TIER 2 HYDROGEOLOGICAL ASSESSMENT

Phase 2 Residential Development at

Southgreen Road, Kildare Town, Co. Kildare

December 2025

DOCUMENT CONTROL

Project Title:	Tier 2 Hydrogeological Assessment Report
Report Ref.:	S45476
Status:	*Final*
Client:	Waterman Moylan
Site Details:	Phase 2 Residential Development, Southgreen Road, Kildare Town, Co. Kildare.
Issued By:	Verde Environmental Consultants Ltd

Document Production / Approval Record				
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LIMITATIONS

This report details the outcome of site investigations works associated with the completion of a Tier 2 Hydrogeological Assessment in relation at the above referenced site completed September and November 2025.

Verde Environmental Consultants Limited (Verde) followed best practice during the collection, delivery, analysis of samples and reporting of results. Services performed were conducted in a competent and professional manner in accordance with accepted practices and procedures.

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EXECUTIVE SUMMARY

Verde Environmental Consultants, (Verde) were commissioned by Waterman Moylan Consultants on behalf of Pousterle Limited to undertake the necessary hydrogeological assessment works in relation to the proposed stormwater discharge to groundwater for the Southgreen Phase 2 development of 153No. residential units at Southgreen Road, Kildare Town, Co. Kildare.

The surface water management strategy has been carefully developed to incorporate nature-based Sustainable Urban Drainage Systems (SuDS) features throughout the site. These elements are integrated into the overall drainage network to facilitate natural attenuation, promote infiltration, and support water quality improvements. Features such as swales, permeable paving, bio-retention tree pits, above ground detention basins and below ground infiltration attenuation areas have been strategically located across the development to manage runoff at source, reduce flow rates, and mimic the site's natural hydrological processes.

The proposed stormwater discharge design consists of:

- Permeable paving at private parking / driveways.
- Bio-retention tree pits used in strategic public areas within landscaping and adjacent to hardstanding areas such as the internal roads network.
- Swales located adjacent to footpaths or the internal roads network to collect rainfall runoff from same.
- Above ground attenuation basins for each sub-catchment to facilitate above ground rainfall storage.
- Below ground infiltration systems for each sub-catchment to facilitate infiltration to ground.

In addition, 2 No. overflow pipes will be provided between the following:

- The southern Catchment A and Central Catchment B;
- The Central Catchment B and the Northern Catchment C.

Safety factors in the amount of storm water that will be generated from the development are incorporated to allow for extra capacity along with an allowance for potential future rainfall increases as a result of climate change.

Verde carried out site investigation works at the proposed development site in two phases. The first phase took place from 24th –26th September 2025 and the second phase was undertaken from 18th –20th November 2025. The works were conducted to obtain site-specific hydrogeological information required to develop a Hydrogeological Conceptual Site Model (CSM). Activities included trial pitting, borehole drilling, groundwater sampling, and permeability testing.

The purpose of the phase 2 site investigation works was to carry out a second round of permeability tests within the wells at the site (BH01, BH02, BH03) and to establish depth to groundwater, estimate the thickness of the unsaturated zone within the silty, sandy, GRAVELS and collect a baseline groundwater sample for analysis. In order to achieve this a fourth borehole (BH04) was required to a depth of 20.25mBGL.

During phase 2 four variable head permeability tests were undertaken within the groundwater monitoring well standpipe of each well location (BH01, BH02, BH03, BH04) within the sandy, GRAVEL strata.

The results of the tests as presented in Appendix B (phase 2) indicate permeability values of;

- BH01 Falling Head Test- 3.36 x 10^{-6} m/s
- BH02 Falling Head Test- 30L of water was added to the standpipe and the hydraulic head did not rise above 5.88mBGL as was draining away.
- BH03 Falling Head Test- 30L of water was added to the standpipe and the water level did not rise, was unable to achieve a hydraulic head as water drained away.
- BH04 Falling Head Test- 4.27 x 10^{-7} m/s. 1000L of water was added to the standpipe, the hydraulic head did not rise above 11.30mBGL. Measurements were taken from 11.30mBGL to return to original GW level 16.9mBGL.

Overall, it can be seen from the permeability tests that the subsoils at the proposed SuDS locations have permeability rates which are considered moderate within the silty, sandy, GRAVEL subsoils of the regionally important Curragh West sand and gravel aquifer. Moderate vulnerability includes a wide range of permeability values (1 × 10^{-4} m/s down to about 1 × 10^{-8} m/s) (WFD Strive Programme 2007-2013[1]).

As shown by the Conceptual Site Model (CSM), in the attached figure 4, the static water level within BH04 was recorded at 16.9mBGL indicating that below the c. 4 – 5m thick silty, gravelly, CLAY strata there is a substantial depth of unsaturated overburden at the proposed SuDS locations. The thick unsaturated zone will allow for natural attenuation of any potential contaminants in the stormwater discharge.

The recommendation of a maintenance program for cleaning the gullies, drain manholes, interceptors and the attenuation tanks should be adhered to as per the engineering design to ensure ongoing effective operation. In addition, a regular groundwater monitoring program should be undertaken at the site to ensure the groundwater quality is not affected by the SuDS design for the proposed development site.

[1] Water Framework Directive – Recharge and Groundwater Vulnerability Strive Programme, Environmental Protection Agency, 2007-2013

1.0 INTRODUCTION

1.1 Project Contractual Basis

Verde Environmental Consultants, (Verde) were commissioned by Waterman Moylan Consultants on behalf of Pousterle Limited to undertake the necessary hydrogeological assessment works in relation to the proposed stormwater discharge to groundwater for the Southgreen Phase 2 development of 153No. residential units at Southgreen Road, Kildare Town, Co. Kildare.

The surface water management strategy has been carefully developed to incorporate nature-based Sustainable Urban Drainage Systems (SuDS) features throughout the site. These elements are integrated into the overall drainage network to facilitate natural attenuation, promote infiltration, and support water quality improvements. Features such as swales, permeable paving, bio-retention tree pits, above ground detention basins and below ground infiltration attenuation areas have been strategically located across the development to manage runoff at source, reduce flow rates, and mimic the site's natural hydrological processes. This approach not only addresses surface water quantity and quality but also enhances local biodiversity and contributes positively to the site's visual and ecological character

1.2 Proposed Development Description

Pousterle Limited intend to apply for permission for the development of a Large-Scale Residential Development (LRD) on a site of approx. 5.74 ha at Southgreen Road, Kildare, Co. Kildare. The proposed development will consist of the construction of a new residential development of 153 no. house type units ranging in height from 1- 2 storeys.

The residential element of the development will consist of:

- 141 no. houses (4 no. 2 bed units; 107 no. 3 bed units; and 30 no. 4 bed units) in a mixture of bungalow, detached, semi-detached, and terrace style units); and
- 12 no. duplex apartment units (4 no. 1 beds and 8 no. 2 beds), with each residential unit afforded with private open space in the form of a front/rear/side garden.

The development will also include:

- Public open space (approx. 7,214 sq m) proposed in the form of 2 no. new large public open space areas within the site (approx. 3,401 sq m and 3,813 sq m respectively).
- A total of 332 no. car parking spaces (303 no. for residents and 29 no. for visitors). This provision includes 1 no. accessible visitor space and 29 no. standard visitor spaces. All residential spaces will be provided with EV charging on curtilage. Residential spaces off curtilage will also be provided with EV charging facilities. 4 no. EV visitor spaces will be provided.

- A total of 331 no. cycle parking spaces (260 no. for residents and 71 no. for visitors) are provided. Resident cycle parking is proposed in the form of secure bicycle store enclosures to the front of terraced units; on curtilage spaces to the rear of units with side access; and a bicycle store for duplex units. Visitor parking is proposed in the form of Sheffield stands.

The development shall be served via a new vehicular access point from Southgreen Road. An additional private vehicular access point is proposed via Old Road to service 1 no. new bungalow 4 bed residential unit. A pedestrian and cyclist access is also proposed via Southgreen Road and via a new secondary access point from the Southern Internal Link Road to the south of the site and Old Road to the east of the site. A double-lane cycle track and footpath are also proposed along Southgreen Road adjacent to the proposed scheme.

The associated site and infrastructural works include provision for an ESB Sub Station; water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works; boundary treatment; internal roads and footpaths; waste storage areas, all electrical services and all associated site development works.

1.3 Legislation and Guidance

This report details the hydrogeological assessment works undertaken at the site in line with criteria set out in the Guidance on the Authorisation of Direct Discharges to Groundwater, published by the Environmental Protection Agency, 2014, which supplements the earlier report published by the EPA entitled Guidance on the Authorisation of Discharges to Groundwater (EPA, 2011). This report will provide the requested information on the geology and soils, including soil depths and an assessment of the risks to surface waters and to groundwater as a result of the development.

2.0 SITE BACKGROUND INFORMATION

2.1 Site Location

The c. 5.74 ha greenfield site is located at Southgreen Road, approximately c.750m northwest of Kildare Town and within the townland of Kildare, as presented in Figure 1. The site is bounded to the north by agricultural land. To the east by the L7016 (Old Road) followed by residential dwellings. To the west by Southgreen Road, followed by residential dwellings. To the south by the Internal Link Road (SILR) connecting to the R401 running in a north-south direction, followed by South Green Phase 1 development and the Cork-Dublin Railway line.

2.2 Environmental Setting

Details of the site physical setting are outlined in Table 2.2 below. Information regarding geology and hydrogeology underlying this area has been obtained from records held by the Geological Survey of Ireland (GSI), Ordnance Survey of Ireland (OSI), Environmental Protection Agency (EPA), National Parks & Wildlife Service (NPWS) and Office of Public Works (OPW). Maps relating to the site from these database sources are presented in Appendix A.

Table 2.2 – Site Physical Setting

FEATURE	DETAILS & COMMENTS
Topography	The site falls from west to east with a steep gradient of approximately 1 in 25 and less. The topography consists of naturally high ground elevations along the western boundary of the site, with levels ranging from 111.19mOD Malin to 113.79mOD Malin. The lowest ground elevations are distributed to the east, ranging from 106.85mOD Malin to 104.03mOD Malin. The local high point on the site (113.79mOD Malin) is located in the northwest portion of the lands and the local low point (104.03mOD Malin) is located in the central far east area of the lands.
Geology	Overburden: The GSI and EPA describe the subsoils beneath the site as Gravels derived from Limestone which is overlain by Glaciofluvial Sands and Gravels of fine loamy drift with Limestones. According to the WFD Recharge and Groundwater Vulnerability Strive 2007-2013 report, the Curragh aquifer consists of glacio–fluvial subsoil deposits overlying Carboniferous limestone bedrock. These deposits vary between 20m and 60m in thickness (Hayes et al., 2001). Although variable, the stratigraphic sequence generally comprises a lower unit of fine sands, followed by a middle layer of gravel and a thin upper layer of till (this till was described along the cutting exposure as e.g. sandy gravelly CLAY or very clayey, very sandy GRAVEL).
	Solid Geology:

