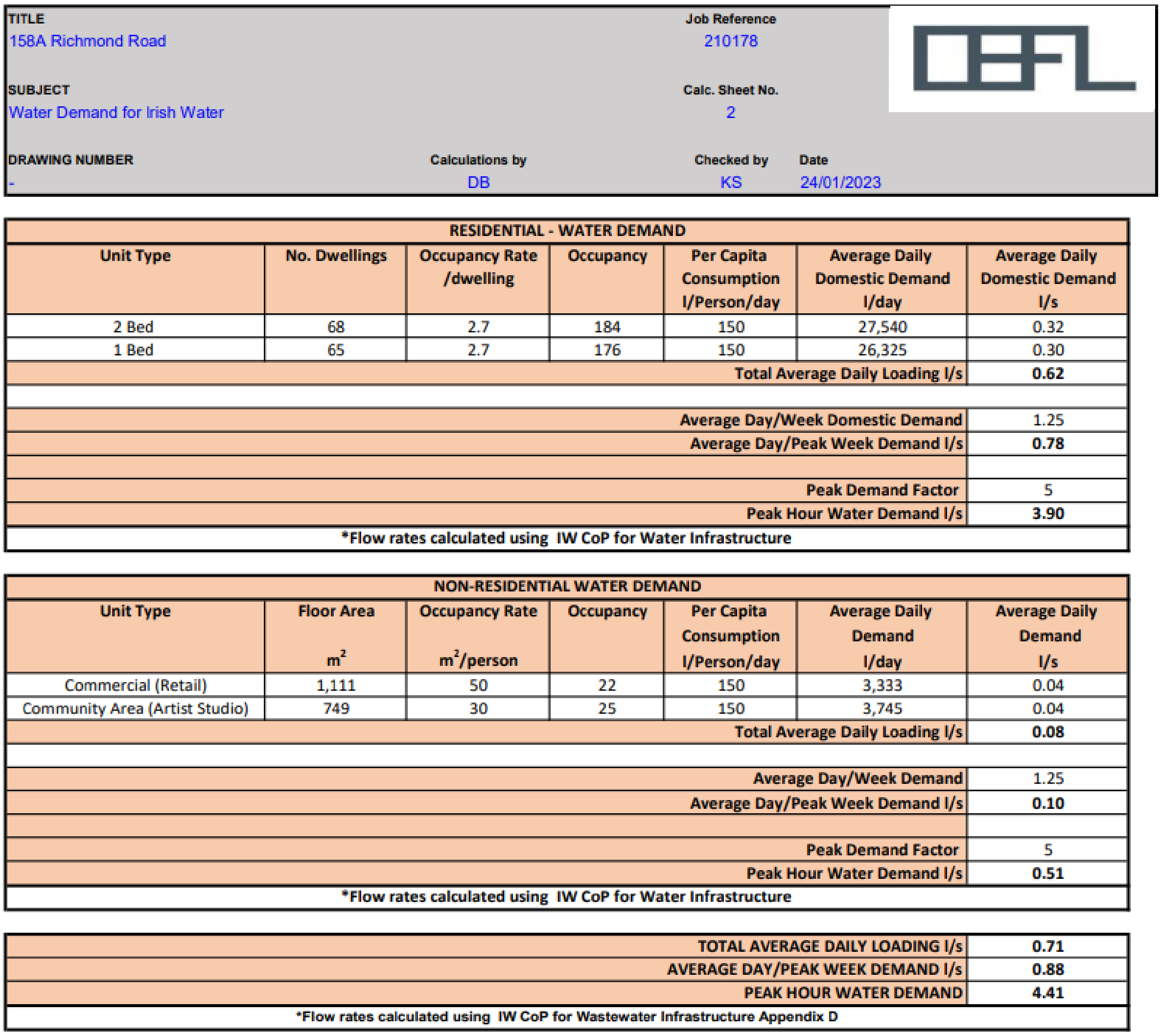


Figure 7-1 Extract of Irish Water Records (Water connection)

Water for firefighting purposes will be routed from the tank room to a separate sprinkler lank room on the ground floor of the site, from where water will be distributed internally to the sprinkler system. 2 Hydrants are located in Richmond Road within 46m of the proposed buildings for firefighting purposes.

The estimated water daily water demand generated by the development is included in Table 7-1 below.

Table 7-1 Water Demand



TITLE
158A Richmond Road

Job Reference
210178

SUBJECT
Water Demand for Irish Water

Calc. Sheet No.
2

DRAWING NUMBER
-

Calculations by
DB

Checked by
KS

Date
24/01/2023

RESIDENTIAL - WATER DEMAND						
Unit Type	**No. Dwellings**	**Occupancy Rate /dwelling**	**Occupancy**	**Per Capita Consumption l/Person/day**	**Average Daily Domestic Demand l/day**	**Average Daily Domestic Demand l/s**
2 Bed	68	2.7	184	150	27,540	0.32
1 Bed	65	2.7	176	150	26,325	0.30
					Total Average Daily Loading l/s	**0.62**
					Average Day/Week Domestic Demand	1.25
					Average Day/Peak Week Demand l/s	**0.78**
					Peak Demand Factor	5
					Peak Hour Water Demand l/s	**3.90**
***Flow rates calculated using IW CoP for Water Infrastructure**						

NON-RESIDENTIAL WATER DEMAND						
Unit Type	**Floor Area m^2**	**Occupancy Rate m^2/person**	**Occupancy**	**Per Capita Consumption l/Person/day**	**Average Daily Demand l/day**	**Average Daily Demand l/s**
Commercial (Retail)	1,111	50	22	150	3,333	0.04
Community Area (Artist Studio)	749	30	25	150	3,745	0.04
					Total Average Daily Loading l/s	**0.08**
					Average Day/Week Demand	1.25
					Average Day/Peak Week Demand l/s	**0.10**
					Peak Demand Factor	5
					Peak Hour Water Demand l/s	**0.51**
***Flow rates calculated using IW CoP for Water Infrastructure**						

TOTAL AVERAGE DAILY LOADING l/s	**0.71**
AVERAGE DAY/PEAK WEEK DEMAND l/s	**0.88**
PEAK HOUR WATER DEMAND	**4.41**
***Flow rates calculated using IW CoP for Wastewater Infrastructure Appendix D**	

The design of the watermain was issued to Irish Water and the letter with the Statement of Design Acceptance from Irish Water is included in **Appendix F.**

Appendix A : Met Eireann Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 316654, Northing: 236444,

	Interval		Years													
DURATION	6months	1year	2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	2.5	3.6	4.1	5.0	5.6	6.0	7.5	9.2	10.3	11.8	13.2	14.3	16.0	17.3	18.4	N/A
10 mins	3.5	5.0	5.7	6.9	7.7	8.4	10.4	12.8	14.3	16.5	18.4	20.0	22.3	24.1	25.6	N/A
15 mins	4.1	5.8	6.8	8.2	9.1	9.8	12.3	15.0	16.8	19.4	21.7	23.5	26.2	28.4	30.2	N/A
30 mins	5.4	7.6	8.8	10.5	11.7	12.6	15.5	18.9	21.1	24.2	26.9	29.0	32.3	34.8	36.9	N/A
1 hours	7.2	9.9	11.4	13.5	15.0	16.1	19.7	23.8	26.4	30.1	33.4	35.9	39.8	42.7	45.2	N/A
2 hours	9.5	12.9	14.7	17.4	19.2	20.6	25.0	29.9	33.1	37.5	41.4	44.4	49.0	52.5	55.4	N/A
3 hours	11.2	15.1	17.2	20.2	22.2	23.7	28.7	34.2	37.7	42.6	46.9	50.2	55.3	59.2	62.3	N/A
4 hours	12.6	16.9	19.1	22.4	24.6	26.3	31.7	37.6	41.4	46.7	51.3	54.9	60.3	64.4	67.8	N/A
6 hours	14.8	19.7	22.3	26.0	28.5	30.3	36.4	43.0	47.2	53.1	58.2	62.1	68.1	72.6	76.3	N/A
9 hours	17.4	23.0	25.9	30.1	32.9	35.0	41.8	49.1	53.9	60.4	66.0	70.3	76.9	81.8	85.9	N/A
12 hours	19.5	25.7	28.9	33.5	36.5	38.8	46.1	54.0	59.1	66.1	72.2	76.8	83.8	89.1	93.5	N/A
18 hours	23.0	30.0	33.6	38.8	42.2	44.8	53.0	61.8	67.5	75.2	81.9	87.0	94.6	100.5	105.2	N/A
24 hours	25.8	33.5	37.4	43.1	46.8	49.6	58.4	68.0	74.1	82.3	89.5	95.0	103.2	109.4	114.5	131.8
2 days	31.6	40.2	44.6	50.8	54.9	57.9	67.5	77.7	84.1	92.9	100.4	106.0	114.5	120.9	126.2	143.8
3 days	36.2	45.7	50.4	57.1	61.4	64.7	74.8	85.6	92.4	101.6	109.4	115.3	124.1	130.8	136.2	154.4
4 days	40.2	50.4	55.4	62.5	67.1	70.5	81.3	92.6	99.7	109.2	117.4	123.5	132.6	139.5	145.0	163.7
6 days	47.3	58.6	64.1	72.0	77.0	80.7	92.4	104.6	112.2	122.5	131.2	137.7	147.3	154.6	160.5	180.1
8 days	53.5	65.8	71.8	80.2	85.6	89.6	102.1	115.1	123.2	134.0	143.2	150.0	160.2	167.8	173.9	194.5
10 days	59.1	72.3	78.7	87.7	93.4	97.7	110.9	124.6	133.1	144.4	154.0	161.1	171.8	179.7	186.1	207.4
12 days	64.4	78.4	85.2	94.6	100.7	105.2	119.0	133.3	142.2	154.0	164.0	171.4	182.4	190.6	197.3	219.3
16 days	74.2	89.5	97.0	107.3	113.9	118.8	133.8	149.3	158.8	171.5	182.2	190.1	201.8	210.5	217.6	240.9
20 days	83.1	99.8	107.8	119.0	126.0	131.3	147.3	163.8	173.9	187.3	198.6	207.0	219.4	228.5	235.9	260.4
25 days	93.6	111.7	120.4	132.4	140.0	145.7	162.8	180.4	191.2	205.5	217.5	226.4	239.5	249.2	257.0	282.7

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Appendix B : Surface Water Storage Calculations [Micro Drainage Cascade Source Control]

Cascade Summary of Results for 220830 Cellular Tank.SRCX

Upstream Structures	**Outflow To**	**Overflow To**
220830 GreenBlue Podium (P3).SRCX	(None)	(None)
220830 GreenBlue Podium (P4).SRCX		
220830 GreenBlue Podium (P5).SRCX		
220830 GreenBlue Podium (P6).SRCX		
220830 GreenBlue Podium (P7).SRCX		
220830 GreenBlue Roof (G1).SRCX		
220830 GreenBlue Roof (G2).SRCX		
220830 GreenBlue Roof (G3).SRCX		
230106 PermPaving.SRCX		
220830 GreenBlue Podium (P8).SRCX		
220830 GreenBlue Roof (G4).SRCX		
220830 GreenBlue Roof (G5).SRCX		

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
15 min Summer	3.272	0.100	1.9	18.1	O K
30 min Summer	3.309	0.137	1.9	24.6	O K
60 min Summer	3.346	0.174	2.0	31.3	O K
120 min Summer	3.385	0.213	2.0	38.3	O K
180 min Summer	3.408	0.236	2.0	42.5	O K
240 min Summer	3.425	0.253	2.0	45.5	O K
360 min Summer	3.448	0.276	2.0	49.6	O K
480 min Summer	3.463	0.291	2.0	52.4	O K
600 min Summer	3.474	0.302	2.0	54.4	O K
720 min Summer	3.482	0.310	2.0	55.7	O K
960 min Summer	3.489	0.317	2.0	57.0	O K

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
15 min Summer	84.523	0.0	39.2	18
30 min Summer	58.468	0.0	57.6	33
60 min Summer	38.020	0.0	94.2	62
120 min Summer	23.997	0.0	121.7	122
180 min Summer	18.178	0.0	139.4	182
240 min Summer	14.896	0.0	152.8	242
360 min Summer	11.219	0.0	172.8	362
480 min Summer	9.163	0.0	187.8	482
600 min Summer	7.826	0.0	199.6	602
720 min Summer	6.878	0.0	209.2	722
960 min Summer	5.608	0.0	224.1	960

Cascade Summary of Results for 220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
1440 min Summer	3.490	0.318	2.0	57.2	O K
2160 min Summer	3.484	0.312	2.0	56.1	O K
2880 min Summer	3.473	0.301	2.0	54.1	O K
4320 min Summer	3.441	0.269	2.0	48.3	O K
5760 min Summer	3.404	0.232	2.0	41.8	O K
7200 min Summer	3.370	0.198	2.0	35.6	O K
8640 min Summer	3.339	0.167	2.0	30.1	O K
10080 min Summer	3.314	0.142	2.0	25.5	O K
15 min Winter	3.285	0.113	1.9	20.3	O K
30 min Winter	3.327	0.155	2.0	27.8	O K
60 min Winter	3.370	0.198	2.0	35.6	O K
120 min Winter	3.415	0.243	2.0	43.8	O K
180 min Winter	3.443	0.271	2.0	48.9	O K
240 min Winter	3.464	0.292	2.0	52.6	O K
360 min Winter	3.494	0.322	2.0	57.9	O K
480 min Winter	3.514	0.342	2.0	61.6	O K
600 min Winter	3.528	0.356	2.0	64.1	O K
720 min Winter	3.538	0.366	2.0	65.9	O K
960 min Winter	3.550	0.378	2.0	68.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
1440 min Summer	4.204	0.0	242.5	1224
2160 min Summer	3.150	0.0	323.6	1600
2880 min Summer	2.565	0.0	344.9	1988
4320 min Summer	1.917	0.0	368.5	2764
5760 min Summer	1.558	0.0	458.0	3520
7200 min Summer	1.326	0.0	483.2	4256
8640 min Summer	1.162	0.0	501.3	4960
10080 min Summer	1.039	0.0	512.7	5648
15 min Winter	84.523	0.0	44.8	18
30 min Winter	58.468	0.0	65.8	33
60 min Winter	38.020	0.0	106.9	62
120 min Winter	23.997	0.0	137.6	122
180 min Winter	18.178	0.0	157.3	182
240 min Winter	14.896	0.0	172.2	240
360 min Winter	11.219	0.0	194.3	360
480 min Winter	9.163	0.0	210.4	478
600 min Winter	7.826	0.0	223.0	596
720 min Winter	6.878	0.0	233.2	712
960 min Winter	5.608	0.0	248.6	942

Cascade Summary of Results for 220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
1440 min Winter	3.554	0.382	2.0	68.7	O K
2160 min Winter	3.535	0.363	2.0	65.4	O K
2880 min Winter	3.513	0.341	2.0	61.5	O K
4320 min Winter	3.455	0.283	2.0	50.9	O K
5760 min Winter	3.393	0.221	2.0	39.7	O K
7200 min Winter	3.341	0.169	2.0	30.5	O K
8640 min Winter	3.302	0.130	1.9	23.4	O K
10080 min Winter	3.274	0.102	1.9	18.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
1440 min Winter	4.204	0.0	266.9	1380
2160 min Winter	3.150	0.0	359.6	1752
2880 min Winter	2.565	0.0	382.0	2164
4320 min Winter	1.917	0.0	408.0	2984
5760 min Winter	1.558	0.0	512.0	3744
7200 min Winter	1.326	0.0	538.6	4400
8640 min Winter	1.162	0.0	557.6	5104
10080 min Winter	1.039	0.0	569.6	5752

Cascade Rainfall Details for 220830 Cellular Tank.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.120

Time (mins) From:	To:	Area (ha)
0	4	0.120

Cascade Model Details for 220830 Cellular Tank.SRCX

Storage is Online Cover Level (m) 4.100

Tank or Pond Structure

Invert Level (m) 3.172

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	0.660	180.0	0.661	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-2000-0776-2000
Design Head (m)	0.776
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	3.156
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.776	2.0	Kick-Flo®	0.493	1.6
Flush-Flo™	0.232	2.0	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	4.0	7.500	5.7
0.300	2.0	1.600	2.8	4.000	4.3	8.000	5.9
0.400	1.9	1.800	2.9	4.500	4.5	8.500	6.1
0.500	1.6	2.000	3.1	5.000	4.7	9.000	6.3
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.1		
1.000	2.2	2.600	3.5	6.500	5.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P3).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.664	0.014	0.0	3.5	Flood Risk
30 min Summer	9.669	0.019	0.1	4.8	Flood Risk
60 min Summer	9.675	0.025	0.1	6.1	Flood Risk
120 min Summer	9.680	0.030	0.1	7.4	Flood Risk
180 min Summer	9.683	0.033	0.2	8.2	Flood Risk
240 min Summer	9.685	0.035	0.2	8.7	Flood Risk
360 min Summer	9.687	0.037	0.2	9.2	Flood Risk
480 min Summer	9.688	0.038	0.2	9.5	Flood Risk
600 min Summer	9.689	0.039	0.2	9.8	Flood Risk
720 min Summer	9.690	0.040	0.2	10.0	Flood Risk
960 min Summer	9.691	0.041	0.2	10.2	Flood Risk
1440 min Summer	9.692	0.042	0.2	10.4	Flood Risk
2160 min Summer	9.692	0.042	0.2	10.4	Flood Risk
2880 min Summer	9.691	0.041	0.2	10.1	Flood Risk
4320 min Summer	9.688	0.038	0.2	9.4	Flood Risk
5760 min Summer	9.685	0.035	0.2	8.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	2.0	19
30 min Summer	58.468	0.0	3.0	34
60 min Summer	38.020	0.0	5.1	64
120 min Summer	23.997	0.0	6.7	122
180 min Summer	18.178	0.0	7.7	182
240 min Summer	14.896	0.0	8.5	242
360 min Summer	11.219	0.0	9.7	354
480 min Summer	9.163	0.0	10.6	406
600 min Summer	7.826	0.0	11.3	464
720 min Summer	6.878	0.0	11.9	526
960 min Summer	5.608	0.0	13.0	662
1440 min Summer	4.204	0.0	14.4	936
2160 min Summer	3.150	0.0	17.8	1340
2880 min Summer	2.565	0.0	19.3	1732
4320 min Summer	1.917	0.0	21.2	2508
5760 min Summer	1.558	0.0	24.2	3280

Cascade Summary of Results for 220830 GreenBlue Podium (P3).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	9.683	0.033	0.2	8.1	Flood Risk
8640 min Summer	9.681	0.031	0.1	7.6	Flood Risk
10080 min Summer	9.679	0.029	0.1	7.2	Flood Risk
15 min Winter	9.666	0.016	0.1	3.9	Flood Risk
30 min Winter	9.671	0.021	0.1	5.3	Flood Risk
60 min Winter	9.677	0.027	0.1	6.8	Flood Risk
120 min Winter	9.684	0.034	0.2	8.3	Flood Risk
180 min Winter	9.687	0.037	0.2	9.2	Flood Risk
240 min Winter	9.689	0.039	0.2	9.8	Flood Risk
360 min Winter	9.692	0.042	0.2	10.4	Flood Risk
480 min Winter	9.693	0.043	0.2	10.7	Flood Risk
600 min Winter	9.694	0.044	0.2	11.0	Flood Risk
720 min Winter	9.695	0.045	0.2	11.1	Flood Risk
960 min Winter	9.696	0.046	0.2	11.3	Flood Risk
1440 min Winter	9.696	0.046	0.2	11.3	Flood Risk
2160 min Winter	9.694	0.044	0.2	10.9	Flood Risk
2880 min Winter	9.692	0.042	0.2	10.3	Flood Risk
4320 min Winter	9.687	0.037	0.2	9.2	Flood Risk
5760 min Winter	9.683	0.033	0.2	8.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.326	0.0	25.6	3968
8640 min Summer	1.162	0.0	26.8	4752
10080 min Summer	1.039	0.0	27.7	5448
15 min Winter	84.523	0.0	2.3	19
30 min Winter	58.468	0.0	3.5	33
60 min Winter	38.020	0.0	5.9	62
120 min Winter	23.997	0.0	7.6	120
180 min Winter	18.178	0.0	8.7	178
240 min Winter	14.896	0.0	9.6	234
360 min Winter	11.219	0.0	11.0	346
480 min Winter	9.163	0.0	12.0	448
600 min Winter	7.826	0.0	12.8	480
720 min Winter	6.878	0.0	13.5	556
960 min Winter	5.608	0.0	14.6	710
1440 min Winter	4.204	0.0	16.2	1010
2160 min Winter	3.150	0.0	20.0	1444
2880 min Winter	2.565	0.0	21.7	1848
4320 min Winter	1.917	0.0	23.9	2636
5760 min Winter	1.558	0.0	27.1	3400

Cascade Summary of Results for 220830 GreenBlue Podium (P3).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Winter	9.680	0.030	0.1	7.5	Flood Risk
8640 min Winter	9.678	0.028	0.1	6.8	Flood Risk
10080 min Winter	9.676	0.026	0.1	6.4	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Winter	1.326	0.0	28.8	4112
8640 min Winter	1.162	0.0	30.1	4848
10080 min Winter	1.039	0.0	31.1	5552

Cascade Rainfall Details for 220830 GreenBlue Podium (P3).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.022

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.022

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Podium (P3).SRCX

Storage is Online Cover Level (m) 9.850

Tank or Pond Structure

Invert Level (m) 9.650

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	248.0	0.108	248.0	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	9.650
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P4).SRCX

Upstream Structures	**Outflow To**	**Overflow To**
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
15 min Summer	23.764	0.014	0.0	2.0	Flood Risk
30 min Summer	23.769	0.019	0.1	2.8	Flood Risk
60 min Summer	23.774	0.024	0.1	3.5	Flood Risk
120 min Summer	23.779	0.029	0.1	4.2	Flood Risk
180 min Summer	23.781	0.031	0.1	4.5	Flood Risk
240 min Summer	23.782	0.032	0.2	4.7	Flood Risk
360 min Summer	23.784	0.034	0.2	5.0	Flood Risk
480 min Summer	23.785	0.035	0.2	5.1	Flood Risk
600 min Summer	23.785	0.035	0.2	5.2	Flood Risk
720 min Summer	23.786	0.036	0.2	5.3	Flood Risk
960 min Summer	23.786	0.036	0.2	5.3	Flood Risk
1440 min Summer	23.786	0.036	0.2	5.2	Flood Risk
2160 min Summer	23.784	0.034	0.2	5.0	Flood Risk
2880 min Summer	23.782	0.032	0.1	4.7	Flood Risk
4320 min Summer	23.778	0.028	0.1	4.2	Flood Risk
5760 min Summer	23.776	0.026	0.1	3.8	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
15 min Summer	84.523	0.0	1.4	19
30 min Summer	58.468	0.0	2.1	33
60 min Summer	38.020	0.0	3.3	62
120 min Summer	23.997	0.0	4.2	122
180 min Summer	18.178	0.0	4.9	180
240 min Summer	14.896	0.0	5.3	216
360 min Summer	11.219	0.0	6.1	276
480 min Summer	9.163	0.0	6.6	340
600 min Summer	7.826	0.0	7.1	408
720 min Summer	6.878	0.0	7.5	476
960 min Summer	5.608	0.0	8.1	614
1440 min Summer	4.204	0.0	9.1	880
2160 min Summer	3.150	0.0	10.7	1276
2880 min Summer	2.565	0.0	11.6	1644
4320 min Summer	1.917	0.0	12.9	2380
5760 min Summer	1.558	0.0	14.4	3112

Cascade Summary of Results for 220830 GreenBlue Podium (P4).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
7200 min Summer	23.774	0.024	0.1	3.5	Flood Risk
8640 min Summer	23.772	0.022	0.1	3.3	Flood Risk
10080 min Summer	23.771	0.021	0.1	3.1	Flood Risk
15 min Winter	23.765	0.015	0.1	2.3	Flood Risk
30 min Winter	23.771	0.021	0.1	3.1	Flood Risk
60 min Winter	23.777	0.027	0.1	3.9	Flood Risk
120 min Winter	23.782	0.032	0.2	4.7	Flood Risk
180 min Winter	23.785	0.035	0.2	5.1	Flood Risk
240 min Winter	23.786	0.036	0.2	5.3	Flood Risk
360 min Winter	23.788	0.038	0.2	5.6	Flood Risk
480 min Winter	23.789	0.039	0.2	5.7	Flood Risk
600 min Winter	23.789	0.039	0.2	5.8	Flood Risk
720 min Winter	23.789	0.039	0.2	5.8	Flood Risk
960 min Winter	23.789	0.039	0.2	5.7	Flood Risk
1440 min Winter	23.787	0.037	0.2	5.4	Flood Risk
2160 min Winter	23.784	0.034	0.2	5.0	Flood Risk
2880 min Winter	23.781	0.031	0.1	4.5	Flood Risk
4320 min Winter	23.776	0.026	0.1	3.9	Flood Risk
5760 min Winter	23.773	0.023	0.1	3.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
7200 min Summer	1.326	0.0	15.3	3824
8640 min Summer	1.162	0.0	16.0	4576
10080 min Summer	1.039	0.0	16.6	5248
15 min Winter	84.523	0.0	1.6	19
30 min Winter	58.468	0.0	2.4	33
60 min Winter	38.020	0.0	3.7	62
120 min Winter	23.997	0.0	4.8	118
180 min Winter	18.178	0.0	5.5	174
240 min Winter	14.896	0.0	6.0	228
360 min Winter	11.219	0.0	6.8	286
480 min Winter	9.163	0.0	7.5	362
600 min Winter	7.826	0.0	8.0	438
720 min Winter	6.878	0.0	8.4	512
960 min Winter	5.608	0.0	9.2	658
1440 min Winter	4.204	0.0	10.3	938
2160 min Winter	3.150	0.0	12.1	1340
2880 min Winter	2.565	0.0	13.1	1728
4320 min Winter	1.917	0.0	14.5	2464
5760 min Winter	1.558	0.0	16.1	3176

Cascade Summary of Results for 220830 GreenBlue Podium (P4).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	23.771	0.021	0.1	3.1	Flood Risk
8640 min Winter	23.770	0.020	0.1	2.9	Flood Risk
10080 min Winter	23.768	0.018	0.1	2.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	17.1	3888
8640 min Winter	1.162	0.0	18.0	4584
10080 min Winter	1.039	0.0	18.6	5440

Cascade Rainfall Details for 220830 GreenBlue Podium (P4).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.013

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.013

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Podium (P4).SRCX

Storage is Online Cover Level (m) 23.950

Tank or Pond Structure

Invert Level (m) 23.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	147.3	0.108	147.3	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	23.750
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P5).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.214	0.014	0.0	14.2	Flood Risk
30 min Summer	9.220	0.020	0.1	19.7	Flood Risk
60 min Summer	9.225	0.025	0.1	25.5	Flood Risk
120 min Summer	9.232	0.032	0.1	31.9	Flood Risk
180 min Summer	9.236	0.036	0.2	35.9	Flood Risk
240 min Summer	9.239	0.039	0.2	39.0	Flood Risk
360 min Summer	9.243	0.043	0.2	43.4	Flood Risk
480 min Summer	9.246	0.046	0.2	46.6	Flood Risk
600 min Summer	9.249	0.049	0.2	49.1	Flood Risk
720 min Summer	9.251	0.051	0.2	51.1	Flood Risk
960 min Summer	9.254	0.054	0.2	54.3	Flood Risk
1440 min Summer	9.258	0.058	0.2	58.6	Flood Risk
2160 min Summer	9.262	0.062	0.2	62.1	Flood Risk
2880 min Summer	9.264	0.064	0.2	64.0	Flood Risk
4320 min Summer	9.266	0.066	0.2	66.2	Flood Risk
5760 min Summer	9.267	0.067	0.2	67.1	Flood Risk
7200 min Summer	9.267	0.067	0.2	67.3	Flood Risk
8640 min Summer	9.267	0.067	0.2	66.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	3.4	19
30 min Summer	58.468	0.0	5.5	34
60 min Summer	38.020	0.0	12.7	64
120 min Summer	23.997	0.0	16.9	124
180 min Summer	18.178	0.0	19.5	184
240 min Summer	14.896	0.0	21.3	244
360 min Summer	11.219	0.0	23.8	362
480 min Summer	9.163	0.0	25.4	482
600 min Summer	7.826	0.0	26.4	602
720 min Summer	6.878	0.0	27.0	722
960 min Summer	5.608	0.0	27.4	962
1440 min Summer	4.204	0.0	26.2	1442
2160 min Summer	3.150	0.0	51.5	2160
2880 min Summer	2.565	0.0	51.2	2508
4320 min Summer	1.917	0.0	46.2	3288
5760 min Summer	1.558	0.0	86.6	4088
7200 min Summer	1.326	0.0	89.1	4904
8640 min Summer	1.162	0.0	89.1	5712