	According to the GSI, the bedrock beneath the site consists of Dinantian Lower Impure Limestones, described as a nodular and muddy limestone and the shales of the Boston Hill formation, which is divided into a number of informal units from the base including the: Lower Calcarenite Unit, Main Bioclastic limestone and Upper laminated Limestone.
Hydrogeology	Regional Classification: The Limestone bedrock underlying the site is classified as Locally Important Aquifer (Bedrock which is Moderately Productive only in Local Zones). This is overlain by a regionally important Gravels aquifer (Curragh Gravels West). The current Water Framework Directive groundwater status for the Curragh Gravels West Groundwater Body (GWB) is "Good" and "Not at Risk" (Code: IE_SE_G_133). Groundwater As groundwater flow generally follows site topography it is assumed that the regional groundwater flow direction beneath the site is in an east to south-easterly direction towards Kildare town. The catchment area of the site is part of the Barrow Sub catchment (SC_060), which is a tributary of the Tully Stream which is "At Risk" and has a "Poor" ecological Status.
	Vulnerability: According to the GSI the vulnerability rating for the aquifer beneath the site is classified as High across the site, indicating the depth to bedrock is greater than 10 meters below ground level (mBGL). The Curragh Gravels are considered to have high permeability subsoils (WFD, Recharge and Groundwater Vulnerability Strive 2007-2013)
Hydrology/Ecology	Surface Water Courses The closest watercourse is the Tully Stream (IE_SE_14T020409) situated c. 2.5km to the southeast of the site. The watercourse is separated by Kildare Town and the M7. The stream flows in a largely southern direction, until it meets the Kildon River (IE_SE_14K270950) approximately c. 12km southwest of the site, and discharges into the Barrow River (IE_SE_14B011500) further southwest. According to the EPA database, the Tully Stream has a Poor water quality rating and is at risk of not achieving good status. There are no water features within the site boundary.
	Protected Areas: The nearest ecological designated site is the Curragh (Kildare) pNHA (code: 000392) c. 1.8km to the east and the Pollardstown Fen Special Area of Conservation (SAC) (code: 000396) and pNHA situated c. 5km to the northeast.
	Flood risk:

	According to a Surface Water Study undertaken by RPS and commissioned by KCC, the subject lands are located within the Tully Stream watercourse catchment and historically drained in a west to east and north to south direction towards the Tully Stream. Upgrades to the overall Kildare Town surface water networks have taken place to reroute runoff along the M7, however, and not under the M7 towards the Tully Stream. The Kildare Town Local Area Plan 2023- 2029- Strategic Flood Risk Assessment (SFRA) indicates no areas in the town of Kildare are at risk of flooding from coastal or fluvial sources and that the town in its entirety is within Flood Zone C. A portion of the subject site (northeast corner) is identified as a development at risk of pluvial flooding and requires a site specific flood risk assessment. According to the Waterman Moylan Flood Risk Assessment Report: - Given the position and elevation of the subject site in relation to the Irish Sea (c. 56km), there is no risk of coastal flooding. - The estimated ground level at the closest segment of the Tully Stream to the subject site is c. 89 m OD Malin. The unlikely potential pathway through open lands and the M7 and considering the lowest proposed FFL of the development is set at 106 m OD Malin, c. 20 m above the stream level, the likelihood of flooding from this fluvial source is low. - The proposed on-site drainage strategy includes the discharge of surface water into attenuation areas that include an above ground detention basin and below ground infiltration system within each sub-catchment (3 No. sub-catchments are proposed). The system has been preliminarily sized to accommodate flows from a 1-in-100-year storm event, incorporating an additional 30% allowance for climate change and 10% for urban creep, in line with best practice guidance. - Given that the drainage network is designed primarily for attenuation and infiltration, surcharging of the onsite system during higher return period storm events is unlikely to result in surface flooding, provided the infiltration performance is achieved in practice.
Radon	According to the EPA Radon Risk Map of Ireland. The subject site is located in a designated risk area with 1 in 10 homes in this area likely to have high radon levels.

The Kildare Town Local Area Plan 2023- 2029 (LAP) identifies areas where potential pluvial flood risk exists (caused by high intensity overland rainfall) as illustrated on Plate 2.1 below. The image shows that the northeast corner of the subject development falls under an area of potential risk of pluvial flooding.

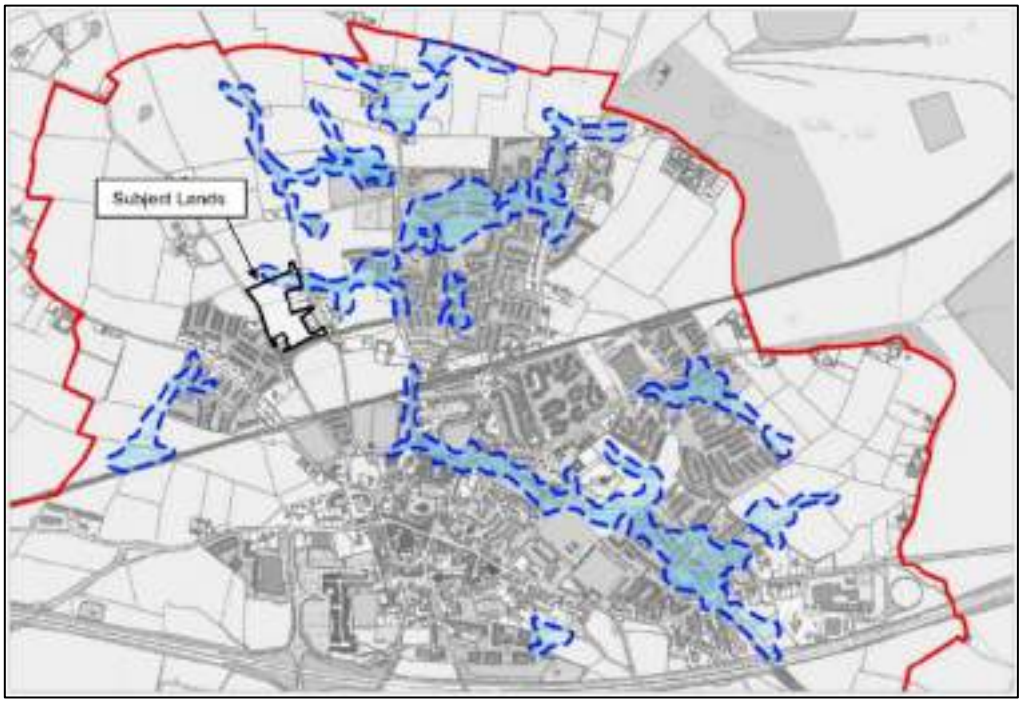


Plate 2.1- Extract of Kildare Local Area Plan Map 10.2 to illustrate Pluvial Flood Risk Areas.

In addition, the Kildare Town Local Area Plan, Strategic Flood Risk Assessment (SFRA), identifies several areas within Kildare Town which have been experiencing infiltration capacity issues. Plate 2.2 below, shows the areas where surface water infiltration into the ground is limited. It is noted that the subject lands are not situated within any of the areas identified as being at risk of pluvial flooding from infiltration constraints.

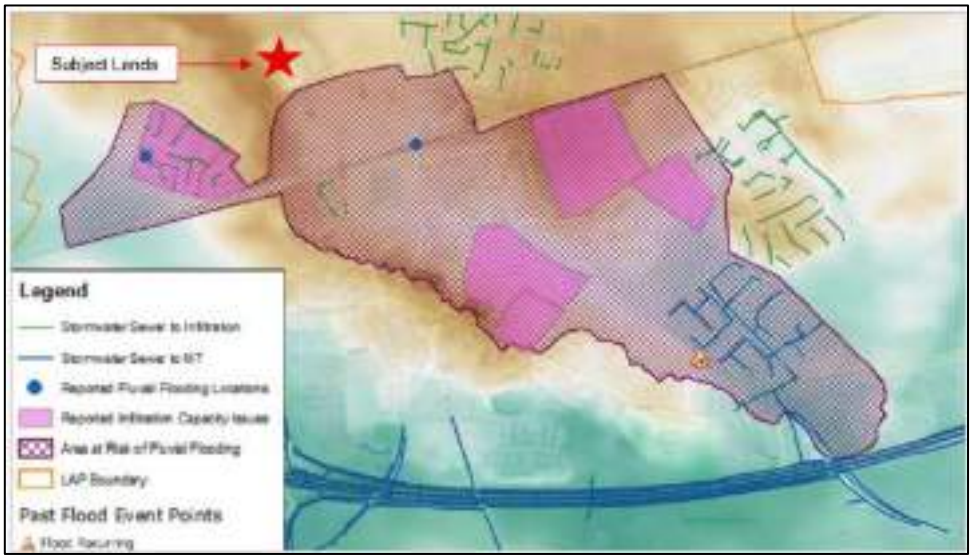


Plate 2.2 - Extract of Kildare Local Area Plan SFRA Pluvial Flood Risk Map due to lack of infiltration capacity

The Kildare Town LAP 2023-2029 Chapter 10 identifies using Nature- Based Surface Water Management (NBMAs) solutions and the provision/ safeguarding of green infrastructure in new developments is critical in contributing to surface water retention and consequently to help prevent and mitigate the effects of flooding, by aiding the natural drainage of a site. NBMAs allow for surface water to drain environmentally friendly and critically moves away from the conventional practice of piping directly to the nearest watercourse or river. An approach that is either filtered or conveyed slowly to water course via permeable surfaces, swales, filter strips etc. Object **IO 2.3** - *Incorporate nature-based water drainage solutions as part of all plans and projects in Kildare Town. Proposals for new development shall align with the Kildare Town Surface Water Study (that accompanies this Plan), the Surface Water Masterplan (once finalised) and the County Kildare Sustainable Urban Drainage Systems Guidance Document (once finalised).* The green infrastructure policies of the Kildare County Development Plan 2023-2029, includes policy **BI P15 -** *Promote and support the development of Sustainable Urban Drainage System (SuDS) to ensure water is drained in an environmentally friendly way by replicating natural systems*.

Kildare County Council Surface Water Study Report Stage 1 and 2 as part of the Kildare LAP 2023-2029, was completed in February 2023. The studies identify sustainable surface water management strategies for the town of Kildare with particular focus on prioritising nature-based solutions where possible, designating areas where surface water can be managed, identifying opportunities for inclusion of additional surface water attenuation facilities, identifying where existing infrastructure connections are located and where future systems can outfall to, and considering the amenity potential and value for any surface water solution within the town of Kildare.

Kildare Town was divided into 6No. surface water subcatchment areas within the study for individual assessment. The subject lands are located within surface water subcatchment no. 5. The study outlines its own reference system to zoned lands within the town of Kildare, different to the Kildare LAP Land Use Zoning Map. According to the study the zoned sites are as follows:

H - Southgreen (5.73 Ha) – zoned employment
I - West of Dunmurray Road (5.73 Ha) – zoned residential
K - West of Old Road (4.53 Ha) – zoned residential
O - Between Old Road and South Green Road (11.59 Ha) – zoned residential

The subject lands are located within the residential Site "O". Plate 2.3 illustrates Site O by dark hatching and the subject lands are shown in the figure by the blue boundary. According to the study the subject lands have been earmarked for the surface water runoff to discharge at a Potential Nature-Based Management Area (NBMA). The management area for which the subject lands is proposed to drain is an existing pond located northeast of the site. The subject lands are not located directly adjacent to the designated NBMA, and third-party lands lie between the subject site and the NBMA to both the north and east. Waterman Moylan advise it is not feasible to design a direct connection from the proposed development's surface water network to the NBMA without either obtaining third-party consent or undertaking a detailed surface water drainage design for the intervening lands.