Cascade Summary of Results for 220830 GreenBlue Podium (P5).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.266	0.066	0.2	66.2	Flood Risk
15 min Winter	9.216	0.016	0.1	15.9	Flood Risk
30 min Winter	9.222	0.022	0.1	22.0	Flood Risk
60 min Winter	9.228	0.028	0.1	28.5	Flood Risk
120 min Winter	9.236	0.036	0.2	35.7	Flood Risk
180 min Winter	9.240	0.040	0.2	40.3	Flood Risk
240 min Winter	9.244	0.044	0.2	43.7	Flood Risk
360 min Winter	9.249	0.049	0.2	48.7	Flood Risk
480 min Winter	9.252	0.052	0.2	52.4	Flood Risk
600 min Winter	9.255	0.055	0.2	55.3	Flood Risk
720 min Winter	9.258	0.058	0.2	57.7	Flood Risk
960 min Winter	9.261	0.061	0.2	61.5	Flood Risk
1440 min Winter	9.266	0.066	0.2	66.6	Flood Risk
2160 min Winter	9.271	0.071	0.2	71.1	Flood Risk
2880 min Winter	9.273	0.073	0.2	73.4	Flood Risk
4320 min Winter	9.275	0.075	0.2	75.0	Flood Risk
5760 min Winter	9.275	0.075	0.2	75.5	Flood Risk
7200 min Winter	9.275	0.075	0.2	75.1	Flood Risk
8640 min Winter	9.274	0.074	0.2	73.9	Flood Risk
10080 min Winter	9.272	0.072	0.2	72.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.039	0.0	86.9	6560
15 min Winter	84.523	0.0	4.0	19
30 min Winter	58.468	0.0	6.5	34
60 min Winter	38.020	0.0	14.7	64
120 min Winter	23.997	0.0	19.3	122
180 min Winter	18.178	0.0	22.0	182
240 min Winter	14.896	0.0	24.0	240
360 min Winter	11.219	0.0	26.5	358
480 min Winter	9.163	0.0	27.8	476
600 min Winter	7.826	0.0	28.5	594
720 min Winter	6.878	0.0	28.8	710
960 min Winter	5.608	0.0	28.5	944
1440 min Winter	4.204	0.0	26.2	1402
2160 min Winter	3.150	0.0	54.6	2080
2880 min Winter	2.565	0.0	53.0	2740
4320 min Winter	1.917	0.0	46.8	3628
5760 min Winter	1.558	0.0	95.3	4440
7200 min Winter	1.326	0.0	96.7	5400
8640 min Winter	1.162	0.0	95.2	6304
10080 min Winter	1.039	0.0	91.4	7168

Cascade Rainfall Details for 220830 GreenBlue Podium (P5).SRCX

```
          Rainfall Model                  FSR        Winter Storms   Yes
   Return Period (years)                  100          Cv (Summer) 0.750
                  Region Scotland and Ireland          Cv (Winter) 0.840
               M5-60 (mm)              16.100 Shortest Storm (mins)    15
                 Ratio R                0.278  Longest Storm (mins) 10080
          Summer Storms                   Yes     Climate Change %   +20
```

Time Area Diagram

Total Area (ha) 0.090

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.090

Cascade Model Details for 220830 GreenBlue Podium (P5).SRCX

Storage is Online Cover Level (m) 9.400

Tank or Pond Structure

Invert Level (m) 9.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1002.0	0.108	1002.0	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	9.200
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.109	0.2
Flush-Flo™	0.046	0.2
Kick-Flo®	0.079	0.2
Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P6).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	22.563	0.013	0.0	1.4	Flood Risk
30 min Summer	22.567	0.017	0.1	1.9	Flood Risk
60 min Summer	22.572	0.022	0.1	2.4	Flood Risk
120 min Summer	22.575	0.025	0.1	2.8	Flood Risk
180 min Summer	22.577	0.027	0.1	3.0	Flood Risk
240 min Summer	22.578	0.028	0.1	3.1	Flood Risk
360 min Summer	22.580	0.030	0.1	3.3	Flood Risk
480 min Summer	22.580	0.030	0.1	3.4	Flood Risk
600 min Summer	22.581	0.031	0.1	3.4	Flood Risk
720 min Summer	22.581	0.031	0.1	3.4	Flood Risk
960 min Summer	22.581	0.031	0.1	3.4	Flood Risk
1440 min Summer	22.579	0.029	0.1	3.3	Flood Risk
2160 min Summer	22.577	0.027	0.1	3.0	Flood Risk
2880 min Summer	22.576	0.026	0.1	2.8	Flood Risk
4320 min Summer	22.573	0.023	0.1	2.5	Flood Risk
5760 min Summer	22.571	0.021	0.1	2.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	1.0	19
30 min Summer	58.468	0.0	1.6	33
60 min Summer	38.020	0.0	2.3	62
120 min Summer	23.997	0.0	3.0	120
180 min Summer	18.178	0.0	3.4	162
240 min Summer	14.896	0.0	3.8	190
360 min Summer	11.219	0.0	4.3	254
480 min Summer	9.163	0.0	4.7	322
600 min Summer	7.826	0.0	5.0	390
720 min Summer	6.878	0.0	5.3	458
960 min Summer	5.608	0.0	5.7	590
1440 min Summer	4.204	0.0	6.4	852
2160 min Summer	3.150	0.0	7.5	1232
2880 min Summer	2.565	0.0	8.1	1588
4320 min Summer	1.917	0.0	9.0	2336
5760 min Summer	1.558	0.0	10.0	3056

Cascade Summary of Results for 220830 GreenBlue Podium (P6).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
7200 min Summer	22.569	0.019	0.1	2.1	Flood Risk
8640 min Summer	22.568	0.018	0.1	2.0	Flood Risk
10080 min Summer	22.567	0.017	0.1	1.9	Flood Risk
15 min Winter	22.564	0.014	0.0	1.6	Flood Risk
30 min Winter	22.569	0.019	0.1	2.1	Flood Risk
60 min Winter	22.574	0.024	0.1	2.7	Flood Risk
120 min Winter	22.579	0.029	0.1	3.2	Flood Risk
180 min Winter	22.580	0.030	0.1	3.4	Flood Risk
240 min Winter	22.581	0.031	0.1	3.5	Flood Risk
360 min Winter	22.583	0.033	0.2	3.6	Flood Risk
480 min Winter	22.583	0.033	0.2	3.7	Flood Risk
600 min Winter	22.583	0.033	0.2	3.7	Flood Risk
720 min Winter	22.583	0.033	0.2	3.6	Flood Risk
960 min Winter	22.582	0.032	0.1	3.5	Flood Risk
1440 min Winter	22.580	0.030	0.1	3.3	Flood Risk
2160 min Winter	22.577	0.027	0.1	2.9	Flood Risk
2880 min Winter	22.574	0.024	0.1	2.7	Flood Risk
4320 min Winter	22.571	0.021	0.1	2.3	Flood Risk
5760 min Winter	22.569	0.019	0.1	2.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
7200 min Summer	1.326	0.0	10.6	3752
8640 min Summer	1.162	0.0	11.1	4496
10080 min Summer	1.039	0.0	11.5	5240
15 min Winter	84.523	0.0	1.2	19
30 min Winter	58.468	0.0	1.8	33
60 min Winter	38.020	0.0	2.6	62
120 min Winter	23.997	0.0	3.4	118
180 min Winter	18.178	0.0	3.9	172
240 min Winter	14.896	0.0	4.2	196
360 min Winter	11.219	0.0	4.8	270
480 min Winter	9.163	0.0	5.3	346
600 min Winter	7.826	0.0	5.6	420
720 min Winter	6.878	0.0	5.9	492
960 min Winter	5.608	0.0	6.4	634
1440 min Winter	4.204	0.0	7.2	898
2160 min Winter	3.150	0.0	8.4	1280
2880 min Winter	2.565	0.0	9.1	1644
4320 min Winter	1.917	0.0	10.1	2380
5760 min Winter	1.558	0.0	11.2	3112

Cascade Summary of Results for 220830 GreenBlue Podium (P6).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	22.567	0.017	0.1	1.9	Flood Risk
8640 min Winter	22.566	0.016	0.1	1.7	Flood Risk
10080 min Winter	22.565	0.015	0.1	1.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	11.9	3896
8640 min Winter	1.162	0.0	12.5	4584
10080 min Winter	1.039	0.0	12.9	5344

Cascade Rainfall Details for 220830 GreenBlue Podium (P6).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.009

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.009

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Podium (P6).SRCX

Storage is Online Cover Level (m) 22.750

Tank or Pond Structure

Invert Level (m) 22.550

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	111.0	0.108	111.0	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	22.550
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P7).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	22.564	0.014	0.0	2.8	Flood Risk
30 min Summer	22.569	0.019	0.1	3.9	Flood Risk
60 min Summer	22.574	0.024	0.1	4.9	Flood Risk
120 min Summer	22.579	0.029	0.1	6.0	Flood Risk
180 min Summer	22.582	0.032	0.1	6.6	Flood Risk
240 min Summer	22.583	0.033	0.2	6.9	Flood Risk
360 min Summer	22.585	0.035	0.2	7.3	Flood Risk
480 min Summer	22.586	0.036	0.2	7.6	Flood Risk
600 min Summer	22.587	0.037	0.2	7.8	Flood Risk
720 min Summer	22.588	0.038	0.2	7.9	Flood Risk
960 min Summer	22.589	0.039	0.2	8.1	Flood Risk
1440 min Summer	22.589	0.039	0.2	8.1	Flood Risk
2160 min Summer	22.588	0.038	0.2	8.0	Flood Risk
2880 min Summer	22.587	0.037	0.2	7.7	Flood Risk
4320 min Summer	22.584	0.034	0.2	7.0	Flood Risk
5760 min Summer	22.581	0.031	0.1	6.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	1.7	19
30 min Summer	58.468	0.0	2.6	34
60 min Summer	38.020	0.0	4.3	64
120 min Summer	23.997	0.0	5.6	122
180 min Summer	18.178	0.0	6.5	182
240 min Summer	14.896	0.0	7.1	240
360 min Summer	11.219	0.0	8.1	314
480 min Summer	9.163	0.0	8.9	376
600 min Summer	7.826	0.0	9.5	436
720 min Summer	6.878	0.0	10.0	506
960 min Summer	5.608	0.0	10.9	642
1440 min Summer	4.204	0.0	12.1	910
2160 min Summer	3.150	0.0	14.7	1316
2880 min Summer	2.565	0.0	15.9	1704
4320 min Summer	1.917	0.0	17.6	2464
5760 min Summer	1.558	0.0	19.8	3224

Cascade Summary of Results for 220830 GreenBlue Podium (P7).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	22.579	0.029	0.1	6.0	Flood Risk
8640 min Summer	22.577	0.027	0.1	5.6	Flood Risk
10080 min Summer	22.575	0.025	0.1	5.3	Flood Risk
15 min Winter	22.565	0.015	0.1	3.2	Flood Risk
30 min Winter	22.571	0.021	0.1	4.3	Flood Risk
60 min Winter	22.577	0.027	0.1	5.5	Flood Risk
120 min Winter	22.582	0.032	0.2	6.7	Flood Risk
180 min Winter	22.586	0.036	0.2	7.4	Flood Risk
240 min Winter	22.587	0.037	0.2	7.8	Flood Risk
360 min Winter	22.590	0.040	0.2	8.2	Flood Risk
480 min Winter	22.591	0.041	0.2	8.5	Flood Risk
600 min Winter	22.592	0.042	0.2	8.7	Flood Risk
720 min Winter	22.592	0.042	0.2	8.8	Flood Risk
960 min Winter	22.592	0.042	0.2	8.8	Flood Risk
1440 min Winter	22.592	0.042	0.2	8.7	Flood Risk
2160 min Winter	22.589	0.039	0.2	8.2	Flood Risk
2880 min Winter	22.587	0.037	0.2	7.7	Flood Risk
4320 min Winter	22.582	0.032	0.2	6.7	Flood Risk
5760 min Winter	22.579	0.029	0.1	6.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.326	0.0	21.0	3960
8640 min Summer	1.162	0.0	22.0	4672
10080 min Summer	1.039	0.0	22.7	5352
15 min Winter	84.523	0.0	2.0	19
30 min Winter	58.468	0.0	3.1	33
60 min Winter	38.020	0.0	4.9	62
120 min Winter	23.997	0.0	6.4	120
180 min Winter	18.178	0.0	7.3	178
240 min Winter	14.896	0.0	8.0	234
360 min Winter	11.219	0.0	9.2	340
480 min Winter	9.163	0.0	10.0	388
600 min Winter	7.826	0.0	10.7	462
720 min Winter	6.878	0.0	11.3	538
960 min Winter	5.608	0.0	12.3	692
1440 min Winter	4.204	0.0	13.7	982
2160 min Winter	3.150	0.0	16.5	1404
2880 min Winter	2.565	0.0	17.9	1812
4320 min Winter	1.917	0.0	19.8	2592
5760 min Winter	1.558	0.0	22.2	3296

Cascade Summary of Results for 220830 GreenBlue Podium (P7).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Winter	22.576	0.026	0.1	5.4	Flood Risk
8640 min Winter	22.574	0.024	0.1	5.0	Flood Risk
10080 min Winter	22.572	0.022	0.1	4.7	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Winter	1.326	0.0	23.6	4032
8640 min Winter	1.162	0.0	24.7	4760
10080 min Winter	1.039	0.0	25.6	5544

Cascade Rainfall Details for 220830 GreenBlue Podium (P7).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.018

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.018

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Podium (P7).SRCX

Storage is Online Cover Level (m) 22.750

Tank or Pond Structure

Invert Level (m) 22.550

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	208.2	0.108	208.2	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	22.550
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Podium (P8).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.214	0.014	0.0	4.9	Flood Risk
30 min Summer	9.219	0.019	0.1	6.7	Flood Risk
60 min Summer	9.225	0.025	0.1	8.6	Flood Risk
120 min Summer	9.230	0.030	0.1	10.7	Flood Risk
180 min Summer	9.234	0.034	0.2	11.9	Flood Risk
240 min Summer	9.236	0.036	0.2	12.7	Flood Risk
360 min Summer	9.239	0.039	0.2	13.7	Flood Risk
480 min Summer	9.241	0.041	0.2	14.3	Flood Risk
600 min Summer	9.242	0.042	0.2	14.7	Flood Risk
720 min Summer	9.243	0.043	0.2	15.0	Flood Risk
960 min Summer	9.244	0.044	0.2	15.5	Flood Risk
1440 min Summer	9.246	0.046	0.2	16.0	Flood Risk
2160 min Summer	9.247	0.047	0.2	16.3	Flood Risk
2880 min Summer	9.246	0.046	0.2	16.2	Flood Risk
4320 min Summer	9.244	0.044	0.2	15.5	Flood Risk
5760 min Summer	9.242	0.042	0.2	14.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	2.3	19
30 min Summer	58.468	0.0	3.7	34
60 min Summer	38.020	0.0	6.7	64
120 min Summer	23.997	0.0	8.8	122
180 min Summer	18.178	0.0	10.2	182
240 min Summer	14.896	0.0	11.2	242
360 min Summer	11.219	0.0	12.8	360
480 min Summer	9.163	0.0	14.0	480
600 min Summer	7.826	0.0	14.9	546
720 min Summer	6.878	0.0	15.7	598
960 min Summer	5.608	0.0	17.0	720
1440 min Summer	4.204	0.0	18.6	982
2160 min Summer	3.150	0.0	24.4	1404
2880 min Summer	2.565	0.0	26.4	1816
4320 min Summer	1.917	0.0	28.9	2596
5760 min Summer	1.558	0.0	33.7	3392

Cascade Summary of Results for 220830 GreenBlue Podium (P8).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	9.240	0.040	0.2	13.9	Flood Risk
8640 min Summer	9.238	0.038	0.2	13.2	Flood Risk
10080 min Summer	9.236	0.036	0.2	12.5	Flood Risk
15 min Winter	9.216	0.016	0.1	5.5	Flood Risk
30 min Winter	9.222	0.022	0.1	7.5	Flood Risk
60 min Winter	9.228	0.028	0.1	9.7	Flood Risk
120 min Winter	9.234	0.034	0.2	12.0	Flood Risk
180 min Winter	9.238	0.038	0.2	13.3	Flood Risk
240 min Winter	9.241	0.041	0.2	14.2	Flood Risk
360 min Winter	9.244	0.044	0.2	15.4	Flood Risk
480 min Winter	9.246	0.046	0.2	16.2	Flood Risk
600 min Winter	9.248	0.048	0.2	16.6	Flood Risk
720 min Winter	9.248	0.048	0.2	17.0	Flood Risk
960 min Winter	9.250	0.050	0.2	17.4	Flood Risk
1440 min Winter	9.251	0.051	0.2	17.9	Flood Risk
2160 min Winter	9.251	0.051	0.2	17.8	Flood Risk
2880 min Winter	9.249	0.049	0.2	17.3	Flood Risk
4320 min Winter	9.245	0.045	0.2	15.8	Flood Risk
5760 min Winter	9.242	0.042	0.2	14.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.326	0.0	35.7	4112
8640 min Summer	1.162	0.0	37.3	4848
10080 min Summer	1.039	0.0	38.4	5648
15 min Winter	84.523	0.0	2.7	19
30 min Winter	58.468	0.0	4.3	33
60 min Winter	38.020	0.0	7.7	62
120 min Winter	23.997	0.0	10.0	120
180 min Winter	18.178	0.0	11.6	180
240 min Winter	14.896	0.0	12.7	238
360 min Winter	11.219	0.0	14.5	352
480 min Winter	9.163	0.0	15.8	462
600 min Winter	7.826	0.0	16.9	572
720 min Winter	6.878	0.0	17.8	674
960 min Winter	5.608	0.0	19.1	770
1440 min Winter	4.204	0.0	20.8	1080
2160 min Winter	3.150	0.0	27.5	1536
2880 min Winter	2.565	0.0	29.7	1960
4320 min Winter	1.917	0.0	32.5	2768
5760 min Winter	1.558	0.0	37.9	3568

Cascade Summary of Results for 220830 GreenBlue Podium (P8).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	9.238	0.038	0.2	13.4	Flood Risk
8640 min Winter	9.235	0.035	0.2	12.4	Flood Risk
10080 min Winter	9.233	0.033	0.2	11.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	40.2	4328
8640 min Winter	1.162	0.0	42.0	5096
10080 min Winter	1.039	0.0	43.3	5848

Cascade Rainfall Details for 220830 GreenBlue Podium (P8).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.031

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.031

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Podium (P8).SRCX

Storage is Online Cover Level (m) 9.400

Tank or Pond Structure

Invert Level (m) 9.200

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	350.0	0.108	350.0	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0108-2000
Design Head (m)	0.108
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	9.200
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.108	0.2	Kick-Flo®	0.078	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.4
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.3		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Roof (G1).SRCX

Upstream Structures	**Outflow To**	**Overflow To**
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
15 min Summer	23.389	0.014	0.0	4.9	Flood Risk
30 min Summer	23.394	0.019	0.1	6.7	Flood Risk
60 min Summer	23.399	0.024	0.1	8.6	Flood Risk
120 min Summer	23.405	0.030	0.1	10.7	Flood Risk
180 min Summer	23.408	0.033	0.2	11.9	Flood Risk
240 min Summer	23.411	0.036	0.2	12.7	Flood Risk
360 min Summer	23.413	0.038	0.2	13.7	Flood Risk
480 min Summer	23.415	0.040	0.2	14.3	Flood Risk
600 min Summer	23.416	0.041	0.2	14.7	Flood Risk
720 min Summer	23.417	0.042	0.2	15.0	Flood Risk
960 min Summer	23.418	0.043	0.2	15.5	Flood Risk
1440 min Summer	23.420	0.045	0.2	16.1	Flood Risk
2160 min Summer	23.421	0.046	0.2	16.4	Flood Risk
2880 min Summer	23.421	0.046	0.2	16.3	Flood Risk
4320 min Summer	23.419	0.044	0.2	15.6	Flood Risk
5760 min Summer	23.417	0.042	0.2	14.8	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
15 min Summer	84.523	0.0	2.3	19
30 min Summer	58.468	0.0	3.6	34
60 min Summer	38.020	0.0	6.6	64
120 min Summer	23.997	0.0	8.7	122
180 min Summer	18.178	0.0	10.1	182
240 min Summer	14.896	0.0	11.1	242
360 min Summer	11.219	0.0	12.7	362
480 min Summer	9.163	0.0	13.9	480
600 min Summer	7.826	0.0	14.8	548
720 min Summer	6.878	0.0	15.6	600
960 min Summer	5.608	0.0	16.9	722
1440 min Summer	4.204	0.0	18.5	982
2160 min Summer	3.150	0.0	24.3	1404
2880 min Summer	2.565	0.0	26.3	1812
4320 min Summer	1.917	0.0	28.7	2596
5760 min Summer	1.558	0.0	33.7	3400

Cascade Summary of Results for 220830 GreenBlue Roof (G1).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Summer	23.414	0.039	0.2	14.1	Flood Risk
8640 min Summer	23.412	0.037	0.2	13.3	Flood Risk
10080 min Summer	23.410	0.035	0.2	12.7	Flood Risk
15 min Winter	23.390	0.015	0.1	5.5	Flood Risk
30 min Winter	23.396	0.021	0.1	7.5	Flood Risk
60 min Winter	23.402	0.027	0.1	9.7	Flood Risk
120 min Winter	23.408	0.033	0.2	12.0	Flood Risk
180 min Winter	23.412	0.037	0.2	13.3	Flood Risk
240 min Winter	23.415	0.040	0.2	14.3	Flood Risk
360 min Winter	23.418	0.043	0.2	15.5	Flood Risk
480 min Winter	23.420	0.045	0.2	16.2	Flood Risk
600 min Winter	23.422	0.047	0.2	16.7	Flood Risk
720 min Winter	23.423	0.048	0.2	17.0	Flood Risk
960 min Winter	23.424	0.049	0.2	17.4	Flood Risk
1440 min Winter	23.425	0.050	0.2	17.9	Flood Risk
2160 min Winter	23.425	0.050	0.2	17.9	Flood Risk
2880 min Winter	23.424	0.049	0.2	17.4	Flood Risk
4320 min Winter	23.420	0.045	0.2	16.0	Flood Risk
5760 min Winter	23.416	0.041	0.2	14.7	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Summer	1.326	0.0	35.7	4176
8640 min Summer	1.162	0.0	37.3	4920
10080 min Summer	1.039	0.0	38.4	5648
15 min Winter	84.523	0.0	2.7	19
30 min Winter	58.468	0.0	4.2	33
60 min Winter	38.020	0.0	7.6	62
120 min Winter	23.997	0.0	9.9	120
180 min Winter	18.178	0.0	11.5	180
240 min Winter	14.896	0.0	12.6	238
360 min Winter	11.219	0.0	14.4	352
480 min Winter	9.163	0.0	15.7	462
600 min Winter	7.826	0.0	16.8	572
720 min Winter	6.878	0.0	17.6	672
960 min Winter	5.608	0.0	19.0	768
1440 min Winter	4.204	0.0	20.7	1080
2160 min Winter	3.150	0.0	27.4	1536
2880 min Winter	2.565	0.0	29.6	1960
4320 min Winter	1.917	0.0	32.4	2768
5760 min Winter	1.558	0.0	37.8	3576

Cascade Summary of Results for 220830 GreenBlue Roof (G1).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	23.413	0.038	0.2	13.6	Flood Risk
8640 min Winter	23.410	0.035	0.2	12.6	Flood Risk
10080 min Winter	23.408	0.033	0.2	11.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	40.1	4328
8640 min Winter	1.162	0.0	41.9	5096
10080 min Winter	1.039	0.0	43.2	5848

Cascade Rainfall Details for 220830 GreenBlue Roof (G1).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.031

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.031

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Roof (G1).SRCX

Storage is Online Cover Level (m) 23.675

Tank or Pond Structure

Invert Level (m) 23.375

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	357.3	0.108	357.3	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0108-2000
Design Head (m)	0.108
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	23.375
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.108	0.2	Kick-Flo®	0.078	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.4
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.3		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Roof (G2).SRCX

Upstream Structures	**Outflow To**	**Overflow To**
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m^3)**	**Status**
15 min Summer	38.689	0.014	0.0	6.8	Flood Risk
30 min Summer	38.695	0.020	0.1	9.4	Flood Risk
60 min Summer	38.700	0.025	0.1	12.1	Flood Risk
120 min Summer	38.706	0.031	0.1	15.0	Flood Risk
180 min Summer	38.710	0.035	0.2	16.7	Flood Risk
240 min Summer	38.713	0.038	0.2	18.0	Flood Risk
360 min Summer	38.716	0.041	0.2	19.7	Flood Risk
480 min Summer	38.718	0.043	0.2	20.8	Flood Risk
600 min Summer	38.720	0.045	0.2	21.5	Flood Risk
720 min Summer	38.721	0.046	0.2	22.0	Flood Risk
960 min Summer	38.723	0.048	0.2	22.8	Flood Risk
1440 min Summer	38.725	0.050	0.2	23.9	Flood Risk
2160 min Summer	38.727	0.052	0.2	24.8	Flood Risk
2880 min Summer	38.727	0.052	0.2	25.0	Flood Risk
4320 min Summer	38.727	0.052	0.2	24.7	Flood Risk
5760 min Summer	38.725	0.050	0.2	23.8	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m^3)**	**Discharge Volume (m^3)**	**Time-Peak (mins)**
15 min Summer	84.523	0.0	2.7	19
30 min Summer	58.468	0.0	4.3	34
60 min Summer	38.020	0.0	8.5	64
120 min Summer	23.997	0.0	11.2	124
180 min Summer	18.178	0.0	13.0	182
240 min Summer	14.896	0.0	14.3	242
360 min Summer	11.219	0.0	16.3	362
480 min Summer	9.163	0.0	17.8	482
600 min Summer	7.826	0.0	18.9	600
720 min Summer	6.878	0.0	19.8	716
960 min Summer	5.608	0.0	21.2	828
1440 min Summer	4.204	0.0	22.5	1094
2160 min Summer	3.150	0.0	32.5	1496
2880 min Summer	2.565	0.0	34.9	1908
4320 min Summer	1.917	0.0	37.4	2724
5760 min Summer	1.558	0.0	46.2	3520