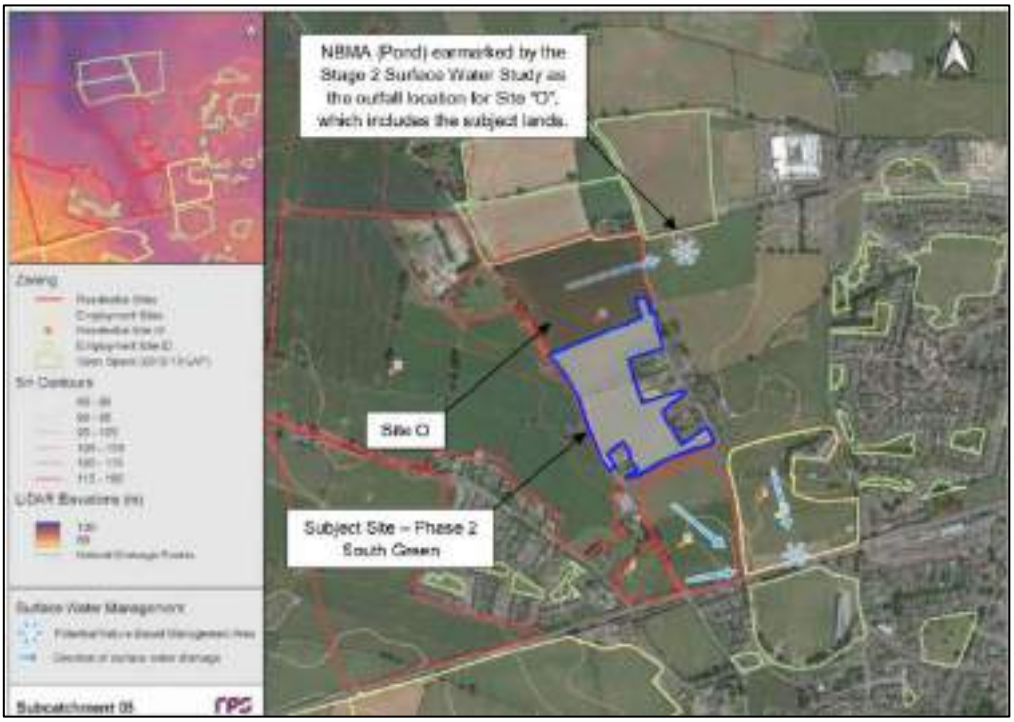


Plate 2.3- Illustrates Site "O" and the location of the proposed Nature- Based Management Area (NBMA)

The Kildare Town LAP Surface Water Study Report, Stage 1 states Kildare Town has four forms of existing surface water drainage and one being *discharge to groundwater via infiltration* due to the absence of a watercourse north of the M7 and limited capacity in the existing drainage network. As shown on Plate 2.4 sourced from the LAP Surface Water Study Report, Stage 1, many existing housing developments have surface water catered for infiltration and includes planned permitted developments either under construction or yet to go to site. Therefore, most areas within the vicinity of the subject lands north of the Kildare Railway Line discharge surface water to the ground via infiltration with lands south of the railway discharging to the ground, to a combined network discharging to the Tully stream, or via discharging to the M7 surface water network.

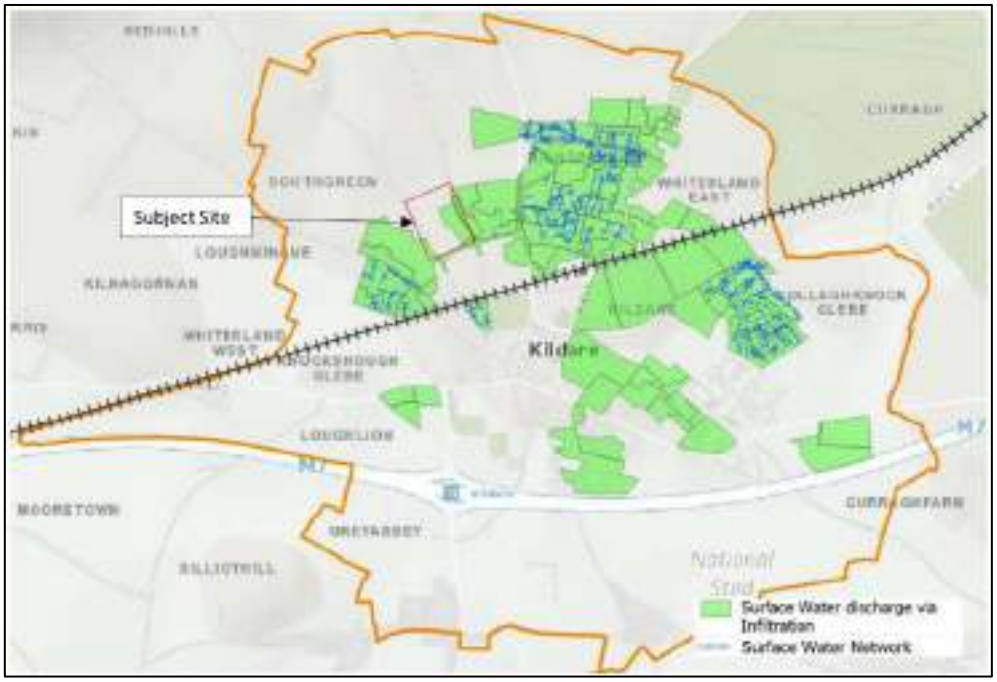


Plate 2.4 Areas draining to infiltration from the Kildare Town LAP 2023- 2029 Surface Water Strategy Stage 1

Recent granted applications have included draining via infiltration and is the predominant approach. Planning for specific areas dedicated to managing surface water is considered and these areas are intended to allow slow infiltration discharge to the groundwater. Therefore, a detailed hydrogeological assessment is required for the subject site.

3.0 AUTHORISATION OF DISCHARGES TO GROUNDWATER

3.1 Guidance Document Background Information

The EPA (Environmental Protection Agency) guidance document on the technical assessments that are needed to authorise discharges to groundwater 2011 has been reviewed in preparation of this document. This assessment is required as a means of satisfying the requirements of the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010) (Groundwater Regulations).

The document provides guidance on:

- Risk screening for potential impact to groundwater based on considerations of pollutant loading, toxicity, pathways and receptor types;
- Appropriate levels of technical assessment for different types and scales of discharges;
- Predicting impact on groundwater quality, and
- Appropriate monitoring to check compliance with receptor-based water quality standards.

Regulation 7 of the Groundwater Regulations further states that "Point source discharges and diffuse sources liable to cause groundwater pollution shall be controlled so as to prevent or limit the input of pollutants into groundwater". This **'prevent or limit'** objective is the core groundwater quality objective addressed by the guidance.

The 'prevent' objective relates to ***hazardous*** substances, whereby all necessary and reasonable measures should be taken to avoid the entry of such substances into groundwater and to avoid any significant increase in concentration in groundwater, even at a local scale. The 'limit' objective relates to ***non-hazardous*** substances, whereby all necessary measures should be taken to limit inputs into groundwater to ensure that such inputs do not cause deterioration in the status of groundwater bodies, nor significant and sustained upward trends in groundwater concentrations.

This guidance addresses both direct and indirect discharges (inputs) to groundwater which can originate from point sources of potential pollution. A supplement document on the direct discharge to groundwater was released by the EPA in January 2014 but direct discharge does not apply to this development.

Under **Regulation 14** of the Groundwater Regulations, the EPA may establish detailed technical rules under which new inputs may be exempted from the requirement that all measures be carried out to meet the 'prevent and limit' objective. The EPA is currently considering possible technical rules for exemptions such as unforeseen

accidental spills. Final decisions on whether a given planned discharge activity may be exempted will be made by the EPA on a case-by-case basis.

"Categories of exempted pollutant inputs that are the consequences of accidents or exceptional circumstances of natural cause that could not reasonably have been foreseen, avoided, or mitigated."

Regulation 56 of the Groundwater Regulations requires that trend assessments be carried out on individual plumes resulting from point sources to verify that new inputs do not cause deterioration in the chemical status of the groundwater body and do not present a risk to human health and the environment (receptors).

The figure below obtained from the EPA guidance document on the technical assessments outlines the risk screening process for indirect and direct discharges to groundwater.

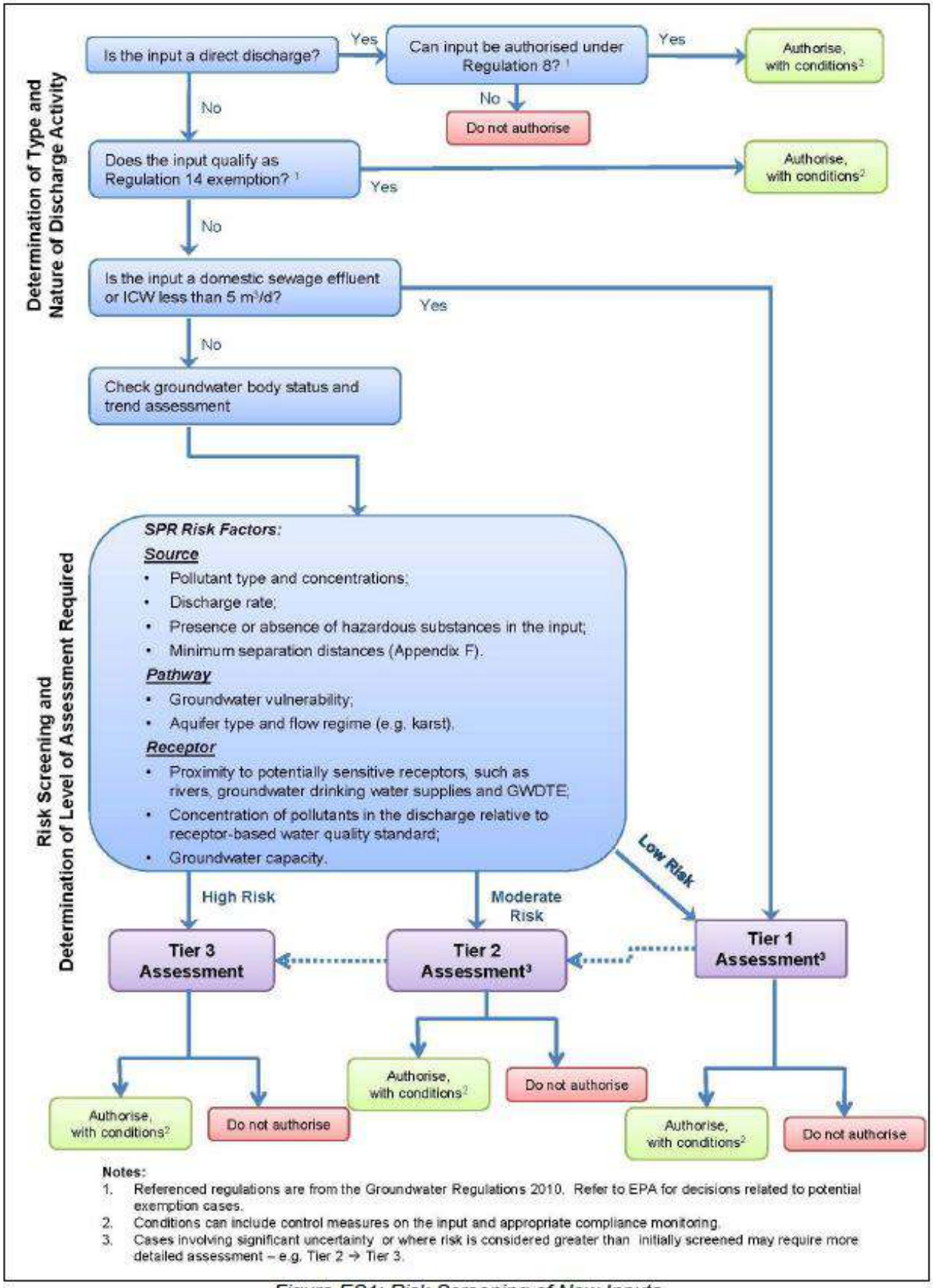


Figure ES1: Risk Screening of New Inputs

3.2 Proposed Surface Water Drain Discharge

The stormwater strategy for the proposed development is detailed as follows and presented in layout engineering drawing in Appendix I of this report sourced from the Engineering Assessment Report completed by Waterman Moylan (July 2025). It is proposed to discharge surface water from the subject site to the ground via. Infiltration:

- To incorporate 3 No. attenuation systems (1 No. system per subcatchment). The attenuation systems will comprise of an above ground detention basin and below ground infiltration area, located within an open green space area adjacent to or within the corresponding subcatchment.
- The attenuation systems are sized to accommodate the extreme 1-in-100-year storm event with 30% climate change and 10% urban creep allowances included.
- The proposed SuDS features for the subject site are summarised below:
    - Permeable paving at private parking / driveways.
    - Bio-retention tree pits used in strategic public areas within landscaping and adjacent to hardstanding areas such as the internal roads network.
    - Swales located adjacent to footpaths or the internal roads network to collect rainfall runoff from same.
    - Above ground attenuation basins for each sub-catchment to facilitate above ground rainfall storage.
    - Below ground infiltration systems for each sub-catchment to facilitate infiltration to ground.
- The proposed SuDS features are designed to intercept, store, slow, filter, and infiltrate runoff from impermeable areas with the aim of:
    - Reducing flood risk
    - Improving water quality
    - Encouraging groundwater recharge
    - Enhancing biodiversity and amenity.

In addition, 2 No. overflow pipes will be provided between the following:

- The southern Catchment A and Central Catchment B;
- The Central Catchment B and the Northern Catchment C.

The overflow pipes are proposed to provide additional resilience in the event of a storm exceeding the design capacity of the surface water network. The 2 No. connections will operate as a below-ground relief mechanism, distinct from above-ground controlled exceedance routes, connecting the entirety of the surface water network and allowing runoff to flow northwards towards the existing pond and the area of the proposed NBMA. It is

noted however that the subject lands are not located adjacent to the NBMA and third-party ownership lands are located between the subject lands and the NBMA. As such, it is not possible to design a direct connection into the NBMA.

The proposed storage at the site is provided as follows:

- Southern Catchment A- A total of 4 No. of swales, 4 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Southern Catchment A requires a total attenuation storage volume of 622m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 665m^3 of storage.
- Central Catchment B- A total of 2 No. of swales, 11 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Central Catchment B requires a total attenuation storage volume of 1,042m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 1,155m^3 of storage.
- Northern Catchment C- A total of 2 No. of swales, 14 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Northern Catchment C requires a total attenuation storage volume of 955m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 1,122m^3 of storage.

The proposed storage provided within each attenuation area during a 1 in 100 year storm event (including 30% climate change) is as follows,

- Southern Catchment A: Detention Basin 250m^3, Infiltration System 315m^3, total of 565m^3
- Central Catchment B: Detention Basin 350m^3, Infiltration System 665m^3, total of 1,015m^3
- Northern Catchment C: Detention Basin 460m^3, Infiltration System 420m^3, total of 880m^3

In total there is a storage of 2,460m^3 provided for the development prior to discharge to groundwater.

3.3 Guidance Document Implementation

Following Figure ES1 in section 3.1 of this report, taken from the EPA Guidance on the Authorisation of Discharges to Groundwater document the flow chart pathway follows;

- The input is not a direct discharge
- The discharge does not qualify as Regulation 14 exemption
- The risk screening indicates that there is a moderate risk from the discharge given the moderate input volume.

4.0 AUTHORISATION OF DISCHARGES TO GROUNDWATER TIER 2 ASSESSMENT

4.1 Tier 2 Assessment Requirements

The Tier 2 assessment is required for the site largely based on the fact that the proposed Sustainable Urban Drainage Systems (SuDS) needed to determine that there is sufficient attenuation capacity for the proposed urban stormwater discharging to ground, as outlined in Table 3 of the EPA guidance document.

A Tier 2 assessment requires:

1) Subsoil Characterisation

Assessment of the subsoil characterisation (to include boreholes if the depth to bedrock is beyond the safe limit of trial holes). Trial pits are preferred to borehole in assessing the subsoil characterisation and subsoil sampling to bedrock.

- Establish depth to bedrock.
- Subsoil permeability estimations.

2) Groundwater Characterisation

Drilling and testing of boreholes and construction of monitoring wells for water level monitoring and sampling purposes. The level of detail required is site specific with the objective to provide representative hydrogeological data.

4.2 Site Investigation

Verde carried out site investigation works at the proposed development site on the 24th to 26th September 2025, where 3No. trial pits and 3No. boreholes were completed during phase one. A second phase including 1No. deep borehole to 20.25mBGL was carried out on the 18th to 20th of November 2025, the locations are shown on Figure 2, included in this report. The site investigation works were carried out in order to obtain site specific hydrogeological information to develop a hydrogeological Conceptual Site Model (CSM) as shown in Figure 4. These works consisted of both trial pitting and borehole drilling works, groundwater sampling and permeability tests, as presented in the photolog included in Appendix C.

The purpose of the phase 2 site investigation works, was to carry out a second round of permeability tests within the wells at the site (BH01, BH02, BH03) and to establish depth to groundwater, estimate the thickness of the unsaturated zone within the gravels and collect a baseline groundwater sample for analysis. In order to achieve this a fourth borehole (BH04) was required to a depth of 20.25mBGL.

4.2.1 Trial Pitting

A total of three trial pits (TP01 – TP03) were excavated on-site using a 3-tonne tracked excavator under the supervision of a Verde environmental scientist at locations presented in Figure 2. The trial pits were excavated to a maximum depth of 1.50 metres below ground level (mBGL). 1No. trial pit was excavated at the three proposed SuDS locations shown in the following drawing, Proposed SuDS Layout, SOU-WMC-PH2-XX-DR-C-P0210, included in Appendix I.

Encountered ground conditions in all trial pits excavated comprised of TOPSOIL to an average depth of 0.30mBGL, followed by brown, loose, very sandy, very gravelly CLAY to c. 0.50- 1mBGL. This is underlain by brown, firm, moist, gravelly, very silty CLAY to c. 1.5mBGL. No bedrock was encountered during the trial pit investigation.

There was no water ingress observed in any of the trial pits during the excavation works and soil was relatively dry throughout.

Soil samples were retrieved from the three trial pits between the depths of 0.50mBGL to 1.20mBGL for Particle Soil Distribution (PSD) analysis. The trial pit logs of the excavations are presented in Appendix D.

4.2.1 Infiltration/Soakaway Tests

A total of three infiltration tests were undertaken by Causeway Geotech Ltd, one at each trial pit location (TP01, TP02, TP03) in accordance with BRE 365 Soakaway Design. Each trial pit was excavated to a depth of 1.50 mBGL, where the test was carried out within the CLAY strata. At each location the infiltration rate was very low. The infiltration test results are included within Appendix B.

4.2.2 Borehole Drilling and Well Installations

Phase 1 Site Investigation 24th – 26th of September:

A total of three boreholes were drilled (BH01, BH02 and BH03) as presented in Figure 2. There was a total of three groundwater monitoring well installed, 1No. at each proposed SuDS location. Verde drilling works were undertaken by Causeway Geotech Ltd using an air rotary drilling rig under the supervision of a Verde Scientist.

Monitoring well BH01 is located in the most up-gradient part of the site located in the northeast corner. The ground encountered at BH01 to a depth of 1.0mBGL was light brown to brown, very sandy, very gravelly, loose, CLAY with frequent sub- rounded cobbles from 6 – 17cm. Followed by brown, very silty, very gravelly, firm, CLAY to a depth of 1.50mBGL. This is underlain by a light brown, firm, very silty CLAY. At 4.20mBGL we encountered a clay, very sandy, GRAVEL layer, with dark grey, coarse, sub- rounded, loose, moist gravels to a depth of

7.20mBGL to which the borehole was terminated. No groundwater strikes were encountered during drilling in the soils and no bedrock was encountered. The monitoring well was installed to 7.20mBGL.

Monitoring well BH02 is located close to the centre of the site. The ground encountered was brown, loose, very sandy, very gravelly CLAY to a depth of 0.80mBGL. This is underlain by a brown, firm, very silty, gravelly CLAY. At 4.90mBGL we encountered a loose, moist, very sandy, very silty GRAVEL layer with dark grey, coarse, sub-rounded, gravels. The gravel layer continued to a depth of 8.4mBGL to which the borehole was terminated. No groundwater strikes were encountered during drilling in the soils and no bedrock was encountered. The monitoring well was installed to 8.4mBGL.

Monitoring well BH03 is located in the most down- gradient part of the site, located in the southeast corner. The ground encountered at BH03 from a depth of 1.50- 3.90mBGL was brown, firm, sandy, slightly gravelly CLAY. This is underlain by a clay, very sandy, GRAVEL layer, with dark- grey, coarse, sub- rounded, loose, moist gravels to a depth of 6.8mBGL to which the borehole was terminated. No groundwater strikes were encountered during drilling in the soils and no bedrock was encountered. The monitoring well was installed to 6.8mBGL.

The purpose of BH01, BH02 and BH03 was to investigate the ground encountered, enable groundwater sampling and to undertake permeability tests on the subsoils. There was no evidence of significant perched groundwater in these wells. The borehole logs are included within this report in Appendix E.

Phase 2 Site Investigation 18th – 20th of November:

A total of 1No. borehole (BH04) drilled to a depth of 20.25mBGL was completed c. 50m north of BH01, within the location of the furthest north proposed SuDS location. Verde drilling works were undertaken by Causeway Geotech Ltd using an air rotary drilling rig under the supervision of a Verde Scientist.

Monitoring well BH04 is in the most northeast part of the site, within a natural recess and down gradient from BH01. The ground encountered at BH04 to a depth of 2.7mBGL was brown, very silty, slightly gravelly, CLAY. Followed by brown, silty, very sandy, gravelly, CLAY to a depth of 4.0mBGL. This is underlain by brown, loose, moist, clayey, GRAVEL. Gravels are dark grey, coarse and sub- angular to a depth of 8.5mBGL. The gravels become brown to reddish brown, loose, moist, sandy GRAVELS to a depth of 14.10mBGL. Sand is coarse, gravel is dark grey to black and white to reddish, fine, sub- angular. Followed by brown, slightly sandy, clayey, GRAVEL. Sand is coarse, gravel is dark grey to black, fine, sub- angular to a depth of 20.25mBGL which the borehole was terminated.

There was groundwater seepage encountered into the borehole at 2.7mBGL, 7.5mBGL and 13.8mBGL, with a groundwater strike at 18.5mBGL. Bedrock was not encountered. The monitoring well was installed to the full depth of 20.25mBGL.

All boreholes were drilled at 210mm diameter so that there was sufficient annular space around the well standpipe to allow for pea gravel and bentonite seals to be installed as presented in the borehole logs in Appendix E. The four boreholes were installed with 50mm diameter HDPE standpipes with plain sections in the upper overburden with slotted screen sections in the underlying groundwater bearing SAND & GRAVELS. Clean pea gravel was used to act as a filter pack around the slotted well screen in the monitoring wells and around the remaining plain screen was backfilled with the drill arisings. A bentonite seal was placed above the slotted screen section and 0.2m from the top to prevent any potential surface water ingress to the monitoring well. The monitoring wells were finished with upright metal covers set in concrete.

4.2.2 Permeability Testing

Permeability testing was carried out by Causeway Geotech Ltd in accordance with the guidance as set out in BS EN ISO 22282-2: 2012 (BSI, 2012). The permeability test results are included within Appendix B.

Phase 1 Site Investigation 24th – 26th of September:

A total of three variable head permeability tests were undertaken within the borehole casing, one at each location (BH01, BH02, BH03) within the sandy, GRAVEL strata.