Cascade Summary of Results for 220830 GreenBlue Roof (G2).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	38.723	0.048	0.2	22.8	Flood Risk
8640 min Summer	38.720	0.045	0.2	21.8	Flood Risk
10080 min Summer	38.719	0.044	0.2	20.9	Flood Risk
15 min Winter	38.691	0.016	0.1	7.6	Flood Risk
30 min Winter	38.697	0.022	0.1	10.5	Flood Risk
60 min Winter	38.703	0.028	0.1	13.5	Flood Risk
120 min Winter	38.710	0.035	0.2	16.8	Flood Risk
180 min Winter	38.714	0.039	0.2	18.8	Flood Risk
240 min Winter	38.717	0.042	0.2	20.2	Flood Risk
360 min Winter	38.721	0.046	0.2	22.1	Flood Risk
480 min Winter	38.724	0.049	0.2	23.5	Flood Risk
600 min Winter	38.726	0.051	0.2	24.5	Flood Risk
720 min Winter	38.728	0.053	0.2	25.2	Flood Risk
960 min Winter	38.730	0.055	0.2	26.2	Flood Risk
1440 min Winter	38.732	0.057	0.2	27.1	Flood Risk
2160 min Winter	38.733	0.058	0.2	27.8	Flood Risk
2880 min Winter	38.733	0.058	0.2	27.7	Flood Risk
4320 min Winter	38.730	0.055	0.2	26.5	Flood Risk
5760 min Winter	38.727	0.052	0.2	24.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.326	0.0	48.9	4320
8640 min Summer	1.162	0.0	50.9	5024
10080 min Summer	1.039	0.0	52.3	5840
15 min Winter	84.523	0.0	3.2	19
30 min Winter	58.468	0.0	5.1	34
60 min Winter	38.020	0.0	9.7	62
120 min Winter	23.997	0.0	12.8	122
180 min Winter	18.178	0.0	14.8	180
240 min Winter	14.896	0.0	16.3	238
360 min Winter	11.219	0.0	18.5	354
480 min Winter	9.163	0.0	20.0	470
600 min Winter	7.826	0.0	21.3	584
720 min Winter	6.878	0.0	22.2	694
960 min Winter	5.608	0.0	23.5	914
1440 min Winter	4.204	0.0	24.4	1196
2160 min Winter	3.150	0.0	36.5	1640
2880 min Winter	2.565	0.0	39.0	2104
4320 min Winter	1.917	0.0	41.7	2984
5760 min Winter	1.558	0.0	51.9	3808

Cascade Summary of Results for 220830 GreenBlue Roof (G2).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m^3)**	**Status**
7200 min Winter	38.723	0.048	0.2	23.0	Flood Risk
8640 min Winter	38.720	0.045	0.2	21.4	Flood Risk
10080 min Winter	38.717	0.042	0.2	20.2	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m^3)**	**Discharge Volume (m^3)**	**Time-Peak (mins)**
7200 min Winter	1.326	0.0	54.9	4544
8640 min Winter	1.162	0.0	57.3	5280
10080 min Winter	1.039	0.0	58.9	6056

Cascade Rainfall Details for 220830 GreenBlue Roof (G2).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.043

Time	**(mins)**	**Area**
From:	**To:**	**(ha)**
0	4	0.043

Time Area Diagram

Total Area (ha) 0.000

Time	**(mins)**	**Area**
From:	**To:**	**(ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Roof (G2).SRCX

Storage is Online Cover Level (m) 38.875

Tank or Pond Structure

Invert Level (m) 38.675

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	479.0	0.108	479.0	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0108-2000
Design Head (m)	0.108
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	38.675
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.108	0.2	Kick-Flo®	0.078	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.4
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.3		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Roof (G3).SRCX

Upstream Structures	**Outflow To**	**Overflow To**
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
15 min Summer	32.014	0.014	0.0	6.9	Flood Risk
30 min Summer	32.019	0.019	0.1	9.6	Flood Risk
60 min Summer	32.025	0.025	0.1	12.3	Flood Risk
120 min Summer	32.031	0.031	0.1	15.3	Flood Risk
180 min Summer	32.035	0.035	0.2	17.1	Flood Risk
240 min Summer	32.037	0.037	0.2	18.5	Flood Risk
360 min Summer	32.041	0.041	0.2	20.2	Flood Risk
480 min Summer	32.043	0.043	0.2	21.4	Flood Risk
600 min Summer	32.045	0.045	0.2	22.1	Flood Risk
720 min Summer	32.046	0.046	0.2	22.7	Flood Risk
960 min Summer	32.048	0.048	0.2	23.5	Flood Risk
1440 min Summer	32.050	0.050	0.2	24.6	Flood Risk
2160 min Summer	32.052	0.052	0.2	25.5	Flood Risk
2880 min Summer	32.052	0.052	0.2	25.8	Flood Risk
4320 min Summer	32.052	0.052	0.2	25.6	Flood Risk
5760 min Summer	32.050	0.050	0.2	24.7	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
15 min Summer	84.523	0.0	2.7	19
30 min Summer	58.468	0.0	4.4	34
60 min Summer	38.020	0.0	8.6	64
120 min Summer	23.997	0.0	11.3	124
180 min Summer	18.178	0.0	13.1	182
240 min Summer	14.896	0.0	14.5	242
360 min Summer	11.219	0.0	16.5	362
480 min Summer	9.163	0.0	18.0	482
600 min Summer	7.826	0.0	19.1	600
720 min Summer	6.878	0.0	20.1	720
960 min Summer	5.608	0.0	21.4	838
1440 min Summer	4.204	0.0	22.6	1108
2160 min Summer	3.150	0.0	33.1	1512
2880 min Summer	2.565	0.0	35.5	1928
4320 min Summer	1.917	0.0	37.9	2728
5760 min Summer	1.558	0.0	47.1	3528

Cascade Summary of Results for 220830 GreenBlue Roof (G3).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Summer	32.048	0.048	0.2	23.7	Flood Risk
8640 min Summer	32.046	0.046	0.2	22.7	Flood Risk
10080 min Summer	32.044	0.044	0.2	21.8	Flood Risk
15 min Winter	32.016	0.016	0.1	7.8	Flood Risk
30 min Winter	32.022	0.022	0.1	10.7	Flood Risk
60 min Winter	32.028	0.028	0.1	13.8	Flood Risk
120 min Winter	32.035	0.035	0.2	17.2	Flood Risk
180 min Winter	32.039	0.039	0.2	19.2	Flood Risk
240 min Winter	32.042	0.042	0.2	20.7	Flood Risk
360 min Winter	32.046	0.046	0.2	22.7	Flood Risk
480 min Winter	32.049	0.049	0.2	24.1	Flood Risk
600 min Winter	32.051	0.051	0.2	25.1	Flood Risk
720 min Winter	32.052	0.052	0.2	25.9	Flood Risk
960 min Winter	32.055	0.055	0.2	26.9	Flood Risk
1440 min Winter	32.057	0.057	0.2	27.9	Flood Risk
2160 min Winter	32.058	0.058	0.2	28.7	Flood Risk
2880 min Winter	32.058	0.058	0.2	28.7	Flood Risk
4320 min Winter	32.056	0.056	0.2	27.5	Flood Risk
5760 min Winter	32.052	0.052	0.2	25.8	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Summer	1.326	0.0	49.9	4320
8640 min Summer	1.162	0.0	52.0	5096
10080 min Summer	1.039	0.0	53.3	5848
15 min Winter	84.523	0.0	3.2	19
30 min Winter	58.468	0.0	5.1	34
60 min Winter	38.020	0.0	9.8	64
120 min Winter	23.997	0.0	12.9	122
180 min Winter	18.178	0.0	14.9	180
240 min Winter	14.896	0.0	16.5	238
360 min Winter	11.219	0.0	18.7	354
480 min Winter	9.163	0.0	20.3	470
600 min Winter	7.826	0.0	21.5	584
720 min Winter	6.878	0.0	22.4	696
960 min Winter	5.608	0.0	23.7	916
1440 min Winter	4.204	0.0	24.6	1298
2160 min Winter	3.150	0.0	37.1	1644
2880 min Winter	2.565	0.0	39.7	2104
4320 min Winter	1.917	0.0	42.2	2984
5760 min Winter	1.558	0.0	53.0	3808

Cascade Summary of Results for 220830 GreenBlue Roof (G3).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	32.049	0.049	0.2	24.0	Flood Risk
8640 min Winter	32.045	0.045	0.2	22.4	Flood Risk
10080 min Winter	32.043	0.043	0.2	21.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	56.1	4608
8640 min Winter	1.162	0.0	58.5	5360
10080 min Winter	1.039	0.0	60.1	6144

Cascade Rainfall Details for 220830 GreenBlue Roof (G3).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.044

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.044

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Roof (G3).SRCX

Storage is Online Cover Level (m) 32.200

Tank or Pond Structure

Invert Level (m) 32.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	493.8	0.108	493.8	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0108-2000
Design Head (m)	0.108
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	32.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.108	0.2	Kick-Flo®	0.078	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.4
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.3		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Roof (G4).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	16.711	0.011	0.0	0.5	Flood Risk
30 min Summer	16.715	0.015	0.1	0.6	Flood Risk
60 min Summer	16.718	0.018	0.1	0.7	Flood Risk
120 min Summer	16.720	0.020	0.1	0.8	Flood Risk
180 min Summer	16.721	0.021	0.1	0.9	Flood Risk
240 min Summer	16.721	0.021	0.1	0.9	Flood Risk
360 min Summer	16.721	0.021	0.1	0.9	Flood Risk
480 min Summer	16.721	0.021	0.1	0.9	Flood Risk
600 min Summer	16.721	0.021	0.1	0.9	Flood Risk
720 min Summer	16.720	0.020	0.1	0.8	Flood Risk
960 min Summer	16.719	0.019	0.1	0.8	Flood Risk
1440 min Summer	16.718	0.018	0.1	0.7	Flood Risk
2160 min Summer	16.716	0.016	0.1	0.7	Flood Risk
2880 min Summer	16.715	0.015	0.1	0.6	Flood Risk
4320 min Summer	16.713	0.013	0.0	0.5	Flood Risk
5760 min Summer	16.712	0.012	0.0	0.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	0.4	18
30 min Summer	58.468	0.0	0.6	32
60 min Summer	38.020	0.0	0.8	60
120 min Summer	23.997	0.0	1.0	90
180 min Summer	18.178	0.0	1.2	122
240 min Summer	14.896	0.0	1.3	156
360 min Summer	11.219	0.0	1.5	224
480 min Summer	9.163	0.0	1.6	290
600 min Summer	7.826	0.0	1.7	354
720 min Summer	6.878	0.0	1.8	418
960 min Summer	5.608	0.0	2.0	540
1440 min Summer	4.204	0.0	2.2	792
2160 min Summer	3.150	0.0	2.5	1152
2880 min Summer	2.565	0.0	2.7	1504
4320 min Summer	1.917	0.0	3.1	2248
5760 min Summer	1.558	0.0	3.3	2944

Cascade Summary of Results for 220830 GreenBlue Roof (G4).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Summer	16.711	0.011	0.0	0.4	Flood Risk
8640 min Summer	16.710	0.010	0.0	0.4	Flood Risk
10080 min Summer	16.710	0.010	0.0	0.4	Flood Risk
15 min Winter	16.712	0.012	0.0	0.5	Flood Risk
30 min Winter	16.716	0.016	0.1	0.7	Flood Risk
60 min Winter	16.720	0.020	0.1	0.8	Flood Risk
120 min Winter	16.722	0.022	0.1	0.9	Flood Risk
180 min Winter	16.722	0.022	0.1	0.9	Flood Risk
240 min Winter	16.723	0.023	0.1	0.9	Flood Risk
360 min Winter	16.722	0.022	0.1	0.9	Flood Risk
480 min Winter	16.722	0.022	0.1	0.9	Flood Risk
600 min Winter	16.721	0.021	0.1	0.9	Flood Risk
720 min Winter	16.720	0.020	0.1	0.8	Flood Risk
960 min Winter	16.719	0.019	0.1	0.8	Flood Risk
1440 min Winter	16.717	0.017	0.1	0.7	Flood Risk
2160 min Winter	16.714	0.014	0.0	0.6	Flood Risk
2880 min Winter	16.713	0.013	0.0	0.5	Flood Risk
4320 min Winter	16.711	0.011	0.0	0.5	Flood Risk
5760 min Winter	16.710	0.010	0.0	0.4	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Summer	1.326	0.0	3.6	3680
8640 min Summer	1.162	0.0	3.7	4408
10080 min Summer	1.039	0.0	3.9	5136
15 min Winter	84.523	0.0	0.5	18
30 min Winter	58.468	0.0	0.7	32
60 min Winter	38.020	0.0	0.9	58
120 min Winter	23.997	0.0	1.2	94
180 min Winter	18.178	0.0	1.3	132
240 min Winter	14.896	0.0	1.5	168
360 min Winter	11.219	0.0	1.7	238
480 min Winter	9.163	0.0	1.8	304
600 min Winter	7.826	0.0	1.9	372
720 min Winter	6.878	0.0	2.0	440
960 min Winter	5.608	0.0	2.2	560
1440 min Winter	4.204	0.0	2.5	808
2160 min Winter	3.150	0.0	2.8	1192
2880 min Winter	2.565	0.0	3.1	1524
4320 min Winter	1.917	0.0	3.4	2288
5760 min Winter	1.558	0.0	3.7	2960

Cascade Summary of Results for 220830 GreenBlue Roof (G4).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
7200 min Winter	16.709	0.009	0.0	0.4	Flood Risk
8640 min Winter	16.709	0.009	0.0	0.4	Flood Risk
10080 min Winter	16.708	0.008	0.0	0.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
7200 min Winter	1.326	0.0	4.0	3752
8640 min Winter	1.162	0.0	4.2	4208
10080 min Winter	1.039	0.0	4.4	4928

Cascade Rainfall Details for 220830 GreenBlue Roof (G4).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.003

Time (mins) From:	To:	Area (ha)
0	4	0.003

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for 220830 GreenBlue Roof (G4).SRCX

Storage is Online Cover Level (m) 16.900

Tank or Pond Structure

Invert Level (m) 16.700

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	41.9	0.108	41.9	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	16.700
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Cascade Summary of Results for 220830 GreenBlue Roof (G5).SRCX

Upstream Structures	Outflow To	Overflow To
(None)	220830 Cellular Tank.SRCX	220830 Cellular Tank.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	16.714	0.014	0.0	0.6	Flood Risk
30 min Summer	16.718	0.018	0.1	0.8	Flood Risk
60 min Summer	16.722	0.022	0.1	1.0	Flood Risk
120 min Summer	16.725	0.025	0.1	1.1	Flood Risk
180 min Summer	16.726	0.026	0.1	1.1	Flood Risk
240 min Summer	16.726	0.026	0.1	1.2	Flood Risk
360 min Summer	16.726	0.026	0.1	1.2	Flood Risk
480 min Summer	16.726	0.026	0.1	1.2	Flood Risk
600 min Summer	16.726	0.026	0.1	1.1	Flood Risk
720 min Summer	16.725	0.025	0.1	1.1	Flood Risk
960 min Summer	16.724	0.024	0.1	1.0	Flood Risk
1440 min Summer	16.721	0.021	0.1	0.9	Flood Risk
2160 min Summer	16.719	0.019	0.1	0.8	Flood Risk
2880 min Summer	16.717	0.017	0.1	0.8	Flood Risk
4320 min Summer	16.715	0.015	0.1	0.7	Flood Risk
5760 min Summer	16.714	0.014	0.0	0.6	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	84.523	0.0	0.6	18
30 min Summer	58.468	0.0	0.8	32
60 min Summer	38.020	0.0	1.1	60
120 min Summer	23.997	0.0	1.4	90
180 min Summer	18.178	0.0	1.6	124
240 min Summer	14.896	0.0	1.7	156
360 min Summer	11.219	0.0	2.0	224
480 min Summer	9.163	0.0	2.2	290
600 min Summer	7.826	0.0	2.3	354
720 min Summer	6.878	0.0	2.4	418
960 min Summer	5.608	0.0	2.6	540
1440 min Summer	4.204	0.0	3.0	792
2160 min Summer	3.150	0.0	3.4	1148
2880 min Summer	2.565	0.0	3.7	1528
4320 min Summer	1.917	0.0	4.1	2248
5760 min Summer	1.558	0.0	4.5	2952

Cascade Summary of Results for 220830 GreenBlue Roof (G5).SRCX

Storm Event	**Max Level (m)**	**Max Depth (m)**	**Max Control (l/s)**	**Max Volume (m³)**	**Status**
7200 min Summer	16.713	0.013	0.0	0.6	Flood Risk
8640 min Summer	16.712	0.012	0.0	0.5	Flood Risk
10080 min Summer	16.711	0.011	0.0	0.5	Flood Risk
15 min Winter	16.716	0.016	0.1	0.7	Flood Risk
30 min Winter	16.721	0.021	0.1	0.9	Flood Risk
60 min Winter	16.725	0.025	0.1	1.1	Flood Risk
120 min Winter	16.727	0.027	0.1	1.2	Flood Risk
180 min Winter	16.728	0.028	0.1	1.2	Flood Risk
240 min Winter	16.728	0.028	0.1	1.3	Flood Risk
360 min Winter	16.728	0.028	0.1	1.2	Flood Risk
480 min Winter	16.727	0.027	0.1	1.2	Flood Risk
600 min Winter	16.726	0.026	0.1	1.1	Flood Risk
720 min Winter	16.725	0.025	0.1	1.1	Flood Risk
960 min Winter	16.723	0.023	0.1	1.0	Flood Risk
1440 min Winter	16.720	0.020	0.1	0.9	Flood Risk
2160 min Winter	16.717	0.017	0.1	0.8	Flood Risk
2880 min Winter	16.715	0.015	0.1	0.7	Flood Risk
4320 min Winter	16.713	0.013	0.0	0.6	Flood Risk
5760 min Winter	16.712	0.012	0.0	0.5	Flood Risk

Storm Event	**Rain (mm/hr)**	**Flooded Volume (m³)**	**Discharge Volume (m³)**	**Time-Peak (mins)**
7200 min Summer	1.326	0.0	4.8	3680
8640 min Summer	1.162	0.0	5.0	4416
10080 min Summer	1.039	0.0	5.2	5144
15 min Winter	84.523	0.0	0.6	18
30 min Winter	58.468	0.0	0.9	32
60 min Winter	38.020	0.0	1.2	58
120 min Winter	23.997	0.0	1.6	94
180 min Winter	18.178	0.0	1.8	132
240 min Winter	14.896	0.0	2.0	168
360 min Winter	11.219	0.0	2.2	240
480 min Winter	9.163	0.0	2.4	308
600 min Winter	7.826	0.0	2.6	374
720 min Winter	6.878	0.0	2.7	436
960 min Winter	5.608	0.0	3.0	560
1440 min Winter	4.204	0.0	3.3	810
2160 min Winter	3.150	0.0	3.8	1172
2880 min Winter	2.565	0.0	4.1	1560
4320 min Winter	1.917	0.0	4.6	2252
5760 min Winter	1.558	0.0	5.0	3056

Cascade Summary of Results for 220830 GreenBlue Roof (G5).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Winter	16.711	0.011	0.0	0.5	Flood Risk
8640 min Winter	16.710	0.010	0.0	0.4	Flood Risk
10080 min Winter	16.710	0.010	0.0	0.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.326	0.0	5.3	3816
8640 min Winter	1.162	0.0	5.6	4256
10080 min Winter	1.039	0.0	5.8	5000

Cascade Rainfall Details for 220830 GreenBlue Roof (G5).SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Shortest Storm (mins)	15
Ratio R	0.278	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.004

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.004

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Cascade Model Details for 220830 GreenBlue Roof (G5).SRCX

Storage is Online Cover Level (m) 16.900

Tank or Pond Structure

Invert Level (m) 16.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	44.1	0.108	44.1	0.109	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0028-2000-0109-2000
Design Head (m)	0.109
Design Flow (l/s)	0.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	28
Invert Level (m)	16.700
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.109	0.2	Kick-Flo®	0.079	0.2
Flush-Flo™	0.046	0.2	Mean Flow over Head Range	-	0.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	1.200	0.6	3.000	0.9	7.000	1.3
0.200	0.3	1.400	0.6	3.500	1.0	7.500	1.4
0.300	0.3	1.600	0.6	4.000	1.0	8.000	1.4
0.400	0.3	1.800	0.7	4.500	1.1	8.500	1.5
0.500	0.4	2.000	0.7	5.000	1.1	9.000	1.5
0.600	0.4	2.200	0.8	5.500	1.2	9.500	1.6
0.800	0.5	2.400	0.8	6.000	1.2		
1.000	0.5	2.600	0.8	6.500	1.3		

Appendix C : Water Network Calculations [Micro Drainage Network Module]

Internal Site Surface Water Drainage Network 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)	100	PIMP (%)	100
M5-60 (mm)	16.100	Add Flow / Climate Change (%)	0
Ratio R	0.278	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.000	4-8	0.107	8-12	0.013

Total Area Contributing (ha) = 0.120

Total Pipe Volume (m³) = 21.561

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	47.794	0.318	150.3	0.024	4.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.001	11.973	0.110	108.8	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S2.000	20.085	0.134	149.9	0.024	4.00	0.0	0.600	o	225	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	4.75	3.600	0.024	0.0	0.0	0.0	1.06	42.3	3.2
S1.001	50.00	4.91	3.282	0.048	0.0	0.0	0.0	1.25	49.8	6.5
S2.000	50.00	4.31	3.379	0.024	0.0	0.0	0.0	1.07	42.4	3.2

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
S2.001	12.015	0.060	200.3	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.002	44.801	0.000	0.0	0.024	0.00	0.0	0.600	o	660	Pipe/Conduit	🔒
S1.003	3.248	0.016	203.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.004	21.604	0.210	103.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.005	5.441	0.027	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.006	25.434	0.127	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔒
S1.007	9.174	0.043	213.6	0.000	0.00	0.0	0.600	o	225	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)
S2.001	50.00	4.53	3.245	0.048	0.0	0.0	0.0	0.92	36.6	6.5
S1.002	50.00	7.90	3.172	0.120	0.0	0.0	0.0	0.25	85.5	16.2
S1.003	50.00	7.95	3.172	0.120	0.0	0.0	0.0	0.91	36.3	16.2
S1.004	50.00	8.23	3.156	0.120	0.0	0.0	0.0	1.29	51.2	16.2
S1.005	50.00	8.33	2.948	0.120	0.0	0.0	0.0	0.92	36.6	16.2
S1.006	50.00	8.79	2.921	0.120	0.0	0.0	0.0	0.92	36.6	16.2
S1.007	50.00	8.96	2.792	0.120	0.0	0.0	0.0	0.89	35.4	16.2

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	**Hyd Sect**	**Diam (mm)**	**MH Name**	**C.Level (m)**	**I.Level (m)**	**D.Depth (m)**	**MH Connection**	**MH DIAM., L*W (mm)**
S1.000	o	225	S1	5.150	3.600	1.325	Open Manhole	1200
S1.001	o	225	S2	4.700	3.282	1.193	Open Manhole	1200
S2.000	o	225	S2	5.000	3.379	1.396	Open Manhole	1200
S2.001	o	225	S3	5.000	3.245	1.530	Open Manhole	1200
S1.002	o	660	S3	4.700	3.172	0.868	Open Manhole	1500
S1.003	o	225	S6	4.179	3.172	0.782	Open Manhole	1500
S1.004	o	225	S6	4.100	3.156	0.719	Open Manhole	1200
S1.005	o	225	S4	4.100	2.948	0.927	Open Manhole	1200
S1.006	o	225	S5	4.300	2.921	1.154	Open Manhole	1200
S1.007	o	225	S6	4.700	2.792	1.683	Open Manhole	1200

Downstream Manhole

PN	**Length (m)**	**Slope (1:X)**	**MH Name**	**C.Level (m)**	**I.Level (m)**	**D.Depth (m)**	**MH Connection**	**MH DIAM., L*W (mm)**
S1.000	47.794	150.3	S2	4.700	3.282	1.193	Open Manhole	1200
S1.001	11.973	108.8	S3	4.700	3.172	1.303	Open Manhole	1500
S2.000	20.085	149.9	S3	5.000	3.245	1.530	Open Manhole	1200
S2.001	12.015	200.3	S3	4.700	3.185	1.290	Open Manhole	1500
S1.002	44.801	0.0	S6	4.179	3.172	0.347	Open Manhole	1500
S1.003	3.248	203.0	S6	4.100	3.156	0.719	Open Manhole	1200
S1.004	21.604	103.0	S4	4.100	2.946	0.929	Open Manhole	1200
S1.005	5.441	200.0	S5	4.300	2.921	1.154	Open Manhole	1200
S1.006	25.434	200.0	S6	4.700	2.794	1.681	Open Manhole	1200
S1.007	9.174	213.6	S	4.800	2.749	1.826	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.024	0.024	0.024
1.001	-	-	100	0.024	0.024	0.024
2.000	-	-	100	0.024	0.024	0.024
2.001	-	-	100	0.024	0.024	0.024
1.002	-	-	100	0.024	0.024	0.024
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.120	0.120	0.120

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)
S1.007	S	4.800	2.749	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	2
Number of Online Controls	1	Number of Storage Structures	2	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.100	Storm Duration (mins)	30
Ratio R	0.278		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.004, Volume (m³): 1.1

Unit Reference	MD-SHE-0070-2000-0776-2000
Design Head (m)	0.776
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	3.156
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.776	2.0	Kick-Flo®	0.493	1.6
Flush-Flo™	0.232	2.0	Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.8	1.200	2.4	3.000	3.7	7.000	5.5
0.200	2.0	1.400	2.6	3.500	4.0	7.500	5.7
0.300	2.0	1.600	2.8	4.000	4.3	8.000	5.9
0.400	1.9	1.800	2.9	4.500	4.5	8.500	6.1
0.500	1.6	2.000	3.1	5.000	4.7	9.000	6.3
0.600	1.8	2.200	3.2	5.500	4.9	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.1		
1.000	2.2	2.600	3.5	6.500	5.3		

Storage Structures for Storm

Porous Car Park Manhole: S2, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	0.16900	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	33.3	Slope (1:X)	1000.0
Safety Factor	1.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.500	Membrane Depth (mm)	0

Tank or Pond Manhole: S6, DS/PN: S1.003

Invert Level (m) 3.172

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	0.660	180.0	0.661	0.0

Time Area Diagram for Green Roof at Pipe Number S1.000 (Storm)

Area (m³) 1555 Evaporation (mm/day) 3
Depression Storage (mm) 100 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.028257	32	36	0.005705	64	68	0.001152	96	100	0.000233
4	8	0.023135	36	40	0.004671	68	72	0.000943	100	104	0.000190
8	12	0.018942	40	44	0.003824	72	76	0.000772	104	108	0.000156
12	16	0.015508	44	48	0.003131	76	80	0.000632	108	112	0.000128
16	20	0.012697	48	52	0.002563	80	84	0.000518	112	116	0.000104
20	24	0.010395	52	56	0.002099	84	88	0.000424	116	120	0.000086
24	28	0.008511	56	60	0.001718	88	92	0.000347			
28	32	0.006968	60	64	0.001407	92	96	0.000284			

Time Area Diagram for Green Roof at Pipe Number S2.000 (Storm)

Area (m³) 1555 Evaporation (mm/day) 3
Depression Storage (mm) 100 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.028257	12	16	0.015508	24	28	0.008511	36	40	0.004671
4	8	0.023135	16	20	0.012697	28	32	0.006968	40	44	0.003824
8	12	0.018942	20	24	0.010395	32	36	0.005705	44	48	0.003131

Time Area Diagram for Green Roof at Pipe Number S2.000 (Storm)

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
48	52	0.002563	68	72	0.000943	88	92	0.000347	108	112	0.000128
52	56	0.002099	72	76	0.000772	92	96	0.000284	112	116	0.000104
56	60	0.001718	76	80	0.000632	96	100	0.000233	116	120	0.000086
60	64	0.001407	80	84	0.000518	100	104	0.000190			
64	68	0.001152	84	88	0.000424	104	108	0.000156			

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

Simulation Criteria

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

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0
Number of Storage Structures 2
Number of Time/Area Diagrams 2
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
Region Scotland and Ireland
M5-60 (mm) 16.100
Ratio R 0.278
Cv (Summer) 0.750
Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 10080
Return Period(s) (years) 1, 30, 100
Climate Change (%) 20, 20, 20