The results of the tests as presented in Appendix B indicate permeability values of;

- BH01 Falling Head Test- permeability was unable to be calculated as water did not drop within 37% of the initial head.
- BH02 Falling Head Test- 1.26 x 10^{-6} m/s
- BH03 Falling Head Test- 5.07 x 10^{-6} m/s

Phase 2 Site Investigation 18th – 20th of November:

A total of four variable head permeability tests were undertaken within the groundwater monitoring well standpipe of each well location (BH01, BH02, BH03, BH04) within the sandy, GRAVEL strata.

The results of the tests as presented in Appendix B (phase 2) indicate permeability values of;

- BH01 Falling Head Test- 3.36 x 10^{-6} m/s
- BH02 Falling Head Test- 30L of water was added to the standpipe and the hydraulic head did not rise above 5.88mBGL as was draining away.

- BH03 Falling Head Test- 30L of water was added to the standpipe and the water level did not rise, was unable to achieve a hydraulic head as water drained away.
- BH04 Falling Head Test- 4.27 x 10^{-7} m/s. 1000L of water was added to the standpipe, the hydraulic head did not rise above 11.30mBGL. Measurements were taken from 11.30mBGL to return to original GW level 16.9mBGL.

4.2.3 Groundwater Sampling

During phase 1 of the works Verde attended the site on the 2nd and 13th of October following the completion of phase 1 of the site investigation works. At all 3No. groundwater monitoring well locations groundwater was not encountered.

Verde returned to site on the 18th – 20th of November to carry out phase 2 of the site investigation works, which included further permeability tests and an additional borehole (BH04). BH04 was required in order to collect a baseline groundwater sample for analysis as part of the Tier 2 Hydrogeological assessment.

On the 18th of November groundwater levels from all monitoring wells were taken (BH01, BH02 and BH03) a small amount of groundwater was indicated in BH02 at 8.15mbtoc (metres below top of casing), BH01 and BH02 remained dry.

On the 19th of November groundwater levels from all monitoring wells were taken (BH01, BH02 and BH03), BH01 and BH03 were dry and BH02 measured at 8.34mbtoc. The amount of groundwater at this location was small, likely due to heavy rainfall during a recent storm, with low chance of recharge and sample recovery once developed and purged to gain enough groundwater for sampling.

On the 20th of November BH04 was completed and a groundwater monitoring well installed to 20.25mBGL and screened within the sandy, GRAVEL strata. A groundwater strike was recorded at 18.5mBGL.

On the 26th of November groundwater levels from all monitoring wells were taken (BH01, BH02, BH03 and BH04). BH01 and BH03 were dry, BH02 measured at 8.64mbtoc and BH04 measured at 16.9mbtoc. BH02 was purged, recovery rate was very slow and there was not sufficient volume of groundwater to retrieve a sample for analysis. BH04 was purged, recovery rate was fast to original groundwater level at the time of taking the sample. A calibrated field water quality multi-meter was used to obtain readings of pH, EC, DO, Redox and temperature, as presented in the sampling logs in Appendix F.

4.3 Conceptual Site Model

The hydrogeological data gathered during the site investigation works, was used to create a Conceptual Site Model (CSM) of the ground conditions below the subject site. This information is shown in Figure 4, included within this report.

Information from the Teagasc and GSI database show the strata underlain the subject site to consist of shallow well drained, mineral, mainly basic Glaciofluvial sands and gravels. These gravels are derived from limestones. It is noted that bedrock was not encountered during the site investigation works - borehole depths ranged from 6.8mBGL in BH03 to 20.25mBGL in BH04.

Overall, it can be seen from the permeability tests as summarised in Appendix B that the subsoils at the proposed SuDS locations have permeability rates which are considered low within the silty, gravelly CLAY subsoil c. 4 – 5m in thickness, overlying the moderate silty, sandy, GRAVEL subsoils of the regionally important Curragh West sand and gravel aquifer (as indicated by logs provided in Appendix E). Moderate vulnerability includes a wide range of permeability values (1×10^{-4} m/s down to about 1×10^{-8} m/s) (WFD Strive Programme 2007-2013[2]).

The static water level within BH04 was recorded at 16.9mBGL following well development, indicating that below the c. 4 – 5m thick CLAY there is a substantial depth of unsaturated overburden (as indicated on Figure 4).

Data available to Verde from site investigations carried out on the Phase 1 of the South Green Residential Development in 2023, indicated a west to east direction of perched groundwater flow (as shown in Plate 4.1 below). It is unknown if there is a hydraulic connection between the shallow groundwater in the deeper sand and gravel subsoils and the assumed underlying limestone bedrock aquifer.

[2] Water Framework Directive – Recharge and Groundwater Vulnerability Strive Programme, Environmental Protection Agency, 2007-2013

Plate 4.1 illustrates the perched groundwater flow direction of the Phase 1 South Green Development to the south of the subject site.



4.4 Subsoil Characterisation

From the trial pits (TP01 to TP03) excavated at the site up to 1.50mBGL the subsoils consisted largely of brown, loose, very sandy, very gravelly CLAY to c. 1.00mBGL, followed by brown, firm, moist, gravelly, very silty CLAY to c. 1.5mBGL. With gravel content increasing with depth.

A total of three bulk subsoils were taken, 1No. from each trial pit across the proposed soakaway locations for particle size distribution (PSD) analysis by Causeway Geotech Ltd. The PSD results, as presented in Appendix B, shows the subsoils to consist of CLAY in the proposed SuDS locations of the site as summarised in Table 4.1 below.

Table 4.1 Soil PSD Analysis Results

Trial Pit Samples	TP01	TP02	TP03
Sample Depth (mBGL)	0.5	1.00	1.20
Particle Size Description	CLAY	CLAY	CLAY

Using the field saturated hydraulic conductivity estimation in Table E.3 appendix E of the guidance document on "estimated permeability ranges for subsoils" places this in the silt/clay range which corresponds with the PSD laboratory results of clay and the low permeability ratings.

4.5 Groundwater Characterisation

There was no evidence of groundwater in the trial pits (TP01, TP02 and TP03). Evidence of perched groundwater at a relatively shallow depth was encountered in BH02, while BH01 and BH03 were dry. However, a groundwater strike was encountered within the sandy, GRAVELS at 18.5mBGL, with seepage of groundwater into the borehole noted at 2.7mBGL, 7.5mBGL and 13.8mBGL at BH04 drilled by Verde in November 2025. Recent groundwater levels recorded by Verde during October and November 2025 indicate that the groundwater encountered within BH04 is shallow groundwater from the Curragh West sand and gravel aquifer which underlain the site.

The static water level within BH04 was recorded at 16.9mBGL following well development, indicating that below the c. 4 – 5m thick silty, gravelly, CLAY there is a substantial depth of unsaturated overburden (as indicated on Figure 4). The permeability tests completed by Causeway Geotech Ltd in November 2025 show the sand and gravels to have a moderate permeability rate.

Table 4.2 below illustrates the groundwater levels recorded within the boreholes during November 2025 in relation to ground elevation (mOD).

Table 4.2 Groundwater Levels for November 2025

Location ID	Elevation (mOD)	19/11/2025		20/11/2025		24/11/2025		26/11/2025	
		GW Level (mbtoc)	GW Level (mOD)	GW Level (mbtoc)	GW Level (mOD)	GW Level (mbtoc)	GW Level (mOD)	GW Level (mbtoc)	GW Level (mOD)
BH01	107.67	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
BH02	107.47	8.15	99.32	8.34	99.13	8.54	98.93	8.64	98.83
BH03	103.97	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
BH04	105.54	-	-	16.90	88.64	16.88	88.66	16.90	88.64

Data available to Verde from the site investigations carried out during the Phase 1 of the South Green Residential Development in 2023, indicated a west to east direction of perched groundwater flow. With shallow boreholes indicating perched groundwater from the gravelly, CLAY strata and a groundwater strike within the sandy, GRAVELS at 18.5mBGL.

There are several groundwater monitoring and abstraction wells within 1km of the development site, none are within the vicinity of the site, however. The site is not reported to be within the protection zones of any

groundwater abstraction well and residential properties in the vicinity of the site are reported to be on a mains water supply.

4.6 Hydraulic Loading of Groundwater

Information from the detailed site investigation, infiltration and permeability values have been used to design the discharge of surface water to ground at an unrestricted rate via the following:

- Southern Catchment A- A total of 4 No. of swales, 4 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Southern Catchment A requires a total attenuation storage volume of 622m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 665m^3 of storage.
- Central Catchment B- A total of 2 No. of swales, 11 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Central Catchment B requires a total attenuation storage volume of1,042m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 1,155m^3 of storage.
- Northern Catchment C- A total of 2 No. of swales, 14 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed. Northern Catchment C requires a total attenuation storage volume of 955m^3 this volume is achieved with the previously mentioned SuDS features which offer a total of 1,122m^3 of storage.

The proposed storage provided within each attenuation area during a 1 in 100 year storm event (including 30% climate change) is as follows,

- Southern Catchment A: Detention Basin 250m^3, Infiltration System 315m^3, total of 565m^3
- Central Catchment B: Detention Basin 350m^3, Infiltration System 665m^3, total of 1,015m^3
- Northern Catchment C: Detention Basin 460m^3, Infiltration System 420m^3, total of 880m^3

In total there is a storage of 2,460m^3 provided for the development prior to discharge to groundwater, which is sufficient to serve the development attenuation requirements.

4.7 Compliance

It was possible to collect a groundwater sample from the groundwater monitoring well BH04, which was installed at the Northern Catchment C location of the proposed SuDS network. The sample was analysed to obtain information on the current groundwater quality status, the analysis is shown in Tables 1A – 1B attached to this report and the laboratory certificates are included in Appendix G.

The groundwater sample was collected on the 26th of November 2025, several days after the drilling works were completed at BH04 to enable the ground conditions to stabilise. This is in accordance with best practice following air rotary drilling. The groundwater sample was collected in laboratory supplied sample containers. The sample was filtered and preserved for metal analysis and preservative was used for ammonia analysis. Sterile containers were also used for bacteriological analysis. The sample was then analysed at UKAS accredited laboratories.

It was not possible to collect groundwater samples from the following locations:

- BH01 located within Northern Catchment C of the proposed SuDS location was dry during groundwater dipping events in September, October and November 2025.
- BH02 located within Central Catchment B of the proposed SuDS location was dry during groundwater dipping events in September and October. A small amount of groundwater was recorded within the monitoring well in November after a period of heavy rainfall. However, once purged the well was very slow to recharge and sample recovery was not possible.
- BH03 located within Southern Catchment A of the proposed SuDS location was dry during groundwater dipping events in September, October and November 2025.

At BH04 the biological analysis indicates very low levels of Coliforms (2 mpn/100ml), Clostridium Perfringens (3 cfu/100ml) and Escherichia coli (4 mpn/100ml) which were above the Drinking Water Standards. This is an indication of faecal contamination, which is most likely related to farming activities such as livestock grazing at the site until September 2025.

There were no hydrocarbons detected above the level of detection (LOD).

There was a slight exceedance in relation to MRP Ortho Phosphate as PO4 of 0.08 mg/l, which exceeded the Groundwater Regulations 2016 of 0.035 mg/l.

The chemical groundwater analysis indicates that the groundwater quality at the subject site is good. The sample indicates an elevated alkalinity (370 mg/l), which is likely naturally occurring due to the underlain limestone bedrock within the area.

5.0 EVALUATION OF THE POTENTIAL IMPACT OF DISCHARGE TO GROUNDWATER ON GROUNDWATER BODY AND SURFACE WATER BODY STATUS

5.1 Groundwater Chemical Status

The current Water Framework Directive groundwater status for the Curragh Gravels West Groundwater Body (IE_SE_G_133) is "Good" and is classified as being "Not At Risk", in accordance with the Water Framework Directive Groundwater 2016-2021 Water Quality Status.

5.2 Recommended Guidance Approach

The proposed development site is located within a Groundwater Body classed as Good with the catchment area being part of the Curragh Gravels West Groundwater Body. The catchment area of the site is part of the Barrow Sub catchment (SC_060), which is a tributary of the Tully Stream which is "At Risk" and has a "Poor" ecological Status.

Stormwater associated with developments can mobilise pollutants that accumulate on impermeable surfaces such as road, car parks and roofs. The contaminants of concern from SuDS stormwater control structures such as the infiltration system proposed for the site include hydrocarbons, heavy metals, suspended solids and organic matter. Other potential contaminants such as detergents can arise from the washing of paved surfaces and car washing. The proposed locations of the three catchment areas (southern catchment A, central catchment B and northern catchment C) are not located in areas where the underlying groundwater is vulnerable given that there is a thick unsaturated zone beneath the site with no direct infiltration to bedrock.

The groundwater analysis indicates the baseline groundwater quality at the subject site is good, with very low levels of faecal contamination.

6.0 FINDINGS AND CONCLUSION

A hydrogeological assessment was undertaken in relation to the proposed SuDS design and associated discharge of stormwater to groundwater for a proposed residential development of 153No. residential units at Southgreen Road, Co. Kildare. The proposed development will be serviced by mains water and foul drainage system present in the area.

The Tier 2 Hydrogeological assessment for the site was undertaken to assess the environmental risks to groundwater from stormwater associated with the proposed development, taking into account the EPA guidance document on authorisation of discharges to groundwater.

Verde carried out site investigation works at the proposed development site in two phases. The first phase on the 24th –26th September 2025 and the second phase on the 18th –20th November 2025. The works were conducted to obtain site-specific hydrogeological information required to develop a Hydrogeological Conceptual Site Model (CSM). Activities included trial pitting, borehole drilling, groundwater sampling, and permeability testing.

During phase one trial pits (TP01, TP02 and TP03) and BRE365 infiltration tests were undertaken within the subsoils at the proposed SuDS locations (southern catchment A, central catchment B and northern catchment C). The infiltration tests failed the specification as the water level did not fall sufficiently enough to complete the test. The tests were completed at 1.50mBGL within the silty, gravelly CLAY and the subsoil type was confirmed by PSD analysis which was indicative of CLAY.

Subsequently 4No. boreholes (BH01, BH02, BH03 and BH04) were drilled at the proposed SuDS locations (southern catchment A, central catchment B and northern catchment C). Groundwater was not encountered at BH01, BH02 and BH03. However, during phase two of the investigation in BH04 groundwater was encountered at 18.5mBGL at BH04 within the silty, sandy GRAVELS.

During phase two, a total of four variable head permeability tests were undertaken within the groundwater monitoring well standpipe of each well location (BH01, BH02, BH03, BH04) within the silty, sandy, GRAVEL strata.

The results of the tests as presented in Appendix B (phase 2) indicate permeability values of;

- BH01 Falling Head Test- 3.36 x 10^{-6} m/s
- BH02 Falling Head Test- 30L of water was added to the standpipe and the hydraulic head did not rise above 5.88mBGL as was draining away.

- BH03 Falling Head Test- 30L of water was added to the standpipe and the water level did not rise, was unable to achieve a hydraulic head as water drained away.
- BH04 Falling Head Test- 4.27 x 10^{-7} m/s. 1000L of water was added to the standpipe, the hydraulic head did not rise above 11.30mBGL. Measurements were taken from 11.30mBGL to return to original GW level 16.9mBGL.

Overall, it can be seen from the permeability tests that the subsoils at the proposed SuDS locations have permeability rates which are considered moderate within the silty, sandy, GRAVEL subsoils of the regionally important Curragh West sand and gravel aquifer. Moderate vulnerability includes a wide range of permeability values (1 × 10^{-4} m/s down to about 1 × 10^{-8} m/s) (WFD Strive Programme 2007-2013[3]).

As shown by the Conceptual Site Model (CSM), in the attached figure 4, the static water level within BH04 was recorded at 16.9mBGL indicating that below the c. 4 – 5m thick silty, gravelly, CLAY strata, there is a substantial depth of unsaturated overburden at the proposed SuDS locations.

As stormwater can mobilise pollutants that accumulate on impermeable surfaces such as roads, car parks and roofs. The contaminants of concern from SuDS stormwater control structures such as the infiltration system proposed for the site include hydrocarbons, heavy metals, suspended solids and organic matter. The proposed location of the infiltration systems are not located in areas where the underlying groundwater is vulnerable given that there is thick unsaturated zone beneath the site with no direct infiltration to bedrock.

During the November 2025 investigation works it was possible to retrieve a baseline groundwater sample from BH04. The groundwater analysis indicates an elevated alkalinity (370 mg/l), which is likely naturally occurring due to the underlain limestone bedrock, minor faecal impact from recent agricultural activities on the subject site, no detections of hydrocarbons and a slight elevation in MRP Ortho Phosphate as PO4 of 0.08 mg/l, which exceeds the Groundwater Regulations of 2016 of 0.035 mg/l. Overall the baseline groundwater quality at the subject site is good.

The Tier 2 Hydrogeological Assessment of the subject site identified a thick unsaturated zone to allow for natural attenuation of any potential contaminants in the stormwater discharge. Routine monitoring of the wells on-site will ensure no adverse impact is occurring to the aquifer beneath the site.

[3] Water Framework Directive – Recharge and Groundwater Vulnerability Strive Programme, Environmental Protection Agency, 2007-2013

7.0 RECOMMENDATIONS

A maintenance programme for cleaning the gullies, drain manholes, attenuation basin and interceptors should be adhered to as per the engineering design to ensure ongoing effective operation.

A regular groundwater monitoring programme should be undertaken at the site to ensure the groundwater quality is not affected by the SuDS design for the proposed development site.

Respectfully submitted on behalf of **Verde Environmental Consultants,**



Natalie Molloy
Geo- Environmental Consultant



Kevin Cleary
Project Director

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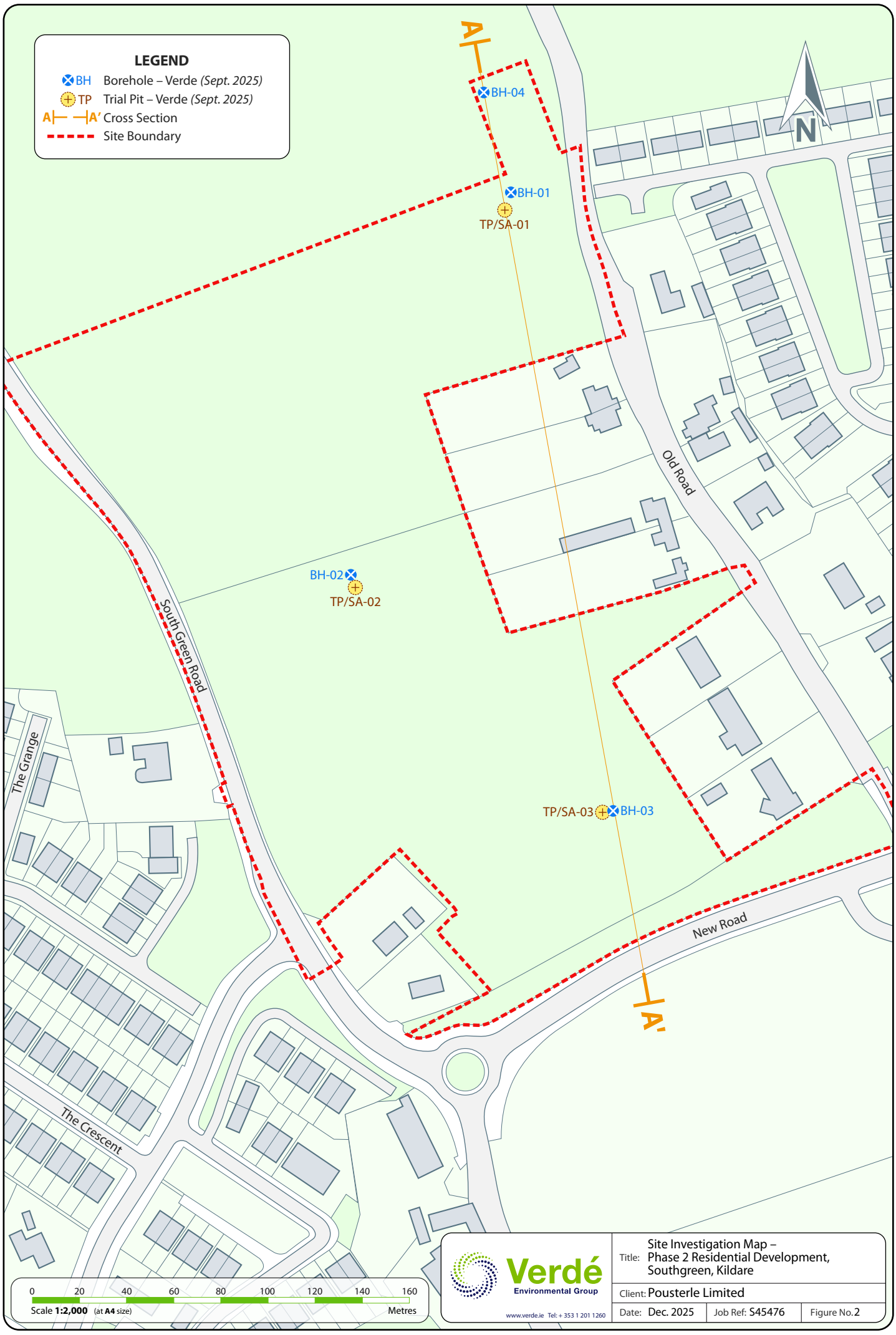
FIGURES



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Title: Site Location Map – Phase 2 Residential Development, Southgreen, Kildare			
Client: Pousterle Limited			
Date: Dec 2025	Job Ref: S45476	Figure No.1	