PN	**US/MH Name**	**Event**	**Duration (mins)**	**US/CL (m)**	**Water Level (m)**	**Surcharged Depth (m)**	**Flooded Volume (m³)**
S1.000	S1	10080 minute 100 year Winter I+20%	10080	5.150	3.615	-0.210	0.000
S1.001	S2	15 minute 100 year Winter I+20%	15	4.700	3.361	-0.146	0.000
S2.000	S2	10080 minute 100 year Winter I+20%	10080	5.000	3.395	-0.209	0.000
S2.001	S3	15 minute 100 year Winter I+20%	15	5.000	3.351	-0.119	0.000
S1.002	S3	15 minute 100 year Winter I+20%	15	4.700	3.332	-0.500	0.000
S1.003	S6	180 minute 100 year Winter I+20%	180	4.179	3.288	-0.109	0.000
S1.004	S6	480 minute 100 year Winter I+20%	480	4.100	3.355	-0.026	0.000
S1.005	S4	180 minute 100 year Winter I+20%	180	4.100	2.987	-0.186	0.000
S1.006	S5	180 minute 100 year Winter I+20%	180	4.300	2.956	-0.190	0.000
S1.007	S6	180 minute 100 year Winter I+20%	180	4.700	2.830	-0.187	0.000

PN	**US/MH Name**	**Flow / Cap.**	**Overflow (l/s)**	**Maximum Vol (m³)**	**Pipe Flow (l/s)**	**Status**
S1.000	S1	0.01		0.012	0.5	OK

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S1.001	S2	0.23		0.161	9.7	OK
S2.000	S2	0.01		0.012	0.5	OK
S2.001	S3	0.31		0.217	9.7	OK
S1.002	S3	0.13		0.672	28.8	OK
S1.003	S6	0.10		21.619	2.6	OK
S1.004	S6	0.04		0.281	1.8	OK
S1.005	S4	0.07		0.066	1.9	OK
S1.006	S5	0.06		0.049	1.9	OK
S1.007	S6	0.07		0.079	1.9	OK

Richmond Road Works Surface Water Drainage Network 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)	100	PIMP (%)	100
M5-60 (mm)	16.100	Add Flow / Climate Change (%)	0
Ratio R	0.278	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.169	4-8	0.101

Total Area Contributing (ha) = 0.270

Total Pipe Volume (m³) = 10.277

Network Design Table for Storm

« - Indicates pipe capacity < flow

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**
1.000	46.231	0.191	242.0	0.067	4.00	0.0	0.600	o	300	Pipe/Conduit	🔒
1.001	70.228	0.234	300.1	0.067	0.00	0.0	0.600	o	300	Pipe/Conduit	🔒
1.002	26.275	0.088	298.6	0.067	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)**
1.000	50.00	4.77	3.300	0.067	0.0	0.0	0.0	1.01	71.1	9.1
1.001	50.00	6.06	3.109	0.134	0.0	0.0	0.0	0.90	63.8	18.1
1.002	50.00	6.55	2.875	0.201	0.0	0.0	0.0	0.90	63.9	27.2

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
1.003	10.610	0.038	279.2	0.069	0.00	0.0	0.600	o	150	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)
1.003	50.00	6.84	2.787	0.270	0.0	0.0	0.0	0.60	10.5«	36.6

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	1	4.986	3.300	1.386	Open Manhole	1200
1.001	o	300	2	4.564	3.109	1.155	Open Manhole	1200
1.002	o	300	3	4.341	2.875	1.166	Open Manhole	1200
1.003	o	150	4	4.706	2.787	1.769	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	46.231	242.0	2	4.564	3.109	1.155	Open Manhole	1200
1.001	70.228	300.1	3	4.341	2.875	1.166	Open Manhole	1200
1.002	26.275	298.6	4	4.706	2.787	1.619	Open Manhole	1200
1.003	10.610	279.2		4.529	2.749	1.630	Open Manhole	0

Area Summary for Storm

Pipe Number	**PIMP Type**	**PIMP Name**	**PIMP (%)**	**Gross Area (ha)**	**Imp. Area (ha)**	**Pipe Total (ha)**
1.000	-	-	100	0.067	0.067	0.067
1.001	-	-	100	0.067	0.067	0.067
1.002	-	-	100	0.067	0.067	0.067
1.003	-	-	100	0.069	0.069	0.069
				Total 0.270	Total 0.270	Total 0.270

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)**
1.003		4.529	2.749	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.200	Storm Duration (mins)	30
Ratio R	0.302		

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

Simulation Criteria

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

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.278
Region Scotland and Ireland Cv (Summer) 0.750
M5-60 (mm) 16.100 Cv (Winter) 0.840

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

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) 1, 30, 100
Climate Change (%) 20, 20, 20

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	1	15 minute 100 year Winter I+20%	15	4.986	4.302	0.702	0.000	0.33
1.001	2	15 minute 100 year Winter I+20%	15	4.564	4.282	0.873	0.000	0.45
1.002	3	30 minute 100 year Winter I+20%	30	4.341	4.232	1.057	0.000	0.71
1.003	4	30 minute 100 year Winter I+20%	30	4.706	4.185	1.248	0.000	5.82

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
1.000	1		1.128	22.3	SURCHARGED
1.001	2		4.504	27.6	FLOOD RISK
1.002	3		6.408	41.0	FLOOD RISK
1.003	4		3.348	55.0	SURCHARGED

Appendix D : Foul Water Network Calculations [Micro Drainage]

FOUL SEWERAGE DESIGN

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	6.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	1.500
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	1.00
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

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
1.000	45.940	0.306	150.1	0.000	16	0.0	1.500	o	225	Pipe/Conduit	🔒
1.001	7.278	0.049	148.5	0.000	0	0.0	1.500	o	225	Pipe/Conduit	🔒
2.000	25.335	0.220	115.2	0.000	51	0.0	1.500	o	225	Pipe/Conduit	🔒
1.002	79.788	0.532	150.0	0.000	36	0.0	1.500	o	225	Pipe/Conduit	🔒
1.003	28.308	0.298	95.0	0.000	30	0.0	1.500	o	225	Pipe/Conduit	🔒
1.004	12.021	0.060	200.0	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)
1.000	3.500	0.000	0.0	16	0.0	18	0.32	0.94	37.2	0.5
1.001	3.190	0.000	0.0	16	0.0	18	0.32	0.94	37.4	0.5
2.000	3.358	0.000	0.0	51	0.0	30	0.50	1.07	42.5	1.6
1.002	3.141	0.000	0.0	103	0.0	45	0.57	0.94	37.2	3.2
1.003	2.609	0.000	0.0	133	0.0	45	0.72	1.18	46.8	4.1
1.004	2.311	0.000	0.0	133	0.0	54	0.56	0.81	32.2	4.1

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	1	5.000	3.500	1.275	Open Manhole	1200
1.001	o	225	2	5.000	3.190	1.585	Open Manhole	1200
2.000	o	225	3	5.000	3.358	1.417	Open Manhole	1200
1.002	o	225	3	4.700	3.141	1.334	Open Manhole	1200
1.003	o	225	4	4.100	2.609	1.266	Open Manhole	1200
1.004	o	225	5	4.800	2.311	2.264	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	45.940	150.1	2	5.000	3.194	1.581	Open Manhole	1200
1.001	7.278	148.5	3	4.700	3.141	1.334	Open Manhole	1200
2.000	25.335	115.2	3	4.700	3.138	1.337	Open Manhole	1200
1.002	79.788	150.0	4	4.100	2.609	1.266	Open Manhole	1200
1.003	28.308	95.0	5	4.800	2.311	2.264	Open Manhole	1200
1.004	12.021	200.0		4.498	2.251	2.022	Open Manhole	0

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)
1.004		4.498	2.251	0.000	0	0

Appendix E : Irish Water Confirmation of Feasibility

Uisce Éireann
Bosca OP448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

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

www.water.ie

CONFIRMATION OF FEASIBILITY

Dieter Bester

DBFL
Ormond House
Ormond Quay Upper
Dublin
Dublin
D07 W704

16 August 2022

Our Ref: CDS22005766 Pre-Connection Enquiry
158A Richmond Road, Drummcondra, Co. Dublin

Dear Applicant/Agent,

We have completed the review of the Pre-Connection Enquiry.

Irish Water has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 150 unit(s) at 158A Richmond Road, Drummcondra, Co. Dublin, (the **Development)**.

Based upon the details provided we can advise the following regarding connecting to the networks;

- **Water Connection** - Feasible without infrastructure upgrade by Irish Water
- **Wastewater Connection** - Feasible without infrastructure upgrade by Irish Water

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Irish Water.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at www.water.ie/connections/get-connected/

Where can you find more information?

- **Section A -** What is important to know?

This letter is issued to provide information about the current feasibility of the proposed connection(s) to Irish Water's network(s). This is not a connection offer and capacity in Irish Water's network(s) may only be secured by entering into a connection agreement with Irish Water.

For any further information, visit **www.water.ie/connections**, **email** **newconnections@water.ie** or contact 1800 278 278**.**

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Section A - What is important to know?

What is important to know?	Why is this important?
Do you need a contract to connect?	• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Irish Water's network(s). • Before the Development can connect to Irish Water's network(s), you must submit a connection application and be granted and sign a connection agreement with Irish Water.
When should I submit a Connection Application?	• A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	• Irish Water connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Irish Water's network(s), including works in the public space, must be carried out by Irish Water*. *Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works
Fire flow Requirements	• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine. • **What to do?** - Contact the relevant Local Fire Authority
Plan for disposal of storm water	• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. • **What to do?** - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Irish Water's network(s)?	• Requests for maps showing Irish Water's network(s) can be submitted to: datarequests@water.ie

What are the design requirements for the connection(s)?	- 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,*** available at www.water.ie/connections
Trade Effluent Licensing	- Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended). - More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

Appendix F : Irish Water Statement of Design Acceptance

UISCE
ÉIREANN : IRISH
WATER

Dieter Bester
Ormond House
Ormond Quay Upper
Dublin, Dublin D07 W704

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

5 September 2022

Re: Design Submission for 158A Richmond Road, Drummcondra, Co. Dublin (the "Development")
(the "Design Submission") / Connection Reference No: CDS22005766

Dear Dieter Bester,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Marina Byrne
Phone: 01 89 25991/ 087619321
Email: mzbyrne@water.ie

Yours sincerely,

Yvonne Harris

Yvonne Harris
Head of Customer Operations

Appendix A

Document Title & Revision

- 210178-DBFL-CS-SP-DR-C-1300-C-1300
- 210178-DBFL-CS-SP-DR-C-3311 Longitudinal Sections Through Foul Water Sewers - Sheet 1

Additional Comments

The design submission will be subject to further technical review at connection application stage.

While Irish Water notes that the wastewater services infrastructure will remain private and not be vested, we have the following comments: It is recommended that the foul sewer should have 3 m clearance from the proposed building.

Irish Water cannot guarantee that its Network in any location will have the capacity to deliver a particular flow rate and associated residual pressure to meet the requirements of the relevant Fire Authority, see Section 1.17 of Water Code of Practice.

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

Appendix G : Stormbloc Brochure and Maintenance Procedures

Stormbloc® Optimum

Attenuate surface water and stormwater effectively even in challenging high-traffic urban environments.

Stormbloc® Optimum is a resilient geocellular storage system that provides underground storage and infiltration of urban runoff.

Lightweight materials combined with robust design make it easy to transport, quick to install and extremely durable, even beneath high-traffic areas such as roads, car parks and warehouse yards.

Stormbloc® Optimum is modular and easily customisable, giving you the freedom to configure storage for even the most challenging SuDS project.

Applications

- New and retrofit Sustainable Drainage (SuDS) schemes.
- Infiltration / soakaway schemes.
- Attenuation schemes.
- Highways and infrastructure projects.
- To increase swale / pond capacity.
- Car parks and Park & Ride schemes.
- Housing Developments.
- Schools and Public / Civil schemes.
- Aquifer re-charge.
- Storage for rainwater harvesting and re-use.

Inspection and Maintenance Access

Access shafts can be easily constructed during installation of the Stormbloc® Optimum system to enable inspection and maintenance.

The channels between the vertical struts allow access for CCTV inspection, maintenance and cleaning and ensures that the storage volume of the system isn't compromised by the build up of silts.

Benefits

Customise Your Storage

Length, width and depth of storage can be customised in order to meet even the most demanding of drainage environments. Two inspection channels enable easy inspection and maintenance.

Save Space On Site

Stormbloc® Optimum stacks into compact nests for transportation and storage, saving valuable space during transport and on site. The nested units can also enable more storage volume to be lifted into excavations at any one time, saving time and cost of lifting machinery. The units unstack simply for installation. With up to 75% space reduction, a double pallet of stacked, nested boxes delivers more than 14 m^3 of stormwater storage, and a single lorry delivery can provide 345 m^3.

Lightweight and Strong

Combining strength with a storage coefficient of 96%, Stormbloc® Optimum allows you to plan and design effective SuDS systems even in challenging urban environments with high traffic levels. The Stormbloc® Optimum can withstand heavy goods vehicle traffic with an overall load of up to 60 tons, and can be installed at base depths of up to 4 metres.

Technical information

	Stormbloc® Optimum Full Block	Stormbloc® Optimum Half Block
Material	Polypropylene	Polypropylene
Length / Width / Height	800 / 800 / 660 mm	800 / 800 / 360 mm
Nominal Block Volume	0.422 m³	0.230 m³
Nominal Storage Capacity per Unit	0.405 m³	0.221 m³
Constructed Block Weight	18.6 kg	13.7 kg
Porosity	96%	96%
Vertical Ultimate Compressive Strength	≥ 420 kN/m²	≥ 420 kN/m²
Horizontal Ultimate Compressive Strength	≥ 165 kN/m²	≥ 225 kN/m²

Stormbloc® Optimum inspection and maintenance channel.

Stormbloc® Optimum installation.

Learn more

To learn more about how Stormbloc® Optimum can help you to make better water management decisions, visit **hydro-int.com**, search **Stormbloc Optimum** online or contact us:

Americas
+1 (207) 756 6200
inquiries@hydro-int.com

Asia Pacific
+61 436 433 686
enquiries@hydro-int.com

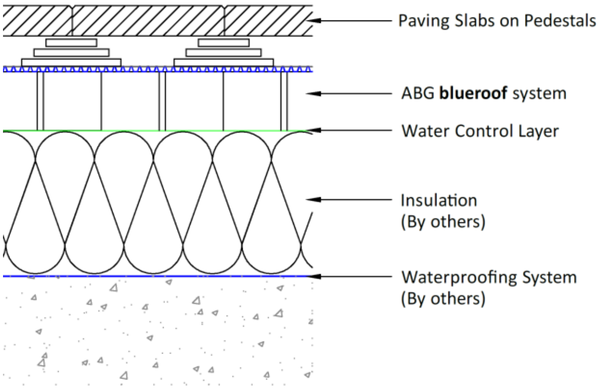
Europe & RoW
+44 (0)1275 878371
enquiries@hydro-int.com

Middle East
+971 506 026 400
enquiries@hydro-int.com

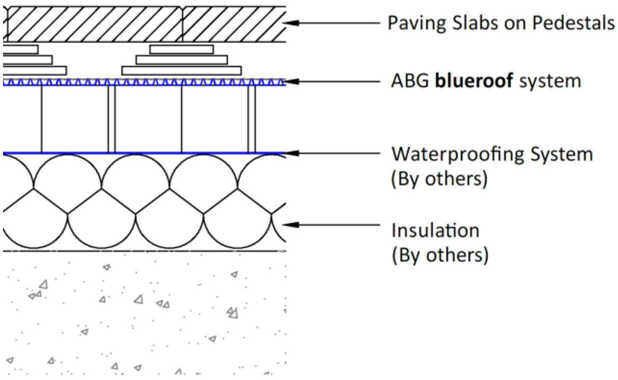
hydro-int.com/contact

Appendix H : ABG Blue/Green Roof Brochure

blueroof System Range D



Inverted Roof Construction



Warm Roof Construction

ABG **blueroof** systems provide a constant drainage path, SuDS attenuation, filtration and controlled release of stormwater, combining all the key elements of a good SuDS design. The storage element of the system must be used in conjunction with the 'blue roof' restrictor chamber. These chambers are bespoke to each project in order to help achieve the project engineer's maximum discharge rates, and to suit the required build-up and final use of the podium/roof area. ABG's 'blue roofs' are generally used for zero falls, inverted/warm roof and podium applications, under a mix of hard and soft landscaped finishes. Other combinations of ABG **blueroof** systems and most surface finishes are available. Please refer to ABG's Technical team for project/system specific advice & 'blue roof' SuDS calculations.

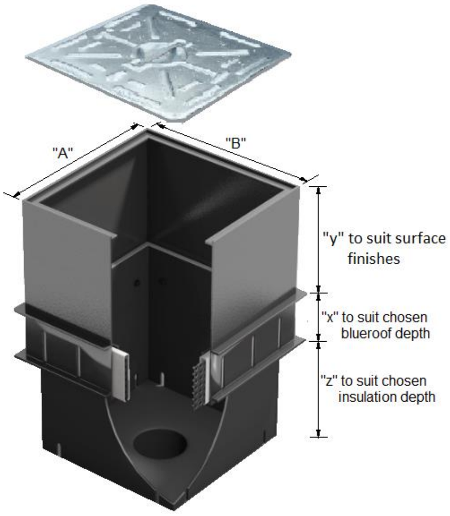
		ABG blueroof VF HD							
System Properties		**58mm**	**80mm**	**108mm**	**130mm**	**158mm**	**180mm**		
Thickness at 2kPa	(mm)	58	80	108	130	158	180	±10%	EN ISO 9863-1
Maximum saturated weight	(kg/m²)	58	80	108	130	158	180	approx.	EN ISO 9864
Stormwater attenuation volume	(l/m^2)	50	65	97	113	145	160		
Growing medium recharge value	(l/m^2)	25	25	25	25	25	25		Per 100mm depth
Drainable void space	%	86	81	90	87	92	89		
Resistance to weathering		Greater than 60% retained tensile strength							EN 12224
Resistance to chemicals		Excellent							EN 14030
Upper Filter/Separator Properties									
Pore size O_{90}	(µm)	120						±30%	EN ISO 12956
Breakthrough head	(mm)	0						nominal	BS 6906 Part 3
CBR puncture resistance	(N)	1 600						-20%	EN ISO 12236
Dynamic perforation cone drop	(mm)	32						+20%	EN ISO 13433
Type and material	Non-woven needle-punched and heat-treated long staple fibre polypropylene Protector: Non-woven felt of polypropylene. Min wt. of 120g/m^2								
'Blue roof' system use & compatible surface finishes									
Suitable for ABG Load Class 2 (Pedestrians, cycles and light vehicles, MUGAs, medium sized plant installations). Landscaped, paved or permeable resin-bound gravel finishes.									

Notes

1. The values given are indicative and correspond to nominal results obtained in our laboratories and testing institutes. In line with our policy of continuous improvement the right is reserved to make changes without notice at any time.
2. Any additional installations such as plant/services, PV panels, paved areas or additional vehicular/traffic access, must be discussed with ABG prior to their installation/use.
3. Final determination of the suitability of any information is the sole responsibility of the user. ABG will be pleased to discuss the use of this or any other product but responsibility for selection of a material and its application in any specific project remains with the user.
4. Can be used in conjunction with rainwater harvesting & grey water recycling systems. Any petrochemical pollution waste discharged from the system to be treated by others.

blueroof Restrictor Chamber

ABG **blueroof** Restrictor Chambers are purpose designed and patented as an integral part of ABG's **blueroof** system. Each chamber contains a restrictor valve and filter and when used in conjunction with our blue roof attenuation layers, controls the blue roof discharge rate in line with the planning consent of the site. Restrictor Chambers are available in 2 main types; a dense polypropylene chamber with galvanised lid for foot traffic only areas and a stainless steel chamber and lid for vehicular trafficked areas such as podiums or walkways (recessed lid also available). All chambers are accessible to allow for on-going maintenance. They are manufactured to order to specific heights as dictated by the chosen ABG **blueroof** system ("x"), surface finish ("y") and insulation depths ("z"). An alternative chamber profile is available when used with a parapet outlet.



Bespoke design specific heights

ABG Restrictor Chamber in place to insulation depth ready to receive the ABG blueroof system

Internal Restrictor Chamber – Polypropylene (maintenance foot traffic only) *(illustrated above)*

Materials	Upper chamber width (mm) ("A")	Upper chamber length (mm) ("B")	Application notes
Polypropylene chamber galvanised steel lid	361	361	Placed in open area of roof. Maintenance foot traffic only. No vehicular traffic. e.g. paved surface finish

Parapet Restrictor Chamber – Polypropylene (maintenance foot traffic only)*(no ribs on one side to fit to parapet)*

Materials	Upper chamber width (mm) ("A")	Upper chamber length (mm) ("B")	Application notes
Polypropylene chamber galvanised steel lid	361	341	Placed tight to parapet wall. Maintenance foot traffic only. No vehicular traffic. e.g. paved surface finish

Internal Restrictor Chamber – Steel (trafficked) *(similar profile to illustration above)*

Materials	Upper chamber width (mm) ("A")	Upper chamber length (mm) ("B")	Application notes
Stainless Steel chamber and lid	375	375	Placed in open area of roof. Pedestrian or vehicular traffic. e.g. podium deck

Parapet Restrictor Chamber – Steel (trafficked)*(no ribs on one side to fit to parapet)*

Materials	Upper chamber width (mm) ("A")	Upper chamber length (mm) ("B")	Application notes
Stainless Steel chamber and lid	375	350	Placed tight to parapet wall. Pedestrian or vehicular traffic. e.g. podium deck

blueroof Filter Geotextile Characteristics

Characteristic	Units	Value	Allowable variance	Standard
Pore size O_{90}	(µm)	115	±30%	EN ISO 12956
Water flow at 50mm head	$l/m^2.s$	105	-15%	EN ISO 11058
Type of material	Non woven needle-punched polypropylene geotextile			
Resistance to chemicals	Excellent			EN ISO 14030

Appendix I : Murphy Geospatial Utility Survey and Utility Survey Report

Geospatial certainty you can trust murphygs.ie

Utility Survey Report

Project Name – Leydons Richmond Road

Project Number – 43568

Client – Malkey Limited

Document Register

Rev	Date	Prepared by	Role	Checked by	Role	Revision Reason
00	28/10/2021	IP	CAD Technician	DS	Quality Manager	First issue

Contents

1 Introduction

1.1 Terms of Reference

Location:	**158A Richmond Rd, Ballybough, Dublin 3**
Client:	**Malkey Limited**
Utility Survey Date start:	**27/10/2021**

This report should be viewed with the following drawings: **MGS43568-U.dwg**

This document is the technical report for this investigation; it therefore supersedes any previous reports whether written or oral.

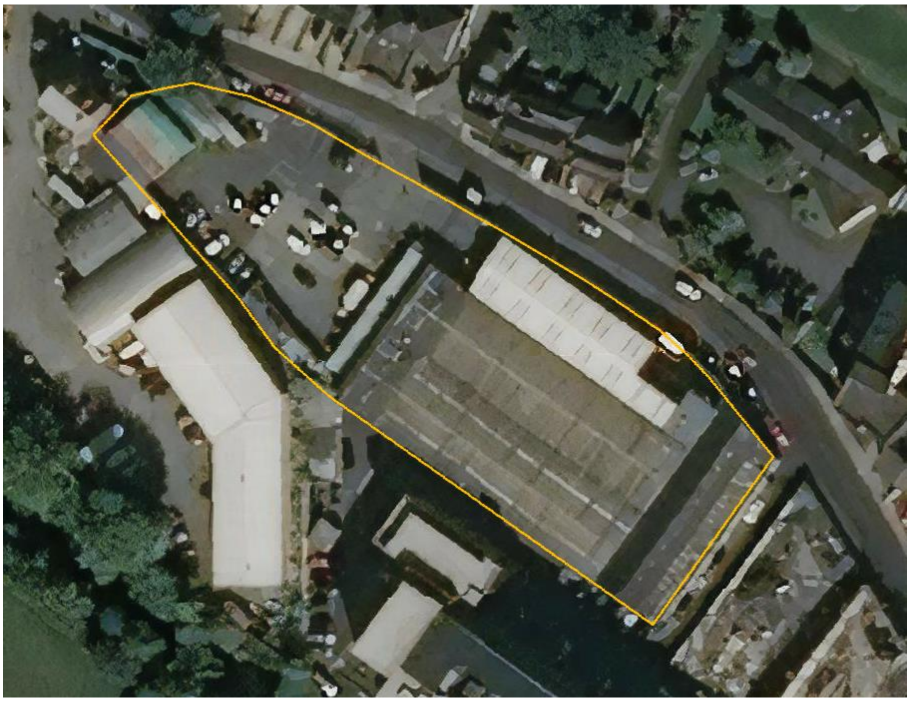
1.2 Background/Purpose of Investigation

Murphy Geospatial were requested to carry out a full GPR & utility survey on behalf of Malkey Limited. The intention of this survey is to detect, locate and record all existing Utilities and highlight any anomalies in the required area for upcoming works.

1.3 Objective of project

The objective of the survey was to locate the position and depth of all existing underground utilities using a combination of non-intrusive survey techniques. As the main investigative techniques used are largely non-destructive, the findings given in this report are based on indirect measurements and the interpretation of acoustic, electrical and electromagnetic signals. The findings represent the best professional opinions of the authors, based on our experience and the results of non-intrusive pipe location carried out elsewhere on similar materials and projects.

1.4 Site aerial view



1.5 Key Personnel

Project Manager:	**Aidan Doherty** *Responsible for the management of the overall project*
Senior Surveyor:	**Luke Maguire** *Lead surveyor responsible for the site work*
Safety Advisor:	**Dermot Guiney** *Responsible for safety inductions (internal requirements only) and advising on safe working practices*
Quality Manager:	**Daniel Stempien** *Responsible for processing and quality assessment of data*

1.6 Specifications and International Standards

All survey works were carried out in accordance with the following guidelines and standards:

- European GPR Association - Policy on the Use of GPR in Utility Detection
- American Society of Civil Engineers- Standard Guideline for the collection and depiction of existing subsurface utility data.
- Radio detection- abc & xyz of locating buried pipes and cables.
- PAS128: 2014 – Publicly Available Specification 128 2014

2 Survey Report

2.1 Survey Restrictions

There was limited or no access to some areas due to parked cars or containers/pallets located on the site – please refer to the drawing.

2.2 Field Data Survey

Survey was carried out in ITM OSGM15 coordinate system. All levels are related to Malin Head Datum. Survey results were overlaid on the topographical background.

2.3 Traffic Management

No Traffic Management was required for this project.

2.4 Methodology

2.4.1 Underground Utility & GPR Survey

Murphy Geospatial detect conductive services with the use of the Radio detection RD8100 receivers and transmitters which use very low electromagnetic frequencies to detect the services utilising the following methods:-

Direct Connection – This technique incorporates the use of a signal generator which is capable of generating sine waves at very low frequencies, typically 8 kHz or 33 kHz which can be applied to a metallic service. The service acts like an aerial and conducts the transmitted signal, which can then be detected on the surface using the receiver.

This is the most accurate method of locating a buried service and is applied in the first instance where access to pipes and cables is possible.

Signal Clamp – The signal clamp will be used to trace buried LV and HV cables. The signal will be applied via a clamp which is placed around the cable at a point the service enters or exits the ground.

Induction – Where a direct signal cannot be applied, the transmitter is used to radiate an indirect signal actively. The transmitter has a built-in aerial, which is capable of transmitting an electromagnetic field into the ground which conducts along the pipe or cable and can be detected on the surface using a receiver.

Passive – In Passive mode, the receiver is used without the transmitter to detect signals, which are generated by power cables or from distant radio transmitters, which constantly induce a signal into metallic services.

This method should only be used once both Direct Connection and Induction methods have been exhausted.

2.4.2 GPR Methodology:

A number of different GPR grids were set out over the site. Data field files were collected with a multi frequency array antenna system to give maximum depth penetration whilst maintaining a high resolution at both shallow and deep depths. Full calibration was carried out at the start scan with constant quality monitoring during acquisition and frequent recalibration checks were carried out where necessary.