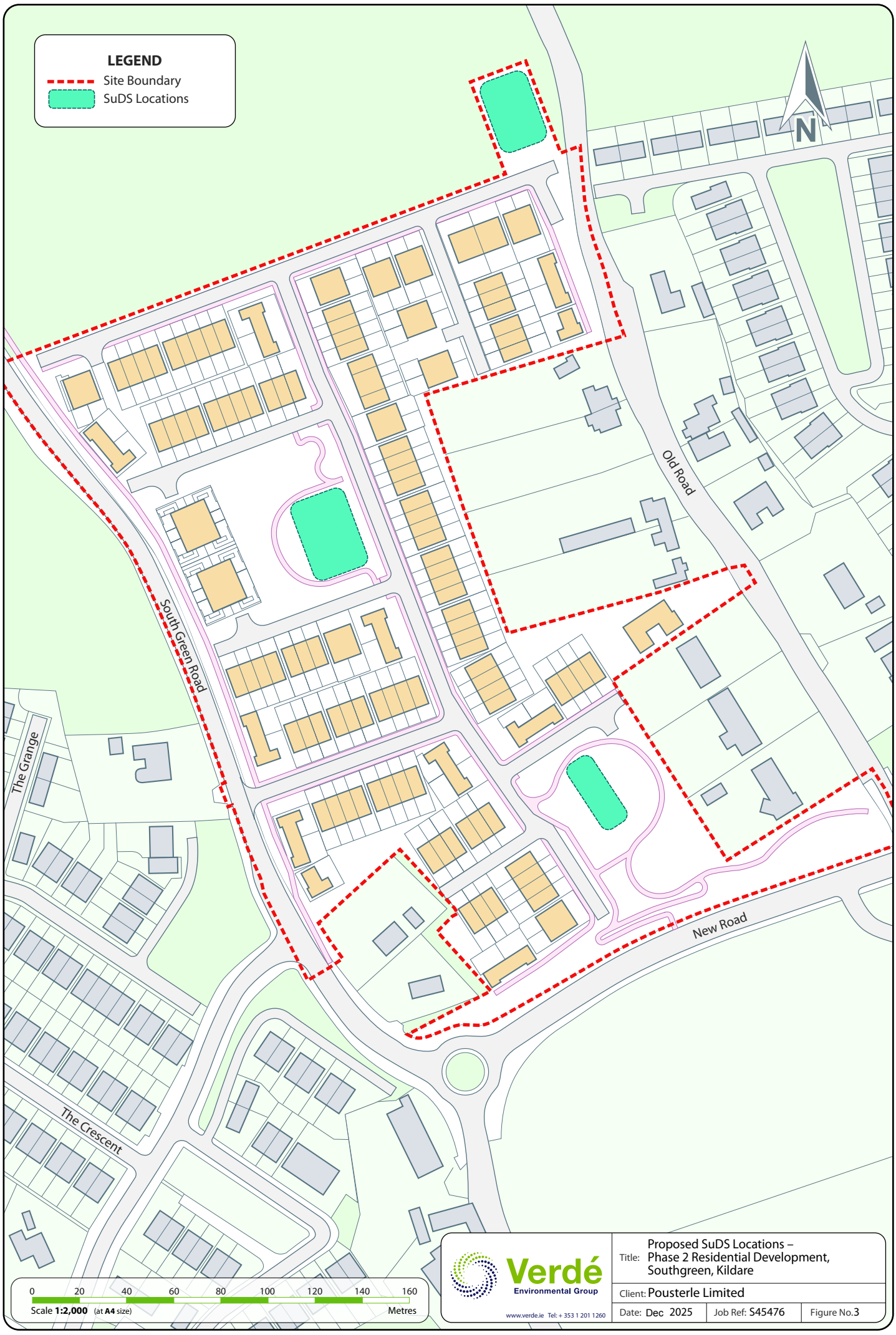


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Title: Site Investigation Map – Phase 2 Residential Development, Southgreen, Kildare

Client: Pousterle Limited

Date: Dec. 2025 | Job Ref: S45476 | Figure No. 2

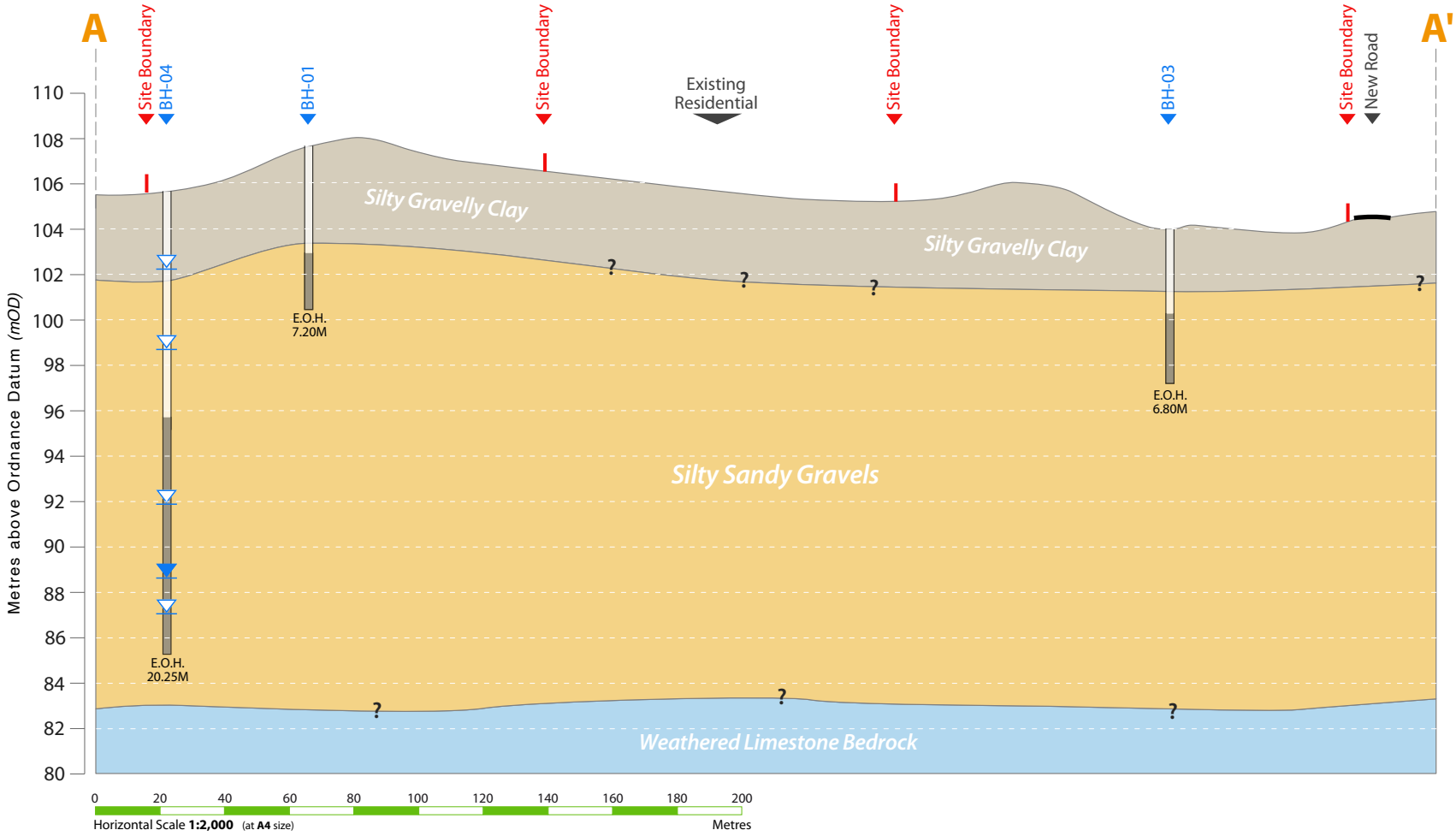


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Title: Proposed SuDS Locations – Phase 2 Residential Development, Southgreen, Kildare

Client: Pousterle Limited

Date: Dec 2025 | Job Ref: S45476 | Figure No.3



LEGEND

- Screened Section of Borehole
- Groundwater Strike Encountered during Drilling
- Static Groundwater Levels
- ? Uncertainties
- Water Table

Verdé Environmental Group

www.verde.ie Tel: + 353 1 201 1260

Title: Cross Section A – A'
Phase 2 Residential Development, Southgreen, Kildare

Client: Pousterle Limited

Date: Dec. 2025 | Job Ref: S45476 | Figure No.4

TABLES

Table 1A - Groundwater Analytical Results - MTBE, BTEX and TPH - Southgreen, Co. Kildare - November 2025

			Sample ID:	BH04	EPA IGV	Groundwater Regs S.I. No. 366 of 2016
			Sampling Date:	06/02/2025		
	Units	LOD		Scheduled		
MTBE & BTEX						
MTBE	ug/l	<5		<5	30	10
Benzene	ug/l	<5		<5	1 #	0.75 #
Toluene	ug/l	<5		<5	10	525
Ethylbenzene	ug/l	<5		<5	10	-
m/p-Xylene	ug/l	<5		<5	10	-
o-Xylene	ug/l	<5		<5	10	-
TPH - Aliphatic						
>C5-C6	ug/l	<10		<10	10	-
>C6-C8	ug/l	<10		<10	10	-
>C8-C10	ug/l	<10		<10	10	-
>C10-C12	ug/l	<5		<5	10	-
>C12-C16	ug/l	<10		<10	10	-
>C16-C21	ug/l	<10		<10	10	-
>C21-C35	ug/l	<10		<10	10	-
Total C5-C35	ug/l	<10		<10	10	-
TPH - Aromatic						
>C5-EC7	ug/l	<10		<10	0.75 #	-
>EC7-EC8	ug/l	<10		<10	10	-
>EC8-EC10	ug/l	<10		<10	10	-
>EC10-EC12	ug/l	<5		<5	10	-
>EC12-EC16	ug/l	<10		<10	10	-
>EC16-EC21	ug/l	<10		<10	10	-
>EC21-EC35	ug/l	<10		<10	10	-
Total >C5-C35	ug/l	<10		<10	10	-
Total TPH (C5-35)	ug/l	<10		<10	10	7.5 #
EPH CWG Interpretation	-	-		-	-	-

Notes

EPA Interim Guideline Values (IGVs) for the protection of groundwater, 2003. The EPA interim guideline value for TPH is considered to "serve as a 'catch-all' and will present results for the general term 'Gasoline Range Organics' and the separate 'BTEX' parameters including MTBE"

GW 2016 - European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 S.I. No. 366/2016

Underlined = exceeds EPA IGV standards

Bold = exceeds GW 2016 standards

" # " = LOD above the relevant standard

" - " = No GAC value available

Table 1B - Groundwater Analytical Results - Microbiological - Southgreen, Co. Kildare - November 2025

			Sample ID:	Drinking Water Standards S.I. No. 122 of 2014	Groundwater Regs S.I. No. 366 of 2016
			Sampling Date:		
	Units	LOD	Scheduled		
Microbiological					
Coliforms 37°C	mpn/100ml	<2.5	2	0	-
Clostridium Perfringens	cfu/100ml	<3	3	0	-
Escherichia coli	mpn/100ml	<0.5	4	0	-
Intestinal Enterococcus	cfu/100ml	<12	18	0	-
Chemical Parameters					
Total Oxidised Nitrogen as N	mg/l	<0.2	6.7	-	-
Nitrate as NO3	mg/l	<0.2	29.7	50	37.5
Nitrite as NO2	mg/l	<0.02	<0.02	0.5	0.375
MRP Ortho Phosphate as PO4	mg/l	<0.06	**0.08**	-	0.035
Total Phosphorous as P	ug/l	<5	56	-	-
Indicator Parameters					
Total Ammonia as NH3	mg/l	<0.03	<0.03	-	-
Free Ammonia as N	mg/l	<0.006	<0.006	-	-
Chloride	mg/l	<0.3	40.8	250	187.5
Total Dissolved Iron	ug/l	<20	<20	200	-
Dissolved Manganese	ug/l	<2	12	50	-
Total Organic Carbon (TOC)	mg/l	<2	<2	No Abnormal Change	-
Dissolved Sodium	mg/l	<0.1	12.4	200	150
Dissolved Calcium	mg/l	<0.2	160.9	200	-
Sulphate as SO4	mg/l	<0.5	16.4	250	187.5
Dissolved Magnesium	mg/l	<0.1	9.4	50	-
Total Dissolved Solids (TDS)	mg/l	<35	738	-	-
Total Suspended Solids	mg/l	<10	65	-	-
Biological Oxygen Demand (BOD) + ATU	mg/l	-	10	-	-
Total Alkalinity	mg/l	<1	370	-	-
True Colour	PCU	<15	214	No Abnormal Change	-
pH	pH Units	<0.01	7.7	6.5-9.5	-

Notes

Drinking Water Standards Regulations 2014 S.I. No. 122/2014

GW 2016 - European Union Environmental Objectives (Groundwater) (Amendment) Regulations 2016 S.I. No. 366/2016