Depth readings from GPR rely on multiplying the measured two-way travel time by the velocity of the radio signals passing through the materials under investigation. As the surface and subsurface of the site changes, frequent recalibration of the subsurface velocities results in an accurate calculation of depths and thicknesses of located features relative to the surface.

Post site processing then took place in the office, using specialised software, GPR Slice. A number of processing stages were involved, including start time correction, amplitude gain adjustments, Gaussian filtering, dynamic correction and noise removal. Once the raw data was processed individual targets were identified on each survey line and linear features mapped out over the survey areas. These GPR results are then incorporated into AutoCAD for final processing.

2.5 Equipment Used

RD4000/8000, Dual-Frequency GPR Radar System, Sonde, Copper Flex, Trimble S3 Total Station/R6 GPS Trimble

2.6 Surveyors Involved

Luke Maguire, Adam Maguire

2.7 Works Programme

Site Works Commenced in October 2021

Delivery of drawings – 28/10/2021

2.8 Software Used for Processing

AutoCAD Civil 3D 2019

AutoCAD 2019

GPR Slice V7.0

GRED HD 3D 01.02.00

GeoPal.

2.9 Quality Assurance Site Procedures

Equipment used was calibrated and tested in line with manufacturer guidelines.

Calibration certificates can be provided on request. Distance & angle checks were carried out on site regularly.

2.10 Findings

2.10.1 Drainage

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
No evidence of foul/combined sewer network was identified within survey area. Storm water network was identified in manholes 3, 4, 6, 5, 2 and 1 running from manholes around the buildings towards manhole 1 where storm water is discharged to manhole offsite – please refer to the drawing. Please note that due to the siltage or blockage in the pipes, it was not possible to verify all drainage connections on site – please refer to the drawing. Drainage service records drawing doesn't show any connections within survey area.	B2P	M2P

2.10.2 Water Mains/Fire Mains

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
Due to possible non-metallic nature, no signal was detected from water valve located offsite which is possible the access valve for the main building connection. Water main pipe were identified in manhole 1 and then these pipes are exposed on the nearby wall. Service records drawing shows only a main water pipe entering the site in the North-East section of the site. Water pipes which are shown on records drawings but which couldn't be located and verified on site were marked with 'records' note and it is recommended to treat their location as indicative only.	B2P (located) B4 (records)	M2P

2.10.3 Electricity, HV, LV, Street lighting, Traffic

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
No evidence of Electrical cable was found within survey area. ESB records shows only electrical connections from offsite to EBOX located offsite. ESB connections which were shown on records but couldn't be located and verified don site were marked with 'records' note and it is recommended to treat their location as indicative only. Public lighting connections to the lamp poles were identified on site. Two lamp posts were reported as being disused – pleas refer to the drawing.	B4	M2P

2.10.4 Eir, Enet, UPC (Virgin), BT and other Comms

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
No evidence of Enet, BT, Eir, UPC was identified on site. There is no Enet, BT, Eir, UPC in this area according to records data.	N/A	M2P

2.10.5 Gas, Oil & Fuel mains

Comments	Quality Level QL-A,B,C,D	Methodology M1 - M4
Due to non-metallic nature no signal was detected of gas pipe which is present within survey area according to the GNI records drawings. GPR results were also not fully conclusive for this gas pipe and only some sections of the gas network were identified on site – please refer to the drawing. Sections which are shown on records drawings but which couldn't be located and verified on site were marked with 'records' note and it is recommended to treat their location as indicative only.	B2P (located) B4 (records)	M2P

2.10.6 GPR data conclusion

Comments
Generally, the depth of investigation from GPR does not exceed 1.5 metres in this area. As well as all the confirmed utility services which have been identified, there are unidentified features shown as GPR Anomalies. These features may be the result of services which are running through the sites, abandoned services, natural geological features or land drains amongst other things.

2.11 Manhole and pit schedules

Each manhole/inspection cover within the survey area was opened and the contents documented. These measurements are recorded on a digital manhole description sheet using Geopal applications. The manholes were individually numbered. All depths recorded inside the chamber were by disto, measuring tape or levelling staff. Details included:

- Cover Levels
- Invert levels
- Service Type
- Service Material
- Pipe sizes
- Chamber dimensions
- Direction of flow
- Photographs

After completing manhole investigation each manhole sheets was exported to Excel format and submitted together with final drawing and GPR report as a part of final deliverables.

2.12 Recommendations

Services which are shown on service records drawings, but which couldn't be located and verified on site and services which couldn't be traced due to no signal being obtained or signal being lost during the trace will require further investigation.

It is recommended to carry out slit trenching investigation in this area which would allow identifying location and depths of these untraceable services.

Drainage lines which couldn't be traced will require further investigation. It is recommended to clean (jet wash) the pipes and carry out CCTV investigation works which would allow identifying connection points for these pipes.

It is recommended to clear the area from any obstacles and re-check those cleared areas for any potential evidence of the manholes or services in those currently obstructed sections of the site.

3 Pas Detection Methods and Quality Level Tables

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-Processing	Location Accuracy		Supporting Data
				Horizontal 1)	Vertical 2)	
D	Desktop utility records search	QL-D	-	Undefined	Undefined	-
C	Site reconnaissance	QL-C	-	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection 3)	QL-B4	-	Undefined	Undefined	A utility segment which is suspected to exist but has not been detected and is therefore shown as an assumed route.
		QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used
		QL-B3P	Yes			
		QL-B2	No	±250 mm or ±40% of detected depth whichever is greater	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. 4)
		QL-B2P	Yes			
		QL-B1	No	±150 mm or ±15% of detected depth whichever is greater	±15% of detected depth	Horizontal and vertical location of the utility detected by multiple geophysical techniques used. 5)
		QL-B1P	Yes			
A	Verification	QL-A	-	±50 mm	±25 mm	Horizontal and vertical location of the top and/or bottom of the utility.

1) Horizontal location is to the centreline of the utility.
2) Vertical location is to the top of the utility.
3) For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 8.2.1.1.2).
4) Electronic depth readings using EML equipment are not normally sufficient to achieve a QL-B2 or higher.
5) Some utilities can only be detected by one of the existing detection techniques. As a consequence, such utilities cannot be classified as a QL-B1.

Method 1) (to be determined in consultation with the client)	Survey Grid/Search Resolution 2)				Quality Levels achievable	Typical Application (informative)
	EML 3)	GPR		Other Techniques 4)		
		General	Post-Processing			
M1	Orthogonal search transect at ≤10 m intervals and when following a utility trace, search transects at ≤5 m intervals	Use as applicable	No	≤5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of an undeveloped area
M1P			Yes		B1P, B2P, B3P	
M2	Orthogonal search transect at ≤5 m intervals and when following a utility trace, search transects at ≤2 m intervals	Either: a) ≤2 m orthogonal; or b) high density array 5)	No	≤2 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a suburban area or where the utility services cross a boundary of a survey area
M2P			Yes		B1P, B2P, B3P	
M3	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤1 m intervals	Either: a) ≤1 m orthogonal; or b) high density array 5)	No	≤1 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a busy urban area or for clearance surveys prior to operations such as borehole/drilling/fencing/ tree planting
M3P			Yes		B1P, B2P, B3P	
M4	Orthogonal search transect at ≤2 m intervals and when following a utility trace, search transects at ≤0.5 m intervals	Either: a) ≤0.5 m orthogonal; or b) high density array 5)	No	≤0.5 m survey grid	B1, B2, B3, B4	Used where the density of services is typical of a congested city area
M4P			Yes		B1P, B2P, B3P	

NOTE 1 In general the effort increases from M1 to M4 and the addition of post-processing. For areas with a greater density of utilities or areas considered high risk by the client, a detection method that has a higher level of effort should be selected.

NOTE 2 "P" indicates off-site post-processing has been included.

1) It is a requirement that a minimum of GPR and EML techniques are used.
2) The tolerance for orthogonal transect centres and survey grids shall be ±0.1 m.
3) It is a requirement that passive EML is deployed over the whole survey area and that where an active EML method can be used, it is used.
4) The transect centre depends on technique used.
5) A high density array comprises 100 mm or closer antenna separation.

4 Disclaimers

The survey aims to map all existing utilities and sub-surface structures and provide information with respect to pipe size, material type and drainage connectivity. However, GPR surveying is limited by the following guidelines and it may not be possible to accurately survey, define and locate all services and sub-surface features. Survey Results are representative of the date and time of survey only.

- Locational accuracy is determined by referring to the manufacturers guidelines for the detectors used.

- Existing record information showing underground services is often incomplete and unknown accuracy; therefore, it should be regarded only as an indication.

- In ideal conditions these spatial accuracies for the underground utilities are +/- 5% for the RD4000 and +/- 10% of depth for the GPR to 2.5m deep. However, variations within the subsurface may alter this estimated accuracy.

- Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.

- GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying.

- Due to the attenuation of the radar signal with depth, resolution is restricted, hence making identification of anomalies difficult with increasing depth.

- The depth penetration and quality of the data depends on the ground conditions on the site. Poor data may be a result of areas with high conductivity. Also, high reflective materials close to the surface i.e., rebar may hide deeper anomalies.

- It is not always possible to trace the entire length of each underground service.

- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown “Taken from Records” on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.

- Unless otherwise stated, all services and sub-surface structures shown on Murphy Geospatial plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.

- Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run on close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.

- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

No allowance has been made within our quotation, unless otherwise stated, for the location and mapping of undeclared services. Failure to detect or fully map any declared service will be recorded within the notes accompanying our final drawings.

Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.

Where Murphy Geospatial issues a CAD drawn utility service plan, this should be read in conjunction with all available public utility records etc. As part of our exhaustive Quality Control procedures, Murphy Geospatial endeavour to add relevant Public Utility record information onto the final issue drawing. An allowance should be made for the width of services, particularly where these are laid in bands or are of significant size etc. For clarification or appropriate easement bands, we would recommend that direct contact is made with the Asset Owner or Statutory Undertaker.

We exclude the following, except where otherwise specified and possible to do so:

- All private service connections, (including water or gas fittings where no through flow of applied signal is possible.
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Internal building services
- Fibre optic cables (except where laid with a standard communications cable or built-in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 38mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10-minute effort using standard heavy duty lifting apparatus.
- Services positioned directly below other pipes or cables etc (i.e., masking signal) - intrusive verification options available on request.
- Deep non-metallic pipes, ducts or culverts (unless probing or Pipe Track 3d is specified as part of the fully invasive survey option).

- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

Service provider utility drawings may not be up to date or give sufficient coverage of all areas surveyed, as such extra precaution should be taken when excavation works are carried out on site and it is recommended to contact service providers before commencing any excavation works within surveyed areas.

All work carried out by Murphy Geospatial conforms to the guidelines set out by The Survey Association (TSA).

5 GNI Gas Pipeline Disclaimer

Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice for Avoiding Danger from Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie.

6 General GPR Limitations

GPR surveying is limited by the following guidelines		**Minimizing GPR Limitations**
Depth and size of Utility	In good ground conditions and within the depth range of two metres the ability to detect a utility will reduce in diameter by 1mm for each 10mm of depth. i.e., a 200mm pipe can be detected at 2m and a 50mm pipe at 0.5m but a 25mm plastic water service pipe to a house cannot be detected at 1.2m with radar	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Shadowing	This can happen where shallow buried utilities hide or mask deeper buried utilities below.	Murphy Geospatial use mutli frequency radar systems to reduce the effect of shadowing.
Soil Condition	GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying. The depth penetration and quality of the data depends on the ground conditions on site. Poor data maybe a result of areas with high conductivity	Murphy Geospatial calibrate our GPR Systems for varying soil types on each project.
Plan Accuracies	Plan accuracies of the order of + or – 150mm maybe achieved but this figure will depend on the depth of the service below ground level.	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Utility location	Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.	Murphy Geospatial utility surveyors are all qualified and certified to locate underground services.
Existing **Utility Records**	Existing record information showing underground services is often incomplete and unknown accuracy; therefore, it should be regarded only as an indication.	It is always our intention to use the Utility provider's details, if supplied prior to survey commencement, as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore

		shown "Taken from Records" on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
Loss of Signal	It is not always possible to trace the entire length of each underground service.	Murphy Geospatial will indicate on the drawing if a service trace is lost.
Utility Congestion	Where similar services run on close proximity, separation maybe impossible.	Murphy Geospatial incorporated Radio Detection surveys in areas where GPR was found to be ineffective.
Pipe Material	Successful tracing of non-metallic pipes maybe limited due to material construction of the pipe.	Murphy Geospatial incorporate Radio Detection/ Manhole& PWG surveys in areas where GPR was found to be ineffective.

The American Society of Civil Engineers in their 'Standard Guidance for the collection and depiction of existing subsurface utility data' has a useful rule of thumb for GPR which in, metric values, can be summarised as: 'In good ground conditions and within the depth range of two metres the ability to detect a utility will reduce in diameter by 1mm for each 10mm of depth. i.e., a 200mm pipe can be detected at 2m and a 50mm pipe at 0.5m but a 25mm plastic water service pipe to a house cannot be detected at 1.2m with radar'.

Appendix J : Site Investigation

Richmond Road Phase 2 – Ground Investigation

Client:	Malkey Limited
Client's Representative:	DBFL Consulting Engineers
Report No.:	22-1762
Date:	January 2023
Status:	Interim Report

This report is an interim report to be used for indicative purposes only and should not be used for detailed design or tendering purposes.

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Approved: ISO 9001 • ISO 14001 • OHSAS 18001

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Document Control Sheet

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Appendix D	Trial pit logs
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Appendix E	Plate load test results
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Appendix G	Waste classification report

Document Control Sheet

Report No.:		22-1762			
Project Title:		Richmond Road Phase 2			
Client:		Malkey Limited			
Client's Representative:		DBFL Consulting Engineers			
Revision:	A00	**Status:**	Interim Report	**Issue Date:**	20th January 2023
Prepared by:		**Reviewed by:**		**Approved by:**	
Sean Ross Sean Ross BSc MSc MIEI PGeo		Colm Hurley Colm Hurley BSc PGeo		Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015+A1:2020, Code of practice for ground investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015+A1:2020, The Code of Practice for Ground Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler).
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler).
P	Nominal 100mm diameter undisturbed piston sample.
B	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
C	Core sub-sample (displayed in the Field Records column on the logs).
L	Liner sample from dynamic sampled borehole.
W	Water sample.
ES / EW	Soil sample for environmental testing / Water sample for environmental testing.
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained).
SPT (c)	Standard penetration test using 60 degree solid cone.
(x,x/x,x,x,x)	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.
(Y for Z/ Y for Z)	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm).
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm).
HVP / HVR	In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa.
V VR	Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength
Soil consistency description	In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of Nx5=Cu is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015+A1:2020	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum) measured in millimetres.

Richmond Road Phase 2

1 AUTHORITY

On the instructions of DBFL Consulting Engineers, ("the Client's Representative"), acting on the behalf of Malkey Limited ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed residential development.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results. A discussion on the recommendations for construction is also provided.

All information given in this report is based upon the ground conditions encountered during the ground investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included trial pits, soil sampling, environmental sampling, in-situ and laboratory testing, and the preparation of a report on the findings including recommendations for construction.

NOTE: The full scope of works has not been completed for the site.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted in the car park of Leydens Wholesalers & Distributors on Richmond Road in Drumcondra in Dublin. The site is bordered by Richmond Road to the north, and industrial units on all other sides. The Tolka River is located 40m to the south of the site.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted on the 20th December 2022, comprised:

- four machine dug trial pits
- an infiltration test performed in two trial pits
- plate load testing at two locations.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, and as shown on the exploratory hole location plan in Appendix A.

4.2 Trial Pits

Four trial pits (TP01–TP02 and IT01-IT02) were excavated using a JCB 3CX fitted with a 600mm wide bucket, to a maximum depth of 1.70m. IT01 and IT02 were excavated to allow completion of infiltration test.

Environmental samples were taken at standard depths in each trial pit.

Disturbed (bulk bag) samples were taken at standard depth intervals and at change of strata.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix B presents the trial pit logs with photographs of the pits and arising provided in Appendix C.

4.3 Infiltration tests

An infiltration/soakaway test was carried out at two locations (IT01- IT02) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

Appendix D presents the results and analysis of the infiltration test.

4.4 Plate load tests

Plate load tests were carried out at two locations (CBR01 and CBR02). Hardstanding at both locations was completed using a JCB3X excavator and the tests undertaken on the sub-base/made ground beneath the hardstanding.

The plate load tests were conducted as incremental loading tests in accordance with Clause 4.1 of BS1377:

Part 9: 1990 (British Standards Institute, 1990). A 450mmdiameter bearing plate was used with five equal loadings to a maximum pressure of approximately 300kPa, followed by unloading. The testing was conducted using a wireless plate load testing system, PLATEMAN, which utilises Bluetooth technology with a remotely-operated rugged PDA system.

Plate movements were measured using three strain gauges fitted to a remotely fixed tripod frame. Each loading increment was maintained until the plate movement had essentially stopped.

The test results provided in Appendix E are as follows:

- plots of the plate settlements, average of the three gauges, against pressure.

- plots of average settlement against time during the loading increments/decrement.

The Modulus of Subgrade Reaction, *k*, is estimated by applying a "best fit" to the settlement-pressure plots, and is reported in MPa/m. The numerical value represents the pressure, in kPa, on the bearing plate that induces 1.25mm of settlement.

An approximate CBR value was estimated using the guidance provided in the Interim Advice Note 73/06 (Revision 1, 2009) of the Design Guidance for Road Pavement Foundations (Draft HD25). The document provides methods to convert the measured k value to the equivalent for a 762mm diameter plate and the consequent relationship with CBR. This method of estimating an equivalent CBR value is relatively conservative.

5 LABORATORY WORK

5.1 Environmental laboratory testing of soils

Environmental testing, was conducted on selected environmental soil samples by Chemtest at its laboratory in Newmarket, Suffolk.

Rilta suite of analysis was carried out on seven samples for landfill disposal criteria. This included testing for a range of determinants, including:

Testing was carried out for a range of determinants, including:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- BTEX compounds
- Volatile Organic Compounds (VOCs)
- Semi-Volatile Organic Compounds (SVOCs)

- Polychlorinated biphenyls (PCBs)
- Phenols
- Organic matter
- Total Organic Carbon (TOC)
- Cyanides
- Asbestos screen
- Sulphate and sulphide
- Sulphur
- Phosphate
- Calcium
- pH
- Waste acceptance criteria (WAC)

Results of environmental laboratory testing are presented in Appendix F.

A waste classification report was compiled analysing the results of the above testing. The report is presented in Appendix G.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise made ground and alluvium. These deposits are underlain by limestones and shales of the Lucan Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Paved surface:** All location encountered 100mm of bitmac surfacing.

- **Made Ground (fill):** greyish brown sandy clayey gravel encountered immediately below bitmac containing anthropogenic material such as concrete and brick fragments, underlain by reworked sandy gravelly clay which also contained fragments of brick, concrete, scrap metal and Styrofoam.

6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was encountered during excavation of TP01 and IT01 as groundwater strikes at depths of 1.50m and 1.30m respectively. Groundwater was not noted during excavation of either of the other pits.

Seasonal variation in groundwater levels should also be factored into design considerations.

7 DISCUSSION

7.1 Proposed construction

It is proposed to construct a new residential development on the site with associated infrastructure.

No further details were available to Causeway Geotech at the time of preparing this report and any designs based on the recommendations or conclusions within this report should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory holes. Causeway Geotech were commissioned to provide a geotechnical report, and it is outwith our remit to advise on structure design.

7.2 Recommendations for construction

7.2.1 Access roads, car parks and hard standing

Based on a summary of the CBR tests undertaken at the site, it is envisaged that the upper strata on site may be suitable for the placement of road make up layers however it should be noted that the two results (0.7% and 30%) are likely representative of the variation in made ground encountered across the site within which the two tests were conducted. Ideally this made ground should be excavated and replaced with engineered backfill for pavement build up.

Table 2.1 of volume 7 section 2 of the Design Manual for Roads and Bridges (below), gives guidance on the average thickness of the pavement layers in relation to the CBR results. As can be seen, a CBR in excess of 15% does not require any capping layers, however a sub-base thickness of 200mm is suggested.

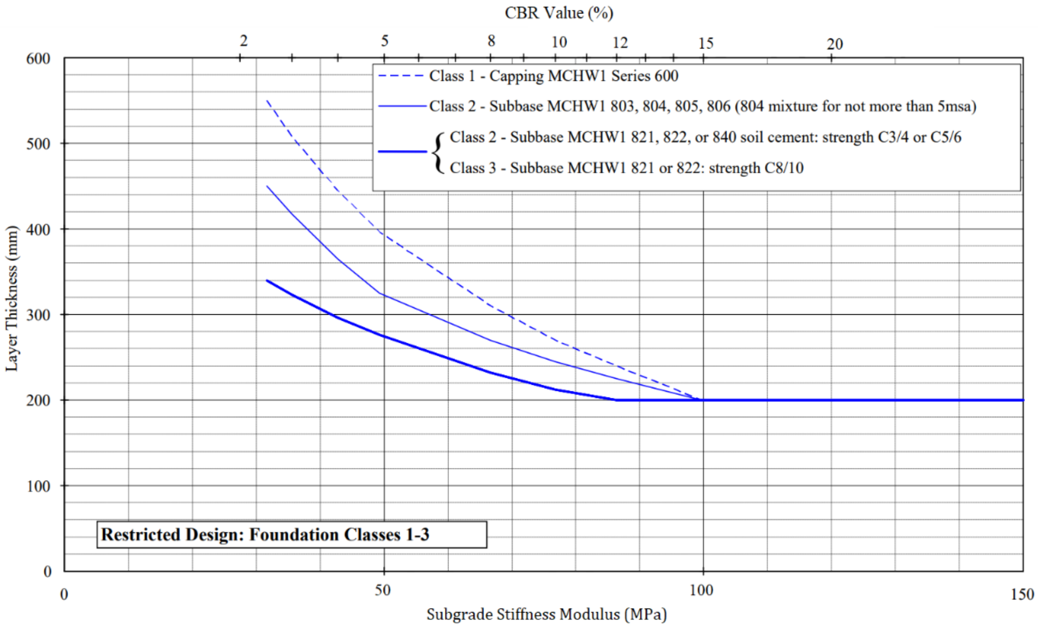


Table 2.1 (DMRB Vol.7 Sec2) 2009

It is recommended that further testing be undertaken during the course of construction works at intervals as set out in the Earthworks Specification, and should any areas indicate lower than expected value, the above plot should be used to determine the thicknesses of any capping or sub-base layers that may need to be placed in these areas.

The use of geosynthetics in the construction of paved areas, will be beneficial, particularly in areas of Made Ground. These could include a geosynthetic (e.g., a geogrid) at subgrade level with further benefit gained by incorporating further layer(s) within the capping/sub-base layer. Road design should be undertaken by a specialist earthworks contractor/designer.

7.3 Infiltration drainage

In infiltration test carried out in trial pit IT01 and IT02, the rates of infiltration were calculated as shown in Table 1 below.

Table 1 Summary of BRE soakaway test results

GI Ref	Infiltration rate (q)	Strata
IT01	n/a	Made Ground: Reworked sandy gravelly CLAY.
IT02	0.169	Made Ground: Reworked sandy gravelly CLAY.

The low-permeability fine-grained soils encountered in IT01 along with the soil descriptions, are therefore considered to be poor infiltration media, and would be deemed unsuitable for the implementation of infiltration drainage systems.

The rate of infiltration calculated in IT02 along with the material descriptions imply that the subsoil may be considered suitable media for an infiltration drainage system.

Reference should be made the Sustainable Drainage Systems (SuDS) design guidance, taking into account meteorological conditions and a hydrogeological assessment.

7.4 Waste classification

For consideration of material to be removed from site, a waste classification of the solid soil laboratory results was completed using HazWasteOnline™ software. A copy of the Waste Classification report is included at Appendix G. The Waste Classification report shows that the material tested can be classified as non-hazardous material considering the List of Wastes (LoW) code 17 for Construction and Demolition Wastes (including soils excavated from contaminated sites), specifically 17 05 03* and 17 05 04.

Following completion of the waste classification, and to determine a suitable disposal route for the soil, assessment of the WAC analysis of the samples was completed. The laboratory results of the WAC testing indicate that the soils from the site are suitable for disposal as Inert waste to an appropriate licenced facility with the exception of those samples listed in Table 2 which exceeded Inert WAC limits.

Table 2 Samples where Non-Haz WAC are exceeded

GI Ref	Determinant Failure	Comment
IT01 0.5m	-TOC (3.5%) exceeds Inert WAC (3.5%) -Antimony (0.074mg/kg) exceed Inert WAC (0.06%)	Exceeds Inert WAC, suitable for disposal as non-hazardous waste.
IT01 1.5m	-TOC (3.4%) exceeds Inert WAC (3.5%) -Antimony (0.064mg/kg) exceed Inert WAC (0.06%)	Exceeds Non-Haz WAC, suitable for disposal as hazardous waste.
TP01 1.5m	-TOC (3.3%) exceeds Inert WAC (3%)	Exceeds Non-Haz WAC, suitable for disposal as hazardous waste. (see Note 1)

Note 1: Per Section 2 paragraph 2.1.2.2 of EU Council Decision 2003-33-EC higher value TOC may be admitted by the competent authority for Inert WAC provided the DOC value of <500 mg/kg is achieved. It is recommended that the receiving destination review WAC test data to ensure suitability for disposal in line with licensing arrangements.

It is noted that this waste classification assessment has been based solely on the available samples results and corresponding investigation findings. In making this assessment all due care and attention to available and relevant legislative and guidance frameworks has been taken in arriving at the conclusions.

Also, potential areas of localised contamination outside the areas of the investigation cannot be discounted. Any potential contamination identified during site development work by visual or olfactory means should be investigated, including further laboratory testing, and appropriate health & safety, waste disposal and remediation measures adopted. Additional testing of the soils to be disposed from site may also be requested by the individual landfill before acceptance at their facility.

8 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland.

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.

BS 5930: 2015+A1:2020: Code of practice for ground investigations. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

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

Land contamination risk management (LCRM), (2020) Environment Agency.

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

Project No.:	22-1762	**Client:**	Malkey Limited
Project Name:	Richmond Road Phase 2	**Client's Representative:**	DBFL Consulting Engineers

Legend Key

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

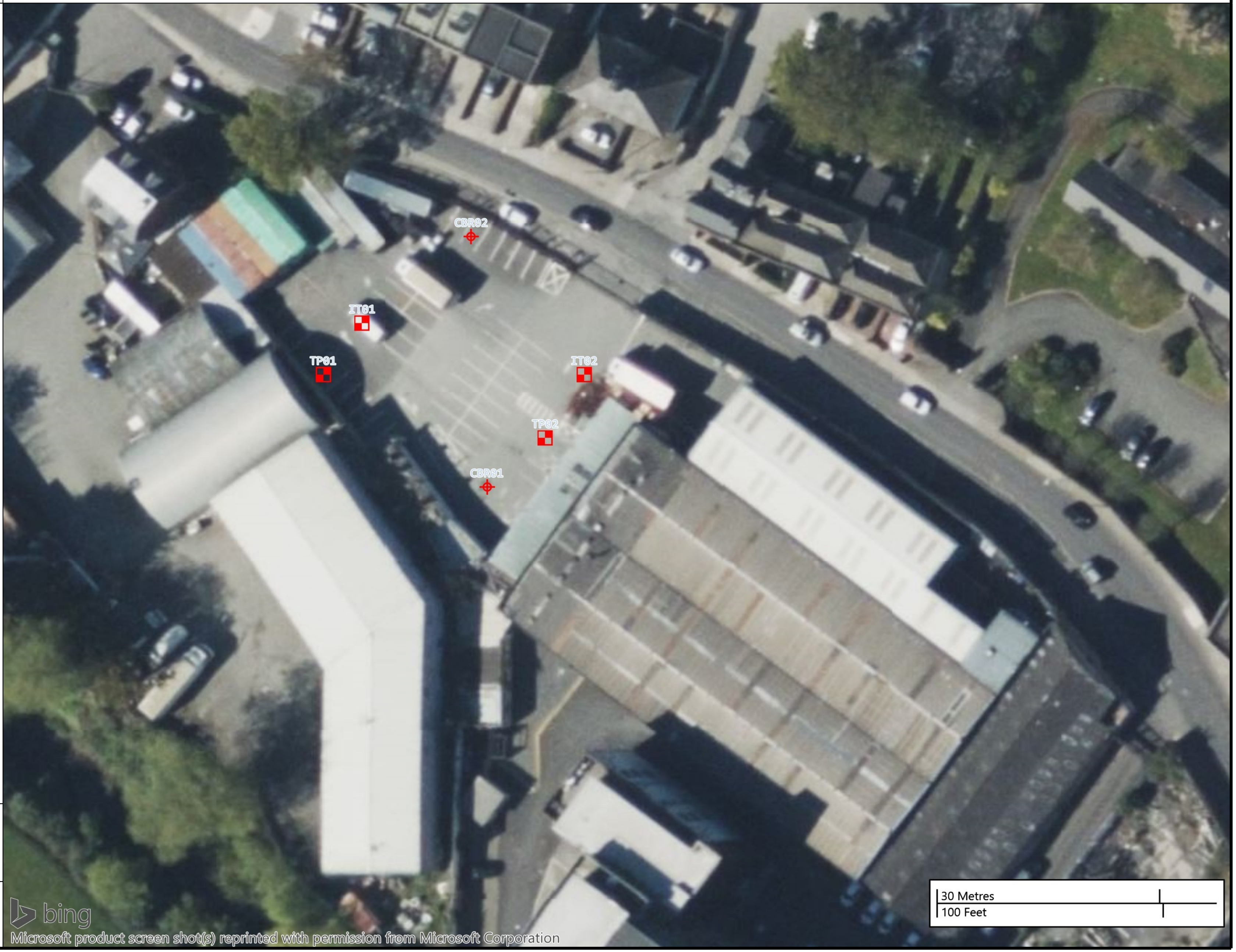
Title:
Site Location Plan

Last Revised:	**Scale:**
20/01/2023	1:10000

Project No.:	22-1762	**Client:**	Malkey Limited
Project Name:	Richmond Road Phase 2	**Client's Representative:**	DBFL Consulting Engineers

Legend Key

- ⌖ Locations By Type - PLT
- ▚ Locations By Type - TP



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

Title:

Site Location Plan

Last Revised:	**Scale:**
20/01/2023	1:750

APPENDIX B

TRIAL PIT LOGS

CAUSEWAY GEOTECH

Project No.: 22-1762

Project Name: Richmond Road Phase 2

Trial Pit ID: TP01

Coordinates: 716607.86 E 736468.04 N

Client: Malkey Limited

Method: Trial Pitting

Client's Representative: DBFL Consulting Engineers

Sheet 1 of 1
Scale: 1:25

Plant: JCB 3CX

Elevation: mOD

Date: 20/12/2022

Logger: DM

FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
				0.10	▩	BITMAC	
0.50 0.50	B1 ES2			0.75	▨	MADE GROUND: Greyish brown sandy clayey angular fine to coarse GRAVEL with fragments of brick and concrete. Sand is fine to coarse.	
1.50 1.50	B3 ES4	Heavy strike at 1.50m.		1.70	▨	MADE GROUND: Soft dark brown sandy gravelly CLAY with fragments of concrete, cinder blocks, scrap metal and wire. Sand is fine to coarse. Gravel is angular to subangular fine to coarse.	▼
						End of trial pit at 1.70m	

Water Strikes

Struck at (m)	Remarks
1.50	Heavy strike at 1.50m.

Depth: 1.70
Width: 0.70
Length: 2.10

Remarks:

Stability: Unstable

Termination Reason: Terminated due to water ingress causing the pit to collapse.

Last Updated: 20/01/2023

AGS

	Project No. 22-1762	**Project Name:** Richmond Road Phase 2	**Trial Pit ID** **TP02**
	Coordinates 716638.20 E 736460.23 N	**Client:** Malkey Limited	
Method: Trial Pitting		**Client's Representative:** DBFL Consulting Engineers	Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** mOD	**Date:** 20/12/2022 **Logger:** DM	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
				0.10	▩	BITMAC	
0.50 0.50	B1 ES2			0.60	▨	MADE GROUND: Greyish brown sandy angular to subangular fine to coarse GRAVEL with fragments of red brick, concrete and pieces of styrafoam. Sand is fine to coarse.	
						End of trial pit at 0.60m	

Water Strikes	
Struck at (m)	Remarks

Depth: 0.60
Width: 0.65
Length: 1.70

Remarks:
Steel plate/ chamber encountered at 0.60m.
No groundwater encountered.

Stability:	**Termination Reason**	**Last Updated**
Stable	Terminated on Engineer's instruction.	20/01/2023

APPENDIX C

TRIAL PIT PHOTOGRAPHS

CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP01
(m) 0.1 0.2 0.3 0.4 0.5

TP01


CAUSEWAY GEOTECH
Project Name
Richmond Road.
Project Number
22-1762
Date
20/12/22
EH Number
TP01
(m) 0.1 0.2 0.3 0.4 0.5

TP01


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP01
(m) 0.1 0.2 0.3 0.4 0.5

TP01


CAUSEWAY GEOTECH
Project Name Richmond Road
Project Number 22-1762
Date 20/12/22
TH Number TP01
(m) 0.1 0.2 0.3 0.4 0.5

TP01


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP02
(m) 0.1 0.2 0.3 0.4 0.5

TP02


CAUSEWAY
GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP02
(m) 0.1 0.2 0.3 0.4 0.5

TP02


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP02
(m) 0.1 0.2 0.3 0.4 0.5

TP02


CAUSEWAY GEOTECH
Project Name
Richmond Road,
Project Number
22-1762
Date
20/12/22
EH Number
TP02
(m) 0.1 0.2 0.3 0.4 0.5

TP02

Project Name Richmond Road.

Project Number 22-1762

Date 20/12/22

EH Number TP02

TP02


CAUSEWAY
GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
IT1
(m) 0.1 0.2 0.3 0.4 0.5

IT01


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
IT1
(m) 0.1 0.2 0.3 0.4 0.5

IT01


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
TP01
(m) 0.1 0.2 0.3 0.4 0.5

IT01


CAUSEWAY GEOTECH
Project Name
Richmond Road
Project Number
22-1762
Date
20/12/22
EH Number
IT2
(m) 0.1 0.2 0.3 0.4 0.5

IT02

CAUSEWAY
GEOTECH

APPENDIX D

SOAKAWAY TEST RESULTS

CAUSEWAY GEOTECH

Project No. 22-1762	**Project Name:** Richmond Road Phase 2		**Trial Pit ID** **IT01**
Coordinates 716612.97 E 736475.15 N	**Client:** Malkey Limited		
Method: Trial Pitting	**Client's Representative:** DBFL Consulting Engineers		Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** mOD	**Date:** 20/12/2022	**Logger:** DM
			FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
				0.10	▨	TARMAC	
				0.50	▨	MADE GROUND: Greyish brown sandy angular to subangular fine to coarse GRAVEL with fragments of brick, concrete and pieces of cloth.	
0.50 0.50	B1 ES2						
		Strike at 1.30m.		1.50	▨	MADE GROUND: Soft to firm brownish black sandy gravelly CLAY with fragments of brick and concrete. Sand is fine to coarse.	▼
1.50 1.50	B3 ES4					End of trial pit at 1.50m	

Water Strikes

Struck at (m)	Remarks
1.30	Strike at 1.30m.

Depth: 1.50

Width: 0.65

Length: 1.80

Remarks:

Stability: Stable

Termination Reason: Terminated at scheduled depth.

Last Updated: 20/01/2023

AGS

Soakaway Infiltration Test

Project No.: 22-1762
Site: Richmond Road Phase 2
Test Location: IT01
Test Date: 20-Dec-22

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.10
test pit base dimensions	0.50	1.70

test pit depth (m) 1.60

depth to groundwater before adding water (m) = Dry

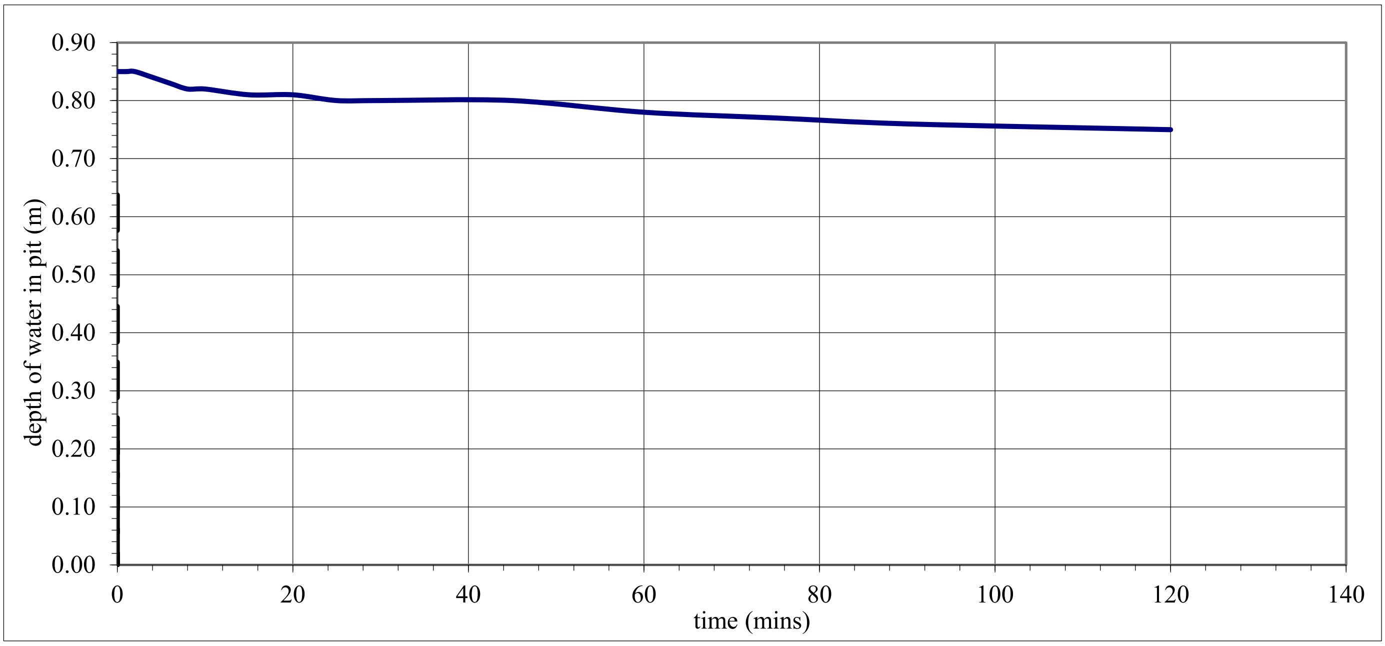
time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.75	0.85
1	0.75	0.85
2	0.75	0.85
4	0.76	0.84
6	0.77	0.83
8	0.78	0.82
10	0.78	0.82
15	0.79	0.81
20	0.79	0.81
25	0.80	0.80
30	0.80	0.80
45	0.80	0.80
60	0.82	0.78
75	0.83	0.77
90	0.84	0.76
120	0.85	0.75

From graph below:
test start - 75% depth at
0.6375 m water depth
time is not determined

test end - 25% depth at
0.2125 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
	0.96	0.6375					
	1.39	0.2125					



CAUSEWAY GEOTECH

Method: Trial Pitting	**Project No.** 22-1762	**Project Name:** Richmond Road Phase 2	**Trial Pit ID** IT02
	Coordinates 716643.27 E 736468.91 N	**Client:** Malkey Limited	
		Client's Representative: DBFL Consulting Engineers	Sheet 1 of 1 Scale: 1:25
Plant: JCB 3CX	**Elevation** mOD	**Date:** 20/12/2022 — **Logger:** DM	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
				0.20	▨	TARMAC	
0.50 0.50	B1 ES2			0.80	▨	MADE GROUND: Brownish grey sandy angular to subangular fine to coarse GRAVEL. Sand is fine to coarse.	
1.50 1.50	B3 ES4			1.50	▨	MADE GROUND: Soft to firm light brown sandy slightly gravelly CLAY with fragments of yellow brick, scrap metal and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.	
						End of trial pit at 1.50m	

Water Strikes

Struck at (m)	Remarks

Depth: 1.50
Width: 0.70
Length: 1.80

Remarks:
No groundwater encountered.

Stability:
Moderately stable

Termination Reason
Terminated at scheduled depth.

Last Updated
20/01/2023

AGS

Soakaway Infiltration Test

Project No.: 22-1762
Site: Richmond Road Phase 2
Test Location: IT02
Test Date: 20-Dec-22

	width (m)	length (m)
test pit top dimensions	0.65	1.90
test pit base dimensions	0.40	1.50
test pit depth (m)	1.60	

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

depth to groundwater before adding water (m) = Dry

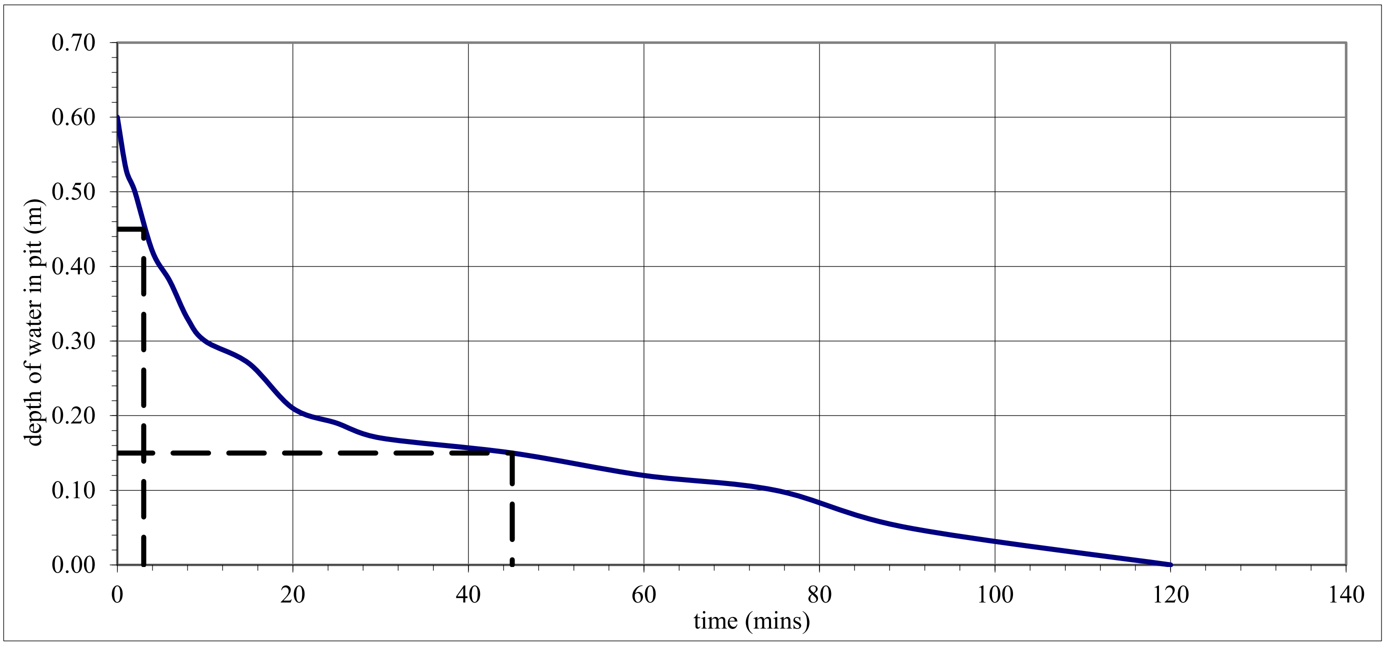
time (mins)	depth to water surface (m)	depth of water in pit (m)
0	1.00	0.60
1	1.07	0.53
2	1.10	0.50
4	1.18	0.42
6	1.22	0.38
8	1.27	0.33
10	1.30	0.30
15	1.33	0.27
20	1.39	0.21
25	1.41	0.19
30	1.43	0.17
45	1.45	0.15
60	1.48	0.12
75	1.50	0.10
90	1.55	0.05
120	1.60	0.00

From graph below:
test start - 75% depth at
0.45 m water depth
time is 3.0 minutes

test end - 25% depth at
0.15 m water depth
time is 45.0 minutes

test infiltration rate (q) = 0.169 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
3	1.15	0.45	42	0.21	1.79	2.8E-03	0.169
45	1.45	0.15					



CAUSEWAY GEOTECH

APPENDIX E

PLATE LOAD TEST RESULTS

TEST REPORT
PLATE LOADING TEST

Project	Richmond Rd	**Test No:**	22-1762
Client		**Lab Ref No:**	CBR01
		Date Reported	21.12.22
		Weather Conditions	Dry
Technician	DM	**Air Temperature °C**	7

Date Tested	20.12.22	**Plate Dia (mm)**	450
Location			
GPS Coord's		**Depth (m)**	0.3
Material Type	MG: CLAY	**Reaction Type**	15T
No Cycles	1	**App Weight (kg)**	43

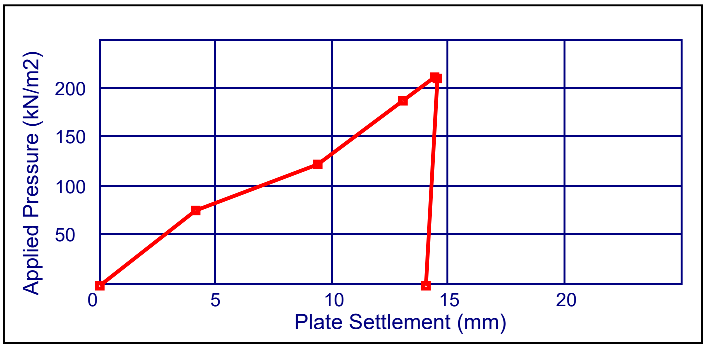
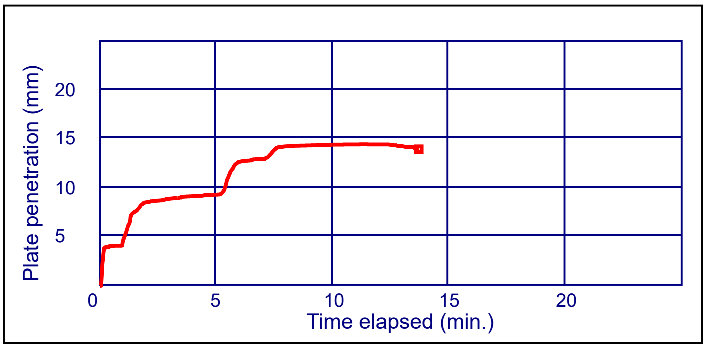


Plate Settlement (mm)	**Applied Pressure (kN/m2)**
0.00	0.0
4.12	77.1
9.36	124.4
13.02	189.6
14.38	213.7
14.51	212.4
14.01	0.0



	Cycle 1
Maximum Applied Pressure (kPa):	**216**
Maximum deformation (mm):	**14.51**
Modulus of subgrade reaction K (MN/m3):	**18.7**
K762 (MN/m3):	**11.7**
Estimated CBR (%):	**0.7**

Comments: Final loading stage not applied due to high settlement.

Approved Signature
Causeway Geotech
Darren O'Mahony
Director

Plate Load - Tested in accordance with
BS 1377 : Part 9 Cl. 4.1 : 1990

UKAS
TESTING
10122

CAUSEWAY
GEOTECH

TEST REPORT
PLATE LOADING TEST

Project	Richmond Rd	**Test No:**	22-1762
Client		**Lab Ref No:**	CBR02
		Date Reported	21.12.22
		Weather Conditions	Dry
Technician	DM	**Air Temperature °C**	7

Date Tested	20.12.22	**Plate Dia (mm)**	450
Location			
GPS Coord's		**Depth (m)**	0.3
Material Type	MG: CLAY	**Reaction Type**	15T
No Cycles	1	**App Weight (kg)**	43

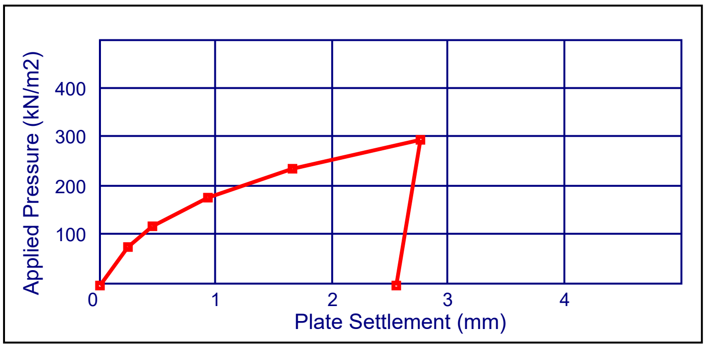
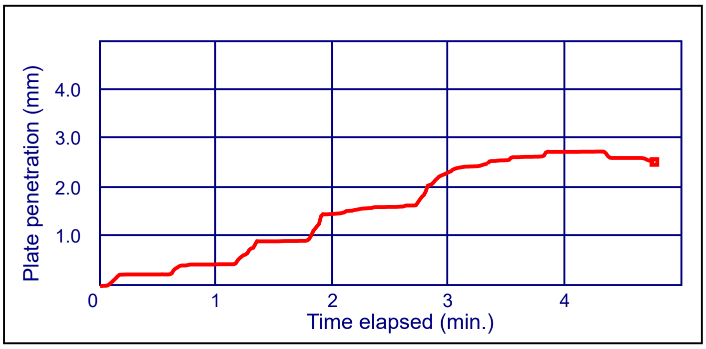


Plate Settlement (mm)	Applied Pressure (kN/m2)
0.00	0.0
0.24	78.9
0.45	121.7
0.93	180.6
1.65	239.7
2.75	299.3
2.55	0.0



	Cycle 1
Maximum Applied Pressure (kPa):	**302**
Maximum deformation (mm):	**2.75**
Modulus of subgrade reaction K (MN/m3):	**165.4**
K762 (MN/m3):	**103.1**
Estimated CBR (%):	**30**

Comments:

Approved Signature
Causeway Geotech
Darren O'Mahony
Director

Plate Load - Tested in accordance with
BS 1377 : Part 9 Cl. 4.1 : 1990

UKAS
TESTING
10122

CAUSEWAY
GEOTECH

APPENDIX F

ENVIRONMENTAL LABORATORY TEST RESULTS

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.: 22-49100-1

Initial Date of Issue: 18-Jan-2023

Client Causeway Geotech Ltd

Client Address:
8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

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Matthew Graham
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Paul Dunlop
Sean Ross
Stephen Franey
S

Project 22-1762 Richmond Road Phase 2

Quotation No.:

Date Received: 23-Dec-2022

Order No.:

Date Instructed: 23-Dec-2022

No. of Samples: 7

Turnaround (Wkdays): 8

Results Due: 10-Jan-2023

Date Approved: 18-Jan-2023

Approved By:

Details: Stuart Henderson, Technical Manager

Results - Soil

Project: 22-1762 Richmond Road Phase 2

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				22-49100	22-49100	22-49100	22-49100	22-49100	22-49100	22-49100
Quotation No.:	**Chemtest Sample ID.:**				1569217	1569218	1569219	1569220	1569221	1569222	1569223
Order No.:	Client Sample Ref.:				1	2	1	2	1	2	1
	Sample Location:				IT01	IT01	IT02	IT02	TP01	TP01	TP02
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	1.5	0.5	1.5	0.5	1.5	0.5
	Date Sampled:				22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	12	29	17	27	9.5	19	17
Arsenic	U	2455	mg/kg	0.5	8.9	7.2	8.1	7.6	12	11	8.7
Barium	U	2455	mg/kg	0	77	55	220	59	48	68	150
Cadmium	U	2455	mg/kg	0.10	0.54	0.78	0.69	0.66	0.79	1.3	0.45
Chromium	U	2455	mg/kg	0.5	5.3	8.9	8.7	8.2	4.1	12	8.5
Molybdenum	U	2455	mg/kg	0.5	2.3	1.9	1.3	1.2	2.1	2.8	0.7
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.1	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	41	21	19	17	30	28	33
Mercury	U	2455	mg/kg	0.05	0.31	0.22	1.1	0.40	0.11	0.36	1.6
Nickel	U	2455	mg/kg	0.50	11	22	18	17	11	27	11
Lead	U	2455	mg/kg	0.50	150	55	120	60	50	66	260
Selenium	U	2455	mg/kg	0.25	0.66	0.69	0.53	0.49	0.46	1.1	0.25
Zinc	U	2455	mg/kg	0.50	130	68	130	66	140	95	77
Chromium (Trivalent)	N	2490	mg/kg	1.0	5.3	8.9	8.7	8.2	4.1	12	8.3
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total Organic Carbon	U	2625	%	0.20	3.5	3.4	1.3	1.8	1.2	3.3	0.91
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 22-1762 Richmond Road Phase 2

Client: Causeway Geotech Ltd	**Chemtest Job No.:**				22-49100	22-49100	22-49100	22-49100	22-49100	22-49100	22-49100
Quotation No.:	**Chemtest Sample ID.:**				1569217	1569218	1569219	1569220	1569221	1569222	1569223
Order No.:	Client Sample Ref.:				1	2	1	2	1	2	1
	Sample Location:				IT01	IT01	IT02	IT02	TP01	TP01	TP02
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.5	1.5	0.5	1.5	0.5	1.5	0.5
	Date Sampled:				22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022	22-Dec-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	0.25	0.11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	0.15	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	1.0	0.42	0.23	0.17	0.19	0.23	0.16
Anthracene	U	2800	mg/kg	0.10	0.22	0.11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	1.3	0.66	0.29	< 0.10	0.34	0.24	0.18
Pyrene	U	2800	mg/kg	0.10	1.1	0.64	0.24	< 0.10	0.37	0.26	0.17
Benzo[a]anthracene	U	2800	mg/kg	0.10	0.65	0.39	< 0.10	< 0.10	< 0.10	0.14	< 0.10
Chrysene	U	2800	mg/kg	0.10	0.60	0.32	< 0.10	< 0.10	< 0.10	0.12	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	0.91	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	0.25	0.24	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	0.65	0.41	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	0.46	0.35	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	0.55	0.30	< 0.10	< 0.10	0.18	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	8.1	4.5	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

					Landflll Waste Acceptance Criteria Limits		
Chemtest Job No:	22-49100				Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Chemtest Sample ID:	1569217						
Sample Ref:	1						
Sample ID:							
Sample Location:	IT01						
Top Depth(m):	0.5						
Bottom Depth(m):							
Sampling Date:	22-Dec-2022						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.5	3	5	6
Loss On Ignition	2610	U	%	4.9	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	8.1	100	--	--
pH	2010	U		8.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.065	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0041	0.041	0.5	2	25
Barium	1455	U	0.018	0.18	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0050	0.5	10	70
Copper	1455	U	0.0031	0.031	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.0084	0.084	0.5	10	30
Nickel	1455	U	0.0011	0.011	0.4	10	40
Lead	1455	U	0.0008	0.0083	0.5	10	50
Antimony	1455	U	0.0074	0.074	0.06	0.7	5
Selenium	1455	U	0.0025	0.025	0.1	0.5	7
Zinc	1455	U	0.004	0.042	4	50	200
Chloride	1220	U	1.9	19	800	15000	25000
Fluoride	1220	U	0.22	2.2	10	150	500
Sulphate	1220	U	33	330	1000	20000	50000
Total Dissolved Solids	1020	N	130	1300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	3.6	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

Chemtest Job No:	22-49100				**Landflll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	1569218						
Sample Ref:	2				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	IT01						
Top Depth(m):	1.5						
Bottom Depth(m):							
Sampling Date:	22-Dec-2022						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.4	3	5	6
Loss On Ignition	2610	U	%	15	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	4.5	100	--	--
pH	2010	U		7.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.092	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0053	0.052	0.5	2	25
Barium	1455	U	0.039	0.39	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0050	0.5	10	70
Copper	1455	U	0.0016	0.016	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.025	0.25	0.5	10	30
Nickel	1455	U	0.0016	0.016	0.4	10	40
Lead	1455	U	0.0022	0.022	0.5	10	50
Antimony	1455	U	0.0065	0.064	0.06	0.7	5
Selenium	1455	U	0.0021	0.020	0.1	0.5	7
Zinc	1455	U	0.003	0.029	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.20	2.0	10	150	500
Sulphate	1220	U	50	500	1000	20000	50000
Total Dissolved Solids	1020	N	240	2300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.7	57	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	29

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

Chemtest Job No: 22-49100
Chemtest Sample ID: 1569219
Sample Ref: 1
Sample ID:
Sample Location: IT02
Top Depth(m): 0.5
Bottom Depth(m):
Sampling Date: 22-Dec-2022

Determinand	**SOP**	**Accred.**	**Units**		**Landfilll Waste Acceptance Criteria Limits**		
					Inert Waste Landfill	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	1.3	3	5	6
Loss On Ignition	2610	U	%	0.91	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		9.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.0050	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0022	0.022	0.5	2	25
Barium	1455	U	0.011	0.11	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	0.0036	0.036	0.5	10	70
Copper	1455	U	0.0009	0.0094	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.0017	0.017	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0050	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0050	0.5	10	50
Antimony	1455	U	0.0024	0.024	0.06	0.7	5
Selenium	1455	U	0.0012	0.012	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.025	4	50	200
Chloride	1220	U	3.8	38	800	15000	25000
Fluoride	1220	U	0.26	2.6	10	150	500
Sulphate	1220	U	11	110	1000	20000	50000
Total Dissolved Solids	1020	N	66	660	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	3.1	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	17

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

					Landfilll Waste Acceptance Criteria Limits		
Chemtest Job No:	22-49100						
Chemtest Sample ID:	1569220						
Sample Ref:	2						
Sample ID:							
Sample Location:	IT02						
Top Depth(m):	1.5						
Bottom Depth(m):							
Sampling Date:	22-Dec-2022						
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	1.8	3	5	6
Loss On Ignition	2610	U	%	19	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		9.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.18	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0044	0.043	0.5	2	25
Barium	1455	U	0.007	0.073	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	0.0015	0.015	0.5	10	70
Copper	1455	U	0.0057	0.057	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.0079	0.080	0.5	10	30
Nickel	1455	U	0.0018	0.018	0.4	10	40
Lead	1455	U	0.0007	0.0066	0.5	10	50
Antimony	1455	U	0.0033	0.033	0.06	0.7	5
Selenium	1455	U	0.0022	0.022	0.1	0.5	7
Zinc	1455	U	0.006	0.058	4	50	200
Chloride	1220	U	6.3	63	800	15000	25000
Fluoride	1220	U	0.26	2.6	10	150	500
Sulphate	1220	U	11	110	1000	20000	50000
Total Dissolved Solids	1020	N	110	1100	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.8	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	27

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

Chemtest Job No: 22-49100
Chemtest Sample ID: 1569221
Sample Ref: 1
Sample ID:
Sample Location: TP01
Top Depth(m): 0.5
Bottom Depth(m):
Sampling Date: 22-Dec-2022

					Landfill Waste Acceptance Criteria Limits		
					Inert Waste Landfill	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	1.2	3	5	6
Loss On Ignition	2610	U	%	9.7	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.026	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0038	0.038	0.5	2	25
Barium	1455	U	0.005	0.052	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	0.0066	0.066	0.5	10	70
Copper	1455	U	0.0012	0.012	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.0036	0.036	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0050	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0050	0.5	10	50
Antimony	1455	U	0.0017	0.018	0.06	0.7	5
Selenium	1455	U	0.0015	0.015	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.025	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.12	1.2	10	150	500
Sulphate	1220	U	4.5	45	1000	20000	50000
Total Dissolved Solids	1020	N	52	520	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	3.2	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	9.5

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

Chemtest Job No:	22-49100				**Landfilll Waste Acceptance Criteria Limits**		
Chemtest Sample ID:	1569222						
Sample Ref:	2				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:							
Sample Location:	TP01						
Top Depth(m):	1.5						
Bottom Depth(m):							
Sampling Date:	22-Dec-2022						
Determinand	**SOP**	**Accred.**	**Units**				
Total Organic Carbon	2625	U	%	3.3	3	5	6
Loss On Ignition	2610	U	%	3.8	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.025	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0012	0.012	0.5	2	25
Barium	1455	U	0.008	0.079	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0050	0.5	10	70
Copper	1455	U	0.0011	0.011	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.013	0.13	0.5	10	30
Nickel	1455	U	0.0007	0.0065	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0050	0.5	10	50
Antimony	1455	U	0.0012	0.012	0.06	0.7	5
Selenium	1455	U	0.0010	0.0098	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.025	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.23	2.3	10	150	500
Sulphate	1220	U	1.6	16	1000	20000	50000
Total Dissolved Solids	1020	N	110	1100	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	2.8	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	19

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: 22-1762 Richmond Road Phase 2

Chemtest Job No:	22-49100
Chemtest Sample ID:	1569223
Sample Ref:	1
Sample ID:	
Sample Location:	TP02
Top Depth(m):	0.5
Bottom Depth(m):	
Sampling Date:	22-Dec-2022

					Landfilll Waste Acceptance Criteria Limits		
Determinand	**SOP**	**Accred.**	**Units**		**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%	0.91	3	5	6
Loss On Ignition	2610	U	%	4.3	--	--	10
Total BTEX	2760	U	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100	--	--
pH	2010	U		8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg	0.029	--	To evaluate	To evaluate
Eluate Analysis			**10:1 Eluate mg/l**	**10:1 Eluate mg/kg**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.031	0.30	0.5	2	25
Barium	1455	U	0.032	0.32	20	100	300
Cadmium	1455	U	< 0.00011	< 0.0011	0.04	1	5
Chromium	1455	U	0.047	0.47	0.5	10	70
Copper	1455	U	0.0011	0.011	2	50	100
Mercury	1455	U	< 0.00005	< 0.00050	0.01	0.2	2
Molybdenum	1455	U	0.0012	0.012	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0050	0.4	10	40
Lead	1455	U	0.0037	0.037	0.5	10	50
Antimony	1455	U	0.0015	0.015	0.06	0.7	5
Selenium	1455	U	0.0010	0.0098	0.1	0.5	7
Zinc	1455	U	0.007	0.073	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.42	4.2	10	150	500
Sulphate	1220	U	6.4	64	1000	20000	50000
Total Dissolved Solids	1020	N	65	650	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	2.9	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	17

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key	
U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

APPENDIX G

WASTE CLASSIFICATION REPORT

Waste Classification Report

HazWasteOnline™ classifies waste as either **hazardous** or **non-hazardous** based on its chemical composition, related legislation and the rules and data defined in the current UK or EU technical guidance (Appendix C) (note that HP 9 Infectious is not assessed). It is the responsibility of the classifier named below to:

a) understand the origin of the waste
b) select the correct List of Waste code(s)
c) confirm that the list of determinands, results and sampling plan are fit for purpose
d) select and justify the chosen metal species (Appendix B)
e) correctly apply moisture correction and other available corrections
f) add the meta data for their user-defined substances (Appendix A)
g) check that the classification engine is suitable with respect to the national destination of the waste (Appendix C)

To aid the reviewer, the laboratory results, assumptions and justifications managed by the classifier are highlighted in pale yellow.

ACPCC-JVDA5-16WD8

Job name

22-1762 Richmond Road Phase 2

Description/Comments

Waste classification on samples recovered from site in December 2022.

Project

22-1762

Site

Richmond Road Phase 2

Classified by

Name:
Sean Ross
Date:
20 Jan 2023 10:40 GMT
Telephone:

Company:
Causeway Geotech Ltd
Unit 1 Fingal House, Stephenstown
Industrial Estate,
Balbriggan
K32 VR66

HazWasteOnline™ provides a two day, hazardous waste classification course that covers the use of the software and both basic and advanced waste classification techniques. Certification has to be renewed every 3 years.

HazWasteOnline™ Certification: -

Course	**Date**
Hazardous Waste Classification	50% complete

Purpose of classification

2 - Material Characterisation

Address of the waste

Richmond Road, Dublin.

Post Code N/A

SIC for the process giving rise to the waste

Description of industry/producer giving rise to the waste

Redevelopment of industrial site into a residential development.

Description of the specific process, sub-process and/or activity that created the waste

Waste created during redevelopment of the site.

Description of the waste

Generally reworked soft to firm brown sandy gravelly clay with construction waste (e.g. concrete, brick and scrap metal fragments).

Job summary

#	Sample name	Depth [m]	Classification Result	Hazard properties	WAC Results		Page
					Inert	Non Haz	
1	IT01-1-22/12/2022-0.5	0.5	Non Hazardous		Fail	Pass	3
2	IT01-2-22/12/2022-1.5	1.5	Non Hazardous		Fail	Pass	6
3	IT02-1-22/12/2022-0.5	0.5	Non Hazardous		Pass	Pass	9
4	IT02-2-22/12/2022-1.5	1.5	Non Hazardous		Pass	Pass	12
5	TP01-1-22/12/2022-0.5	0.5	Non Hazardous		Pass	Pass	15
6	TP01-2-22/12/2022-1.5	1.5	Non Hazardous		Fail	Pass	18
7	TP02-1-22/12/2022-0.5	0.5	Non Hazardous		Pass	Pass	21

Related documents

#	Name	Description
1	HWOL_22-49100-20230118 143343.hwol	Eurofins Chemtest .hwol file used to populate the Job
2	Example waste stream template for contaminated soils	waste stream template used to create this Job

WAC results

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate the samples in this Job: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

Report

Created by: Sean Ross

Created date: 20 Jan 2023 10:40 GMT

Classification of sample: IT01-1-22/12/2022-0.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
IT01-1-22/12/2022-0.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
0.5 m			
Moisture content:			
12% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 12% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	**User entered data**	Conv. Factor	Compound conc.	**Classification value**	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number							
1		antimony { antimony trioxide }				<2 mg/kg	1.197	<2.394 mg/kg	<0.000239 %		**<LOD**
		051-005-00-X	215-175-0	1309-64-4							
2		arsenic { arsenic trioxide }				8.9 mg/kg	1.32	10.341 mg/kg	0.00103 %	✓	
		033-003-00-0	215-481-4	1327-53-3							
3		cadmium { cadmium oxide }				0.54 mg/kg	1.142	0.543 mg/kg	0.0000543 %	✓	
		048-002-00-0	215-146-2	1306-19-0							
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				5.3 mg/kg	1.462	6.817 mg/kg	0.000682 %	✓	
			215-160-9	1308-38-9							
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5 mg/kg	2.27	<1.135 mg/kg	<0.000113 %		**<LOD**
		024-017-00-8									
6		copper { dicopper oxide; copper (I) oxide }				41 mg/kg	1.126	40.622 mg/kg	0.00406 %	✓	
		029-002-00-X	215-270-7	1317-39-1							
7		lead { lead chromate }			1	150 mg/kg	1.56	205.896 mg/kg	0.0132 %	✓	
		082-004-00-2	231-846-0	7758-97-6							
8		mercury { mercury dichloride }				0.31 mg/kg	1.353	0.369 mg/kg	0.0000369 %	✓	
		080-010-00-X	231-299-8	7487-94-7							
9		molybdenum { molybdenum(VI) oxide }				2.3 mg/kg	1.5	3.036 mg/kg	0.000304 %	✓	
		042-001-00-9	215-204-7	1313-27-5							
10		nickel { nickel chromate }				11 mg/kg	2.976	28.81 mg/kg	0.00288 %	✓	
		028-035-00-7	238-766-5	14721-18-7							
11		selenium { nickel selenate }				0.66 mg/kg	2.554	1.483 mg/kg	0.000148 %	✓	
		028-031-00-5	239-125-2	15060-62-5							
12		zinc { zinc chromate }				130 mg/kg	2.774	317.362 mg/kg	0.0317 %	✓	
		024-007-00-3	236-878-9	13530-65-9							
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		**<LOD**
		603-181-00-X	216-653-1	1634-04-4							
14		benzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		**<LOD**
		601-020-00-8	200-753-7	71-43-2							
15		toluene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		**<LOD**
		601-021-00-3	203-625-9	108-88-3							

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16	●	ethylbenzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-023-00-4	202-849-4	100-41-4									
17		xylene				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		**<LOD**
		601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
18		naphthalene				0.25	mg/kg		0.22	mg/kg	0.000022 %	✓	
		601-052-00-2	202-049-5	91-20-3									
19	●	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-917-1	208-96-8									
20	●	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			201-469-6	83-32-9									
21	●	fluorene				0.15	mg/kg		0.132	mg/kg	0.0000132 %	✓	
			201-695-5	86-73-7									
22	●	phenanthrene				1	mg/kg		0.88	mg/kg	0.000088 %	✓	
			201-581-5	85-01-8									
23	●	anthracene				0.22	mg/kg		0.194	mg/kg	0.0000194 %	✓	
			204-371-1	120-12-7									
24	●	fluoranthene				1.3	mg/kg		1.144	mg/kg	0.000114 %	✓	
			205-912-4	206-44-0									
25	●	pyrene				1.1	mg/kg		0.968	mg/kg	0.0000968 %	✓	
			204-927-3	129-00-0									
26		benzo[a]anthracene				0.65	mg/kg		0.572	mg/kg	0.0000572 %	✓	
		601-033-00-9	200-280-6	56-55-3									
27		chrysene				0.6	mg/kg		0.528	mg/kg	0.0000528 %	✓	
		601-048-00-0	205-923-4	218-01-9									
28		benzo[b]fluoranthene				0.91	mg/kg		0.801	mg/kg	0.0000801 %	✓	
		601-034-00-4	205-911-9	205-99-2									
29		benzo[k]fluoranthene				0.25	mg/kg		0.22	mg/kg	0.000022 %	✓	
		601-036-00-5	205-916-6	207-08-9									
30		benzo[a]pyrene; benzo[def]chrysene				0.65	mg/kg		0.572	mg/kg	0.0000572 %	✓	
		601-032-00-3	200-028-5	50-32-8									
31	●	indeno[123-cd]pyrene				0.46	mg/kg		0.405	mg/kg	0.0000405 %	✓	
			205-893-2	193-39-5									
32		dibenz[a,h]anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-041-00-2	200-181-8	53-70-3									
33	●	benzo[ghi]perylene				0.55	mg/kg		0.484	mg/kg	0.0000484 %	✓	
			205-883-8	191-24-2									
34	●	polychlorobiphenyls; PCB				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		602-039-00-4	215-648-1	1336-36-3									
35	⚛	barium { ● barium sulphide }				77	mg/kg	1.233	83.582	mg/kg	0.00836 %	✓	
		016-002-00-X	244-214-4	21109-95-5									
36	●	coronene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-881-7	191-07-1									
										Total:	0.0636 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: IT01-1-22/12/2022-0.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample FAILS the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	3.5	3	5
2	LOI (loss on ignition)	%	4.9	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	8.1	100	-
7	pH	pH	8	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.065	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.041	0.5	2
10	barium	mg/kg	0.18	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	<0.005	0.5	10
13	copper	mg/kg	0.031	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.084	0.5	10
16	nickel	mg/kg	0.011	0.4	10
17	lead	mg/kg	0.0083	0.5	10
18	antimony	mg/kg	0.074	0.06	0.7
19	selenium	mg/kg	0.025	0.1	0.5
20	zinc	mg/kg	0.042	4	50
21	chloride	mg/kg	19	800	15,000
22	fluoride	mg/kg	2.2	10	150
23	sulphate	mg/kg	330	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	1300	4,000	60,000

Key

🟨	User supplied data
🟦	Inert WAC criteria fail

Classification of sample: IT01-2-22/12/2022-1.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
IT01-2-22/12/2022-1.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
1.5 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
29% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 29% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	**User entered data**	Conv. Factor	Compound conc.	**Classification value**	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number							
1		antimony { antimony trioxide }				<2 mg/kg	1.197	<2.394 mg/kg	<0.000239 %		<**LOD**
		051-005-00-X	215-175-0	1309-64-4							
2		arsenic { arsenic trioxide }				7.2 mg/kg	1.32	6.75 mg/kg	0.000675 %	✓	
		033-003-00-0	215-481-4	1327-53-3							
3		cadmium { cadmium oxide }				0.78 mg/kg	1.142	0.633 mg/kg	0.0000633 %	✓	
		048-002-00-0	215-146-2	1306-19-0							
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				8.9 mg/kg	1.462	9.236 mg/kg	0.000924 %	✓	
			215-160-9	1308-38-9							
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5 mg/kg	2.27	<1.135 mg/kg	<0.000113 %		<**LOD**
		024-017-00-8									
6		copper { dicopper oxide; copper (I) oxide }				21 mg/kg	1.126	16.787 mg/kg	0.00168 %	✓	
		029-002-00-X	215-270-7	1317-39-1							
7		lead { lead chromate }			1	55 mg/kg	1.56	60.911 mg/kg	0.0039 %	✓	
		082-004-00-2	231-846-0	7758-97-6							
8		mercury { mercury dichloride }				0.22 mg/kg	1.353	0.211 mg/kg	0.0000211 %	✓	
		080-010-00-X	231-299-8	7487-94-7							
9		molybdenum { molybdenum(VI) oxide }				1.9 mg/kg	1.5	2.024 mg/kg	0.000202 %	✓	
		042-001-00-9	215-204-7	1313-27-5							
10		nickel { nickel chromate }				22 mg/kg	2.976	46.489 mg/kg	0.00465 %	✓	
		028-035-00-7	238-766-5	14721-18-7							
11		selenium { nickel selenate }				0.69 mg/kg	2.554	1.251 mg/kg	0.000125 %	✓	
		028-031-00-5	239-125-2	15060-62-5							
12		zinc { zinc chromate }				68 mg/kg	2.774	133.936 mg/kg	0.0134 %	✓	
		024-007-00-3	236-878-9	13530-65-9							
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<**LOD**
		603-181-00-X	216-653-1	1634-04-4							
14		benzene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<**LOD**
		601-020-00-8	200-753-7	71-43-2							
15		toluene				<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<**LOD**
		601-021-00-3	203-625-9	108-88-3							

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
16	●	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
17		xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		**<LOD**
18		naphthalene	601-052-00-2	202-049-5	91-20-3		0.11	mg/kg		0.0781	mg/kg	0.00000781 %	✓	
19	●	acenaphthylene		205-917-1	208-96-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
20	●	acenaphthene		201-469-6	83-32-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
21	●	fluorene		201-695-5	86-73-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
22	●	phenanthrene		201-581-5	85-01-8		0.42	mg/kg		0.298	mg/kg	0.0000298 %	✓	
23	●	anthracene		204-371-1	120-12-7		0.11	mg/kg		0.0781	mg/kg	0.00000781 %	✓	
24	●	fluoranthene		205-912-4	206-44-0		0.66	mg/kg		0.469	mg/kg	0.0000469 %	✓	
25	●	pyrene		204-927-3	129-00-0		0.64	mg/kg		0.454	mg/kg	0.0000454 %	✓	
26		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		0.39	mg/kg		0.277	mg/kg	0.0000277 %	✓	
27		chrysene	601-048-00-0	205-923-4	218-01-9		0.32	mg/kg		0.227	mg/kg	0.0000227 %	✓	
28		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		0.59	mg/kg		0.419	mg/kg	0.0000419 %	✓	
29		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		0.24	mg/kg		0.17	mg/kg	0.000017 %	✓	
30		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		0.41	mg/kg		0.291	mg/kg	0.0000291 %	✓	
31	●	indeno[123-cd]pyrene		205-893-2	193-39-5		0.35	mg/kg		0.248	mg/kg	0.0000248 %	✓	
32		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
33	●	benzo[ghi]perylene		205-883-8	191-24-2		0.3	mg/kg		0.213	mg/kg	0.0000213 %	✓	
34	●	polychlorobiphenyls; PCB	602-039-00-4	215-648-1	1336-36-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
35	⚛	barium { ● barium sulphide }	016-002-00-X	244-214-4	21109-95-5		55	mg/kg	1.233	48.168	mg/kg	0.00482 %	✓	
36	●	coronene		205-881-7	191-07-1		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
											Total:	0.0312 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: IT01-2-22/12/2022-1.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample FAILS the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	3.4	3	5
2	LOI (loss on ignition)	%	15	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	4.5	100	-
7	pH	pH	7.6	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.092	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.052	0.5	2
10	barium	mg/kg	0.39	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	<0.005	0.5	10
13	copper	mg/kg	0.016	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.25	0.5	10
16	nickel	mg/kg	0.016	0.4	10
17	lead	mg/kg	0.022	0.5	10
18	antimony	mg/kg	0.064	0.06	0.7
19	selenium	mg/kg	0.02	0.1	0.5
20	zinc	mg/kg	0.029	4	50
21	chloride	mg/kg	<10	800	15,000
22	fluoride	mg/kg	2	10	150
23	sulphate	mg/kg	500	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	57	500	800
26	TDS (total dissolved solids)	mg/kg	2300	4,000	60,000

Key
🟨 User supplied data
🟦 Inert WAC criteria fail

Classification of sample: IT02-1-22/12/2022-0.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
IT02-1-22/12/2022-0.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
0.5 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
17% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 17% Wet Weight Moisture Correction applied (MC)

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1		antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<2 mg/kg	1.197	<2.394 mg/kg	<0.000239 %		<LOD
2		arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		8.1 mg/kg	1.32	8.877 mg/kg	0.000888 %	✓	
3		cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.69 mg/kg	1.142	0.654 mg/kg	0.0000654 %	✓	
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		8.7 mg/kg	1.462	10.554 mg/kg	0.00106 %	✓	
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<0.5 mg/kg	2.27	<1.135 mg/kg	<0.000113 %		<LOD
6		copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		19 mg/kg	1.126	17.755 mg/kg	0.00178 %	✓	
7		lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	120 mg/kg	1.56	155.358 mg/kg	0.00996 %	✓	
8		mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		1.1 mg/kg	1.353	1.236 mg/kg	0.000124 %	✓	
9		molybdenum { molybdenum(VI) oxide }	042-001-00-9	215-204-7	1313-27-5		1.3 mg/kg	1.5	1.619 mg/kg	0.000162 %	✓	
10		nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		18 mg/kg	2.976	44.465 mg/kg	0.00445 %	✓	
11		selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		0.53 mg/kg	2.554	1.123 mg/kg	0.000112 %	✓	
12		zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		130 mg/kg	2.774	299.33 mg/kg	0.0299 %	✓	
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
14		benzene	601-020-00-8	200-753-7	71-43-2		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
15		toluene	601-021-00-3	203-625-9	108-88-3		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
16	●	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
17		xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002 mg/kg		<0.002 mg/kg	<0.0000002 %		<LOD
18		naphthalene	601-052-00-2	202-049-5	91-20-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
19	●	acenaphthylene		205-917-1	208-96-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
20	●	acenaphthene		201-469-6	83-32-9		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
21	●	fluorene		201-695-5	86-73-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
22	●	phenanthrene		201-581-5	85-01-8		0.23 mg/kg		0.191 mg/kg	0.0000191 %	✓	
23	●	anthracene		204-371-1	120-12-7		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
24	●	fluoranthene		205-912-4	206-44-0		0.29 mg/kg		0.241 mg/kg	0.0000241 %	✓	
25	●	pyrene		204-927-3	129-00-0		0.24 mg/kg		0.199 mg/kg	0.0000199 %	✓	
26		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
27		chrysene	601-048-00-0	205-923-4	218-01-9		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
28		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
29		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
30		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
31	●	indeno[123-cd]pyrene		205-893-2	193-39-5		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
32		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
33	●	benzo[ghi]perylene		205-883-8	191-24-2		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
34	●	polychlorobiphenyls; PCB	602-039-00-4	215-648-1	1336-36-3		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
35	⚗	barium { ● barium sulphide }	016-002-00-X	244-214-4	21109-95-5		220 mg/kg	1.233	225.236 mg/kg	0.0225 %	✓	
36	●	coronene		205-881-7	191-07-1		<0.1 mg/kg		<0.1 mg/kg	<0.00001 %		<LOD
									Total:	0.0716 %		

Key

🟨	User supplied data
░	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚗	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: IT02-1-22/12/2022-0.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample PASSES the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	1.3	3	5
2	LOI (loss on ignition)	%	0.91	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	<2	100	-
7	pH	pH	9.5	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.005	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.022	0.5	2
10	barium	mg/kg	0.11	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	0.036	0.5	10
13	copper	mg/kg	0.0094	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.017	0.5	10
16	nickel	mg/kg	<0.005	0.4	10
17	lead	mg/kg	<0.005	0.5	10
18	antimony	mg/kg	0.024	0.06	0.7
19	selenium	mg/kg	0.012	0.1	0.5
20	zinc	mg/kg	<0.025	4	50
21	chloride	mg/kg	38	800	15,000
22	fluoride	mg/kg	2.6	10	150
23	sulphate	mg/kg	110	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	660	4,000	60,000

Key

🟨 User supplied data

Classification of sample: IT02-2-22/12/2022-1.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:	**IT02-2-22/12/2022-1.5**	LoW Code:	
Sample Depth:	**1.5 m**	Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Moisture content:	**27%** (wet weight correction)	Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)

Hazard properties

None identified

Determinands

Moisture content: 27% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	**User entered data**		Conv. Factor	Compound conc.		**Classification value**	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
1		antimony { antimony trioxide }				<2	mg/kg	1.197	<2.394	mg/kg	<0.000239 %		**<LOD**
		051-005-00-X	215-175-0	1309-64-4									
2		arsenic { arsenic trioxide }				7.6	mg/kg	1.32	7.325	mg/kg	0.000733 %	✓	
		033-003-00-0	215-481-4	1327-53-3									
3		cadmium { cadmium oxide }				0.66	mg/kg	1.142	0.55	mg/kg	0.000055 %	✓	
		048-002-00-0	215-146-2	1306-19-0									
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				8.2	mg/kg	1.462	8.749	mg/kg	0.000875 %	✓	
			215-160-9	1308-38-9									
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		**<LOD**
		024-017-00-8											
6		copper { dicopper oxide; copper (I) oxide }				17	mg/kg	1.126	13.972	mg/kg	0.0014 %	✓	
		029-002-00-X	215-270-7	1317-39-1									
7		lead { lead chromate }			1	60	mg/kg	1.56	68.32	mg/kg	0.00438 %	✓	
		082-004-00-2	231-846-0	7758-97-6									
8		mercury { mercury dichloride }				0.4	mg/kg	1.353	0.395	mg/kg	0.0000395 %	✓	
		080-010-00-X	231-299-8	7487-94-7									
9		molybdenum { molybdenum(VI) oxide }				1.2	mg/kg	1.5	1.314	mg/kg	0.000131 %	✓	
		042-001-00-9	215-204-7	1313-27-5									
10		nickel { nickel chromate }				17	mg/kg	2.976	36.935	mg/kg	0.00369 %	✓	
		028-035-00-7	238-766-5	14721-18-7									
11		selenium { nickel selenate }				0.49	mg/kg	2.554	0.914	mg/kg	0.0000914 %	✓	
		028-031-00-5	239-125-2	15060-62-5									
12		zinc { zinc chromate }				66	mg/kg	2.774	133.658	mg/kg	0.0134 %	✓	
		024-007-00-3	236-878-9	13530-65-9									
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		603-181-00-X	216-653-1	1634-04-4									
14		benzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-020-00-8	200-753-7	71-43-2									
15		toluene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-021-00-3	203-625-9	108-88-3									

#		Determinand			CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
16	●	ethylbenzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-023-00-4	202-849-4	100-41-4									
17		xylene				<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		**<LOD**
		601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]									
18		naphthalene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-052-00-2	202-049-5	91-20-3									
19	●	acenaphthylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-917-1	208-96-8									
20	●	acenaphthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			201-469-6	83-32-9									
21	●	fluorene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			201-695-5	86-73-7									
22	●	phenanthrene				0.17	mg/kg		0.124	mg/kg	0.0000124 %	✓	
			201-581-5	85-01-8									
23	●	anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			204-371-1	120-12-7									
24	●	fluoranthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-912-4	206-44-0									
25	●	pyrene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			204-927-3	129-00-0									
26		benzo[a]anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-033-00-9	200-280-6	56-55-3									
27		chrysene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-048-00-0	205-923-4	218-01-9									
28		benzo[b]fluoranthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-034-00-4	205-911-9	205-99-2									
29		benzo[k]fluoranthene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-036-00-5	205-916-6	207-08-9									
30		benzo[a]pyrene; benzo[def]chrysene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-032-00-3	200-028-5	50-32-8									
31	●	indeno[123-cd]pyrene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-893-2	193-39-5									
32		dibenz[a,h]anthracene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		601-041-00-2	200-181-8	53-70-3									
33	●	benzo[ghi]perylene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-883-8	191-24-2									
34	●	polychlorobiphenyls; PCB				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
		602-039-00-4	215-648-1	1336-36-3									
35	⚛	barium { ● barium sulphide }				59	mg/kg	1.233	53.127	mg/kg	0.00531 %	✓	
		016-002-00-X	244-214-4	21109-95-5									
36	●	coronene				<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
			205-881-7	191-07-1									
										Total:	0.0306 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: IT02-2-22/12/2022-1.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample PASSES the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	1.8	3	5
2	LOI (loss on ignition)	%	19	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	<2	100	-
7	pH	pH	9	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.18	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.043	0.5	2
10	barium	mg/kg	0.073	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	0.015	0.5	10
13	copper	mg/kg	0.057	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.08	0.5	10
16	nickel	mg/kg	0.018	0.4	10
17	lead	mg/kg	0.0066	0.5	10
18	antimony	mg/kg	0.033	0.06	0.7
19	selenium	mg/kg	0.022	0.1	0.5
20	zinc	mg/kg	0.058	4	50
21	chloride	mg/kg	63	800	15,000
22	fluoride	mg/kg	2.6	10	150
23	sulphate	mg/kg	110	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	1100	4,000	60,000

Key
🟨 User supplied data

Classification of sample: TP01-1-22/12/2022-0.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
TP01-1-22/12/2022-0.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
0.5 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
9.5% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 9.5% Wet Weight Moisture Correction applied (MC)

#	Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
1	antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		2.1	mg/kg	1.197	2.275	mg/kg	0.000228 %	✓	
2	arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		12	mg/kg	1.32	14.339	mg/kg	0.00143 %	✓	
3	cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.79	mg/kg	1.142	0.817	mg/kg	0.0000817 %	✓	
4	chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		4.1	mg/kg	1.462	5.423	mg/kg	0.000542 %	✓	
5	chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		<LOD
6	copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		30	mg/kg	1.126	30.568	mg/kg	0.00306 %	✓	
7	lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	50	mg/kg	1.56	70.582	mg/kg	0.00453 %	✓	
8	mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		0.11	mg/kg	1.353	0.135	mg/kg	0.0000135 %	✓	
9	molybdenum { molybdenum(VI) oxide }	042-001-00-9	215-204-7	1313-27-5		2.1	mg/kg	1.5	2.851	mg/kg	0.000285 %	✓	
10	nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		11	mg/kg	2.976	29.629	mg/kg	0.00296 %	✓	
11	selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		0.46	mg/kg	2.554	1.063	mg/kg	0.000106 %	✓	
12	zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		140	mg/kg	2.774	351.484	mg/kg	0.0351 %	✓	
13	tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
14	benzene	601-020-00-8	200-753-7	71-43-2		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
15	toluene	601-021-00-3	203-625-9	108-88-3		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD

#		Determinand EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
16	●	ethylbenzene 601-023-00-4	202-849-4	100-41-4		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
17		xylene 601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		**<LOD**
18		naphthalene 601-052-00-2	202-049-5	91-20-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
19	●	acenaphthylene	205-917-1	208-96-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
20	●	acenaphthene	201-469-6	83-32-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
21	●	fluorene	201-695-5	86-73-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
22	●	phenanthrene	201-581-5	85-01-8		0.19	mg/kg		0.172	mg/kg	0.0000172 %	✓	
23	●	anthracene	204-371-1	120-12-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
24	●	fluoranthene	205-912-4	206-44-0		0.34	mg/kg		0.308	mg/kg	0.0000308 %	✓	
25	●	pyrene	204-927-3	129-00-0		0.37	mg/kg		0.335	mg/kg	0.0000335 %	✓	
26		benzo[a]anthracene 601-033-00-9	200-280-6	56-55-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
27		chrysene 601-048-00-0	205-923-4	218-01-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
28		benzo[b]fluoranthene 601-034-00-4	205-911-9	205-99-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
29		benzo[k]fluoranthene 601-036-00-5	205-916-6	207-08-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
30		benzo[a]pyrene; benzo[def]chrysene 601-032-00-3	200-028-5	50-32-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
31	●	indeno[123-cd]pyrene	205-893-2	193-39-5		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
32		dibenz[a,h]anthracene 601-041-00-2	200-181-8	53-70-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
33	●	benzo[ghi]perylene	205-883-8	191-24-2		0.18	mg/kg		0.163	mg/kg	0.0000163 %	✓	
34	●	polychlorobiphenyls; PCB 602-039-00-4	215-648-1	1336-36-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
35	⚛	barium { ● barium sulphide } 016-002-00-X	244-214-4	21109-95-5		48	mg/kg	1.233	53.583	mg/kg	0.00536 %	✓	
36	●	coronene	205-881-7	191-07-1		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
										Total:	0.0541 %		

Key

🟨	User supplied data
⬜	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: TP01-1-22/12/2022-0.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample PASSES the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	1.2	3	5
2	LOI (loss on ignition)	%	9.7	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	<2	100	-
7	pH	pH	8.6	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.026	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.038	0.5	2
10	barium	mg/kg	0.052	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	0.066	0.5	10
13	copper	mg/kg	0.012	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.036	0.5	10
16	nickel	mg/kg	<0.005	0.4	10
17	lead	mg/kg	<0.005	0.5	10
18	antimony	mg/kg	0.018	0.06	0.7
19	selenium	mg/kg	0.015	0.1	0.5
20	zinc	mg/kg	<0.025	4	50
21	chloride	mg/kg	<10	800	15,000
22	fluoride	mg/kg	1.2	10	150
23	sulphate	mg/kg	45	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	520	4,000	60,000

Key

🟨 User supplied data

Classification of sample: TP01-2-22/12/2022-1.5

Non Hazardous Waste
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
TP01-2-22/12/2022-1.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
1.5 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
19% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 19% Wet Weight Moisture Correction applied (MC)

#		Determinand			CLP Note	**User entered data**		Conv. Factor	Compound conc.		**Classification value**	MC Applied	Conc. Not Used
		EU CLP index number	EC Number	CAS Number									
1		antimony { antimony trioxide }				<2	mg/kg	1.197	<2.394	mg/kg	<0.000239 %		**<LOD**
		051-005-00-X	215-175-0	1309-64-4									
2		arsenic { arsenic trioxide }				11	mg/kg	1.32	11.764	mg/kg	0.00118 %	✓	
		033-003-00-0	215-481-4	1327-53-3									
3		cadmium { cadmium oxide }				1.3	mg/kg	1.142	1.203	mg/kg	0.00012 %	✓	
		048-002-00-0	215-146-2	1306-19-0									
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }				12	mg/kg	1.462	14.206	mg/kg	0.00142 %	✓	
			215-160-9	1308-38-9									
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }				<0.5	mg/kg	2.27	<1.135	mg/kg	<0.000113 %		**<LOD**
		024-017-00-8											
6		copper { dicopper oxide; copper (I) oxide }				28	mg/kg	1.126	25.535	mg/kg	0.00255 %	✓	
		029-002-00-X	215-270-7	1317-39-1									
7		lead { lead chromate }			1	66	mg/kg	1.56	83.388	mg/kg	0.00535 %	✓	
		082-004-00-2	231-846-0	7758-97-6									
8		mercury { mercury dichloride }				0.36	mg/kg	1.353	0.395	mg/kg	0.0000395 %	✓	
		080-010-00-X	231-299-8	7487-94-7									
9		molybdenum { molybdenum(VI) oxide }				2.8	mg/kg	1.5	3.402	mg/kg	0.00034 %	✓	
		042-001-00-9	215-204-7	1313-27-5									
10		nickel { nickel chromate }				27	mg/kg	2.976	65.091	mg/kg	0.00651 %	✓	
		028-035-00-7	238-766-5	14721-18-7									
11		selenium { nickel selenate }				1.1	mg/kg	2.554	2.275	mg/kg	0.000228 %	✓	
		028-031-00-5	239-125-2	15060-62-5									
12		zinc { zinc chromate }				95	mg/kg	2.774	213.471	mg/kg	0.0213 %	✓	
		024-007-00-3	236-878-9	13530-65-9									
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		603-181-00-X	216-653-1	1634-04-4									
14		benzene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-020-00-8	200-753-7	71-43-2									
15		toluene				<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
		601-021-00-3	203-625-9	108-88-3									

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
16	●	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		**<LOD**
17		xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		**<LOD**
18		naphthalene	601-052-00-2	202-049-5	91-20-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
19	●	acenaphthylene		205-917-1	208-96-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
20	●	acenaphthene		201-469-6	83-32-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
21	●	fluorene		201-695-5	86-73-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
22	●	phenanthrene		201-581-5	85-01-8		0.23	mg/kg		0.186	mg/kg	0.0000186 %	✓	
23	●	anthracene		204-371-1	120-12-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
24	●	fluoranthene		205-912-4	206-44-0		0.24	mg/kg		0.194	mg/kg	0.0000194 %	✓	
25	●	pyrene		204-927-3	129-00-0		0.26	mg/kg		0.211	mg/kg	0.0000211 %	✓	
26		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		0.14	mg/kg		0.113	mg/kg	0.0000113 %	✓	
27		chrysene	601-048-00-0	205-923-4	218-01-9		0.12	mg/kg		0.0972	mg/kg	0.00000972 %	✓	
28		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
29		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
30		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
31	●	indeno[123-cd]pyrene		205-893-2	193-39-5		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
32		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
33	●	benzo[ghi]perylene		205-883-8	191-24-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
34	●	polychlorobiphenyls; PCB	602-039-00-4	215-648-1	1336-36-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
35	⚛	barium { ● barium sulphide }	016-002-00-X	244-214-4	21109-95-5		68	mg/kg	1.233	67.941	mg/kg	0.00679 %	✓	
36	●	coronene		205-881-7	191-07-1		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		**<LOD**
											Total:	0.0464 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚛	Speciated Deteminand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: TP01-2-22/12/2022-1.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample FAILS the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	3.3	3	5
2	LOI (loss on ignition)	%	3.8	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	<2	100	-
7	pH	pH	8.2	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.025	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.012	0.5	2
10	barium	mg/kg	0.079	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	<0.005	0.5	10
13	copper	mg/kg	0.011	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.13	0.5	10
16	nickel	mg/kg	0.0065	0.4	10
17	lead	mg/kg	<0.005	0.5	10
18	antimony	mg/kg	0.012	0.06	0.7
19	selenium	mg/kg	0.0098	0.1	0.5
20	zinc	mg/kg	<0.025	4	50
21	chloride	mg/kg	<10	800	15,000
22	fluoride	mg/kg	2.3	10	150
23	sulphate	mg/kg	16	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	1100	4,000	60,000

Key

🟨	User supplied data
🟦	Inert WAC criteria fail

Classification of sample: TP02-1-22/12/2022-0.5

✓ **Non Hazardous Waste**
Classified as **17 05 04**
in the List of Waste

Sample details

Sample name:		LoW Code:	
TP02-1-22/12/2022-0.5		Chapter:	17: Construction and Demolition Wastes (including excavated soil from contaminated sites)
Sample Depth:			
0.5 m		Entry:	17 05 04 (Soil and stones other than those mentioned in 17 05 03)
Moisture content:			
17% (wet weight correction)			

Hazard properties

None identified

Determinands

Moisture content: 17% Wet Weight Moisture Correction applied (MC)

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data	Conv. Factor	Compound conc.	Classification value	MC Applied	Conc. Not Used
1		antimony { antimony trioxide }	051-005-00-X	215-175-0	1309-64-4		<2 mg/kg	1.197	<2.394 mg/kg	<0.000239 %		<LOD
2		arsenic { arsenic trioxide }	033-003-00-0	215-481-4	1327-53-3		8.7 mg/kg	1.32	9.534 mg/kg	0.000953 %	✓	
3		cadmium { cadmium oxide }	048-002-00-0	215-146-2	1306-19-0		0.45 mg/kg	1.142	0.427 mg/kg	0.0000427 %	✓	
4		chromium in chromium(III) compounds { chromium(III) oxide (worst case) }		215-160-9	1308-38-9		8.3 mg/kg	1.462	10.069 mg/kg	0.00101 %	✓	
5		chromium in chromium(VI) compounds { chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex }	024-017-00-8				<0.5 mg/kg	2.27	<1.135 mg/kg	<0.000113 %		<LOD
6		copper { dicopper oxide; copper (I) oxide }	029-002-00-X	215-270-7	1317-39-1		33 mg/kg	1.126	30.838 mg/kg	0.00308 %	✓	
7		lead { lead chromate }	082-004-00-2	231-846-0	7758-97-6	1	260 mg/kg	1.56	336.608 mg/kg	0.0216 %	✓	
8		mercury { mercury dichloride }	080-010-00-X	231-299-8	7487-94-7		1.6 mg/kg	1.353	1.797 mg/kg	0.00018 %	✓	
9		molybdenum { molybdenum(VI) oxide }	042-001-00-9	215-204-7	1313-27-5		0.7 mg/kg	1.5	0.872 mg/kg	0.0000872 %	✓	
10		nickel { nickel chromate }	028-035-00-7	238-766-5	14721-18-7		11 mg/kg	2.976	27.173 mg/kg	0.00272 %	✓	
11		selenium { nickel selenate }	028-031-00-5	239-125-2	15060-62-5		0.25 mg/kg	2.554	0.53 mg/kg	0.000053 %	✓	
12		zinc { zinc chromate }	024-007-00-3	236-878-9	13530-65-9		77 mg/kg	2.774	177.296 mg/kg	0.0177 %	✓	
13		tert-butyl methyl ether; MTBE; 2-methoxy-2-methylpropane	603-181-00-X	216-653-1	1634-04-4		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
14		benzene	601-020-00-8	200-753-7	71-43-2		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD
15		toluene	601-021-00-3	203-625-9	108-88-3		<0.001 mg/kg		<0.001 mg/kg	<0.0000001 %		<LOD

#		Determinand	EU CLP index number	EC Number	CAS Number	CLP Note	User entered data		Conv. Factor	Compound conc.		Classification value	MC Applied	Conc. Not Used
16	●	ethylbenzene	601-023-00-4	202-849-4	100-41-4		<0.001	mg/kg		<0.001	mg/kg	<0.0000001 %		<LOD
17		xylene	601-022-00-9	202-422-2 [1] 203-396-5 [2] 203-576-3 [3] 215-535-7 [4]	95-47-6 [1] 106-42-3 [2] 108-38-3 [3] 1330-20-7 [4]		<0.002	mg/kg		<0.002	mg/kg	<0.0000002 %		<LOD
18		naphthalene	601-052-00-2	202-049-5	91-20-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
19	●	acenaphthylene		205-917-1	208-96-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
20	●	acenaphthene		201-469-6	83-32-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
21	●	fluorene		201-695-5	86-73-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
22	●	phenanthrene		201-581-5	85-01-8		0.16	mg/kg		0.133	mg/kg	0.0000133 %	✓	
23	●	anthracene		204-371-1	120-12-7		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
24	●	fluoranthene		205-912-4	206-44-0		0.18	mg/kg		0.149	mg/kg	0.0000149 %	✓	
25	●	pyrene		204-927-3	129-00-0		0.17	mg/kg		0.141	mg/kg	0.0000141 %	✓	
26		benzo[a]anthracene	601-033-00-9	200-280-6	56-55-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
27		chrysene	601-048-00-0	205-923-4	218-01-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
28		benzo[b]fluoranthene	601-034-00-4	205-911-9	205-99-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
29		benzo[k]fluoranthene	601-036-00-5	205-916-6	207-08-9		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
30		benzo[a]pyrene; benzo[def]chrysene	601-032-00-3	200-028-5	50-32-8		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
31	●	indeno[123-cd]pyrene		205-893-2	193-39-5		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
32		dibenz[a,h]anthracene	601-041-00-2	200-181-8	53-70-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
33	●	benzo[ghi]perylene		205-883-8	191-24-2		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
34	●	polychlorobiphenyls; PCB	602-039-00-4	215-648-1	1336-36-3		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
35	⚗	barium { ● barium sulphide }	016-002-00-X	244-214-4	21109-95-5		150	mg/kg	1.233	153.57	mg/kg	0.0154 %	✓	
36	●	coronene		205-881-7	191-07-1		<0.1	mg/kg		<0.1	mg/kg	<0.00001 %		<LOD
											Total:	0.0633 %		

Key

🟨	User supplied data
▨	Determinand values ignored for classification, see column 'Conc. Not Used' for reason
●	Determinand defined or amended by HazWasteOnline (see Appendix A)
⚗	Speciated Determinand - Unless the Determinand is Note 1, the Conversion Factor is used to calculate the compound concentration
<LOD	Below limit of detection
ND	Not detected
CLP: Note 1	Only the metal concentration has been used for classification

WAC results for sample: TP02-1-22/12/2022-0.5

WAC Settings: samples in this Job do not constitute a single population.

WAC limits used to evaluate this sample: "Ireland"
The WAC used in this report are the WAC defined for the inert and non-hazardous classes of landfill in the Republic of Ireland. You should check the actual acceptance criteria when the disposal site is identified as they may differ from the generic WAC used in this report.

The sample PASSES the Inert (Inert waste landfill) criteria.

The sample PASSES the Non Haz (Non hazardous waste landfill) criteria.

WAC Determinands

Solid Waste Analysis				Landfill Waste Acceptance Criteria Limits	
#	Determinand		User entered data	Inert waste landfill	Non hazardous waste landfill
1	TOC (total organic carbon)	%	0.91	3	5
2	LOI (loss on ignition)	%	4.3	-	-
3	BTEX (benzene, toluene, ethylbenzene and xylenes)	mg/kg	<0.01	6	-
4	PCBs (polychlorinated biphenyls, 7 congeners)	mg/kg	<0.1	1	-
5	Mineral oil (C10 to C40)	mg/kg	<10	500	-
6	PAHs (polycyclic aromatic hydrocarbons)	mg/kg	<2	100	-
7	pH	pH	8.3	-	>6
8	ANC (acid neutralisation capacity)	mol/kg	0.029	-	-
Eluate Analysis 10:1					
9	arsenic	mg/kg	0.3	0.5	2
10	barium	mg/kg	0.32	20	100
11	cadmium	mg/kg	<0.0011	0.04	1
12	chromium	mg/kg	0.47	0.5	10
13	copper	mg/kg	0.011	2	50
14	mercury	mg/kg	<0.0005	0.01	0.2
15	molybdenum	mg/kg	0.012	0.5	10
16	nickel	mg/kg	<0.005	0.4	10
17	lead	mg/kg	0.037	0.5	10
18	antimony	mg/kg	0.015	0.06	0.7
19	selenium	mg/kg	0.0098	0.1	0.5
20	zinc	mg/kg	0.073	4	50
21	chloride	mg/kg	<10	800	15,000
22	fluoride	mg/kg	4.2	10	150
23	sulphate	mg/kg	64	1,000	20,000
24	phenol index	mg/kg	<0.3	1	-
25	DOC (dissolved organic carbon)	mg/kg	<50	500	800
26	TDS (total dissolved solids)	mg/kg	650	4,000	60,000

Key

🟨	User supplied data

Appendix A: Classifier defined and non EU CLP determinands

chromium(III) oxide (worst case) (EC Number: 215-160-9, CAS Number: 1308-38-9)

Description/Comments: Data from C&L Inventory Database
Data source: https://echa.europa.eu/information-on-chemicals/cl-inventory-database/-/discli/details/33806
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H332 , Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Resp. Sens. 1; H334 , Skin Sens. 1; H317 , Repr. 1B; H360FD , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

ethylbenzene (EC Number: 202-849-4, CAS Number: 100-41-4)

EU CLP index number: 601-023-00-4
Description/Comments:
Additional Hazard Statement(s): Carc. 2; H351
Reason for additional Hazards Statement(s):
03 Jun 2015 - Carc. 2; H351 hazard statement sourced from: IARC Group 2B (77) 2000

acenaphthylene (EC Number: 205-917-1, CAS Number: 208-96-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Acute Tox. 4; H302 , Acute Tox. 1; H330 , Acute Tox. 1; H310 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315

acenaphthene (EC Number: 201-469-6, CAS Number: 83-32-9)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Aquatic Chronic 2; H411

fluorene (EC Number: 201-695-5, CAS Number: 86-73-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

phenanthrene (EC Number: 201-581-5, CAS Number: 85-01-8)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Carc. 2; H351 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410 , Skin Irrit. 2; H315

anthracene (EC Number: 204-371-1, CAS Number: 120-12-7)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 17 Jul 2015
Hazard Statements: Eye Irrit. 2; H319 , STOT SE 3; H335 , Skin Irrit. 2; H315 , Skin Sens. 1; H317 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

fluoranthene (EC Number: 205-912-4, CAS Number: 206-44-0)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Acute Tox. 4; H302 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

pyrene (EC Number: 204-927-3, CAS Number: 129-00-0)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 2014
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 21 Aug 2015
Hazard Statements: Skin Irrit. 2; H315 , Eye Irrit. 2; H319 , STOT SE 3; H335 , Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

indeno[123-cd]pyrene (EC Number: 205-893-2, CAS Number: 193-39-5)

Description/Comments: Data from C&L Inventory Database
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 06 Aug 2015
Hazard Statements: Carc. 2; H351

- **benzo[ghi]perylene** (EC Number: 205-883-8, CAS Number: 191-24-2)

Description/Comments: Data from C&L Inventory Database; SDS Sigma Aldrich 28/02/2015
Data source: http://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
Data source date: 23 Jul 2015
Hazard Statements: Aquatic Acute 1; H400 , Aquatic Chronic 1; H410

- **polychlorobiphenyls; PCB** (EC Number: 215-648-1, CAS Number: 1336-36-3)

EU CLP index number: 602-039-00-4
Description/Comments: Worst Case: IARC considers PCB Group 1; Carcinogenic to humans; POP specific threshold from ATP1 (Regulation 756/2010/EU) to POPs Regulation (Regulation 850/2004/EC). Where applicable, the calculation method laid down in European standards EN 12766-1 and EN 12766-2 shall be applied.
Additional Hazard Statement(s): Carc. 1A; H350
Reason for additional Hazards Statement(s):
29 Sep 2015 - Carc. 1A; H350 hazard statement sourced from: IARC Group 1 (23, Sup 7, 100C) 2012

- **barium sulphide** (EC Number: 244-214-4, CAS Number: 21109-95-5)

EU CLP index number: 016-002-00-X
Description/Comments:
Additional Hazard Statement(s): EUH031 >= 0.8 %
Reason for additional Hazards Statement(s):
14 Dec 2015 - EUH031 >= 0.8 % hazard statement sourced from: WM3, Table C12.2

- **coronene** (EC Number: 205-881-7, CAS Number: 191-07-1)

Description/Comments: Data from C&L Inventory Database; no entries in Registered Substances or Pesticides Properties databases; SDS: Sigma Aldrich, 1907/2006 compliant, dated 2012 - no entries; IARC – Group 3, not carcinogenic.
Data source: http://clp-inventory.echa.europa.eu/SummaryOfClassAndLabelling.aspx?SubstanceID=17010&HarmOnly=no?fc=true&lang=en
Data source date: 16 Jun 2014
Hazard Statements: STOT SE 2; H371

Appendix B: Rationale for selection of metal species

antimony {antimony trioxide}

Worst case CLP species based on hazard statements/molecular weight and low solubility. Industrial sources include: flame retardants in electrical apparatus, textiles and coatings

arsenic {arsenic trioxide}

Reasonable case CLP species based on hazard statements/molecular weight and most common (stable) oxide of arsenic. Industrial sources include: smelting; main precursor to other arsenic compounds

cadmium {cadmium oxide}

Reasonable case CLP species based on hazard statements/molecular weight, very low solubility in water. Industrial sources include: electroplating baths, electrodes for storage batteries, catalysts, ceramic glazes, phosphors, pigments and nematocides.

chromium in chromium(III) compounds {chromium(III) oxide (worst case)}

Reasonable case species based on hazard statements/molecular weight. Industrial sources include: tanning, pigment in paint, inks and glass

chromium in chromium(VI) compounds {chromium (VI) compounds, with the exception of barium chromate and of compounds specified elsewhere in this Annex}

Worst case species based on hazard statements/molecular weight

copper {dicopper oxide; copper (I) oxide}

Reasonable case CLP species based on hazard statements/molecular weight and insolubility in water. Industrial sources include: oxidised copper metal, brake pads, pigments, antifouling paints, fungicide.

lead {lead chromate}

Worst case CLP species based on hazard statements/molecular weight

mercury {mercury dichloride}

Worst case CLP species based on hazard statements/molecular weight (edit as required)

molybdenum {molybdenum(VI) oxide}

Worst case CLP species based on hazard statements/molecular weight

nickel {nickel chromate}

Worst case CLP species based on hazard statements/molecular weight

selenium {nickel selenate}

Worst case CLP species based on hazard statements/molecular weight

zinc {zinc chromate}

Worst case CLP species based on hazard statements/molecular weight

barium {barium sulphide}

No Cr VI in samples therefore worst case scenario not applicable.

Appendix C: Version

HazWasteOnline Classification Engine: WM3 1st Edition v1.1.NI - Jan 2021
HazWasteOnline Classification Engine Version: 2023.11.5483.10161 (11 Jan 2023)
HazWasteOnline Database: 2023.11.5483.10161 (11 Jan 2023)

This classification utilises the following guidance and legislation:
WM3 v1.1.NI - Waste Classification - 1st Edition v1.1.NI - Jan 2021
CLP Regulation - Regulation 1272/2008/EC of 16 December 2008
1st ATP - Regulation 790/2009/EC of 10 August 2009
2nd ATP - Regulation 286/2011/EC of 10 March 2011
3rd ATP - Regulation 618/2012/EU of 10 July 2012
4th ATP - Regulation 487/2013/EU of 8 May 2013
Correction to 1st ATP - Regulation 758/2013/EU of 7 August 2013
5th ATP - Regulation 944/2013/EU of 2 October 2013
6th ATP - Regulation 605/2014/EU of 5 June 2014
WFD Annex III replacement - Regulation 1357/2014/EU of 18 December 2014
Revised List of Waste 2014 - Decision 2014/955/EU of 18 December 2014
7th ATP - Regulation 2015/1221/EU of 24 July 2015
8th ATP - Regulation (EU) 2016/918 of 19 May 2016
9th ATP - Regulation (EU) 2016/1179 of 19 July 2016
10th ATP - Regulation (EU) 2017/776 of 4 May 2017
HP14 amendment - Regulation (EU) 2017/997 of 8 June 2017
13th ATP - Regulation (EU) 2018/1480 of 4 October 2018
14th ATP - Regulation (EU) 2020/217 of 4 October 2019
15th ATP - Regulation (EU) 2020/1182 of 19 May 2020
The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use)(Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1567 of 16th December 2020
The Waste and Environmental Permitting etc. (Legislative Functions and Amendment etc.) (EU Exit) Regulations 2020 - UK: 2020 No. 1540 of 16th December 2020
17th ATP - Regulation (EU) 2021/849 of 11 March 2021
18th ATP - Regulation (EU) 2022/692 of 16 February 2022

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