Underlined = exceeds drinking water 2014 standard

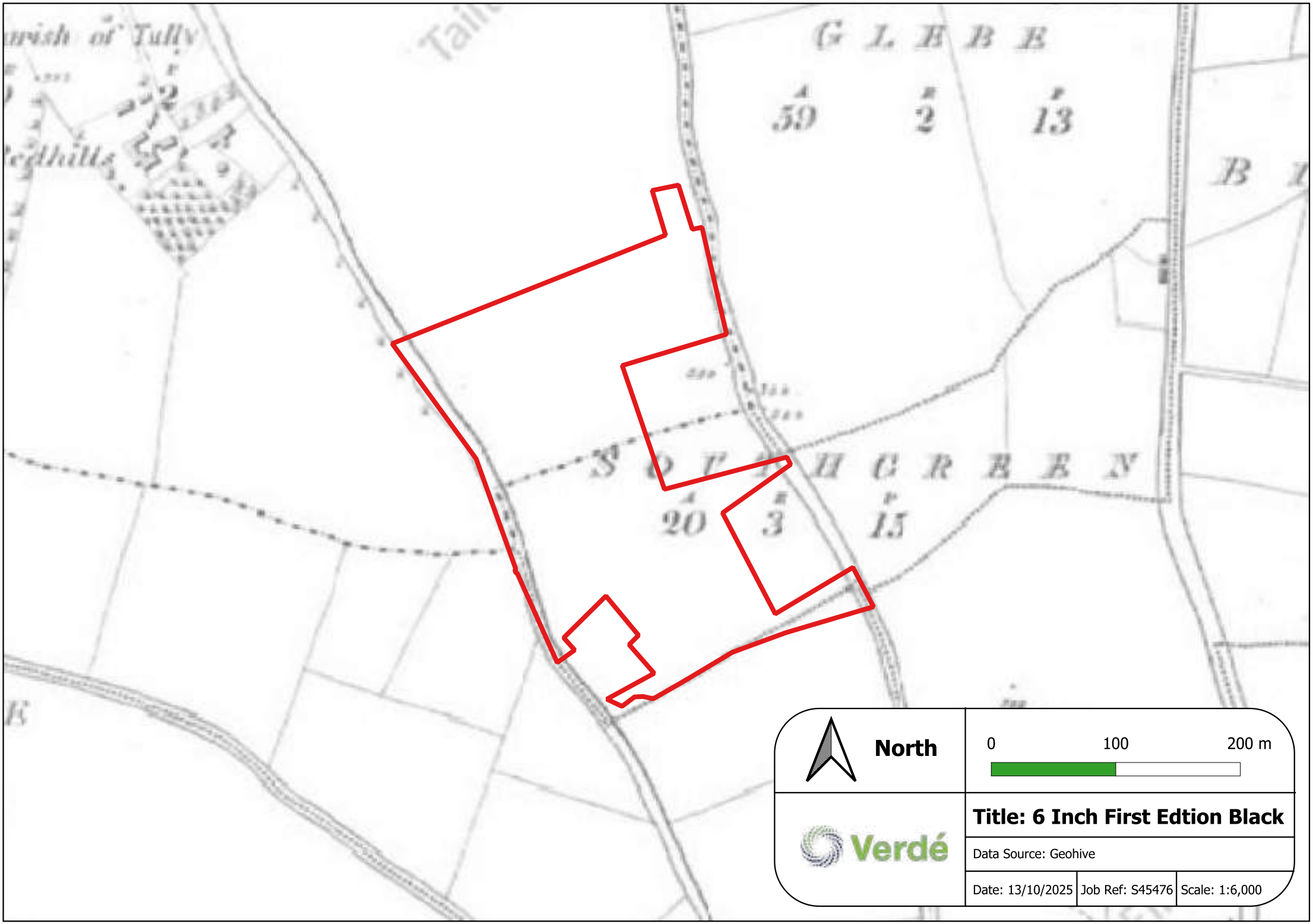
Bold = exceeds GW 2016 standards

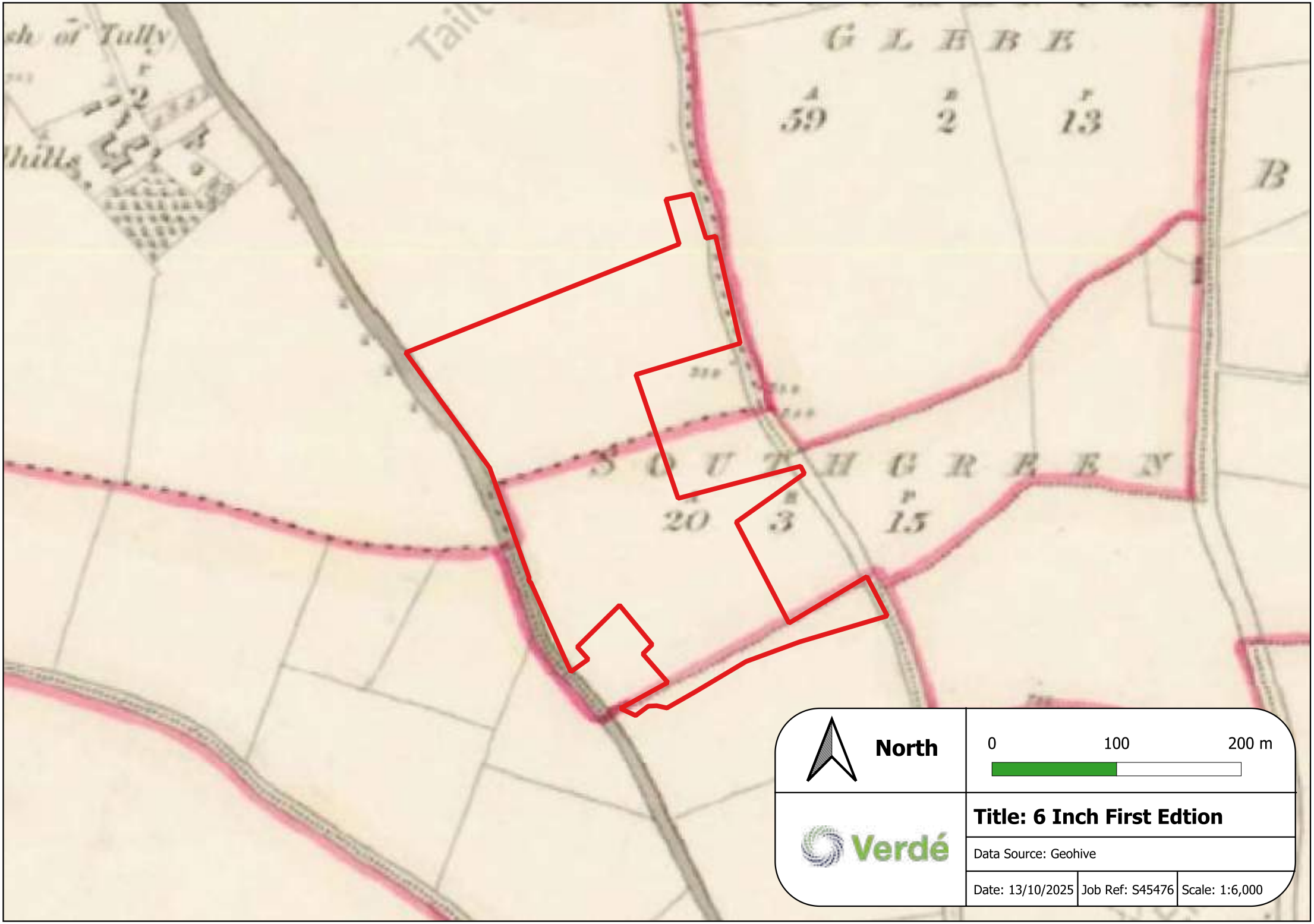
" # " = LOD above the relevant standard

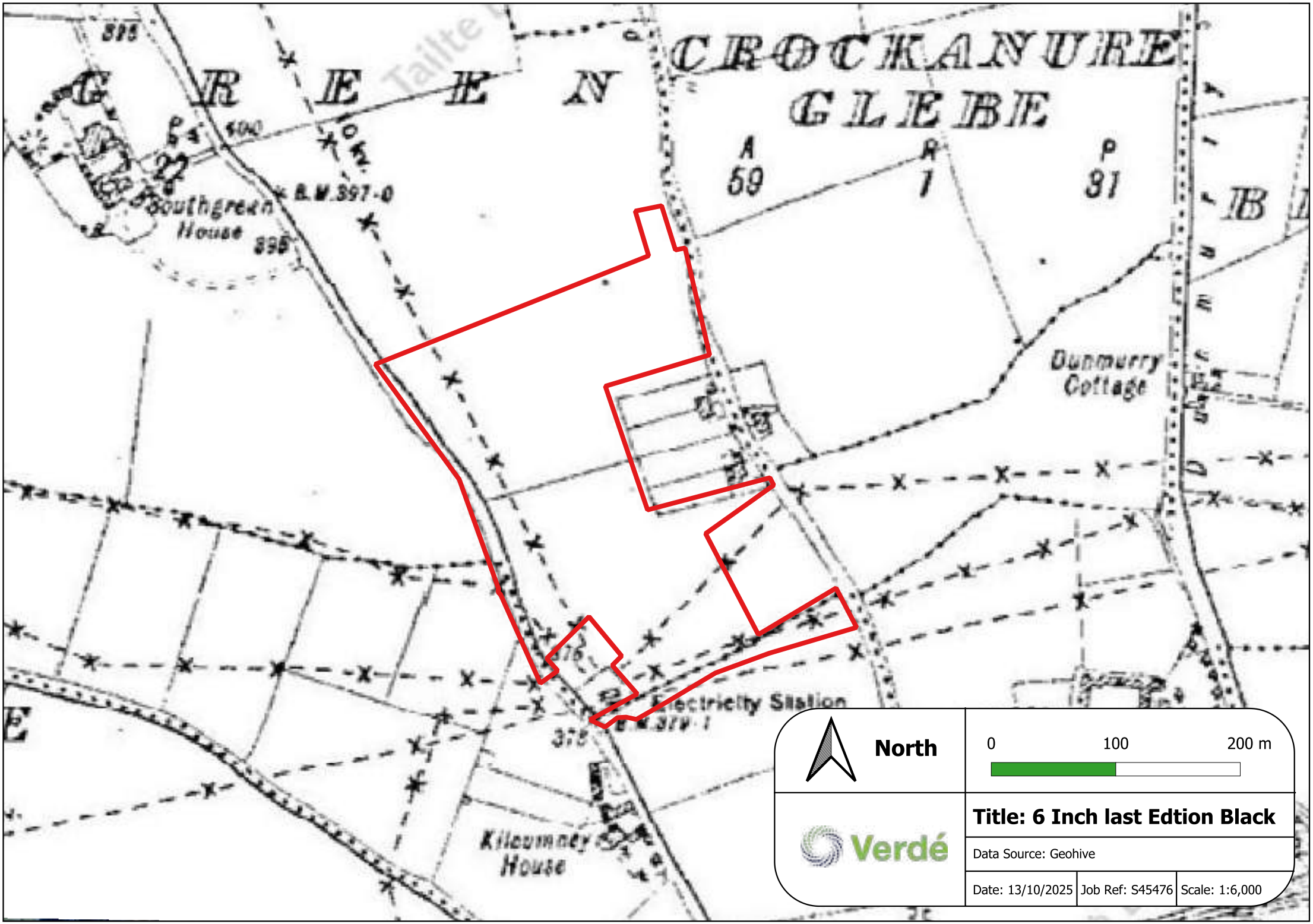
" - " = No GAC value available

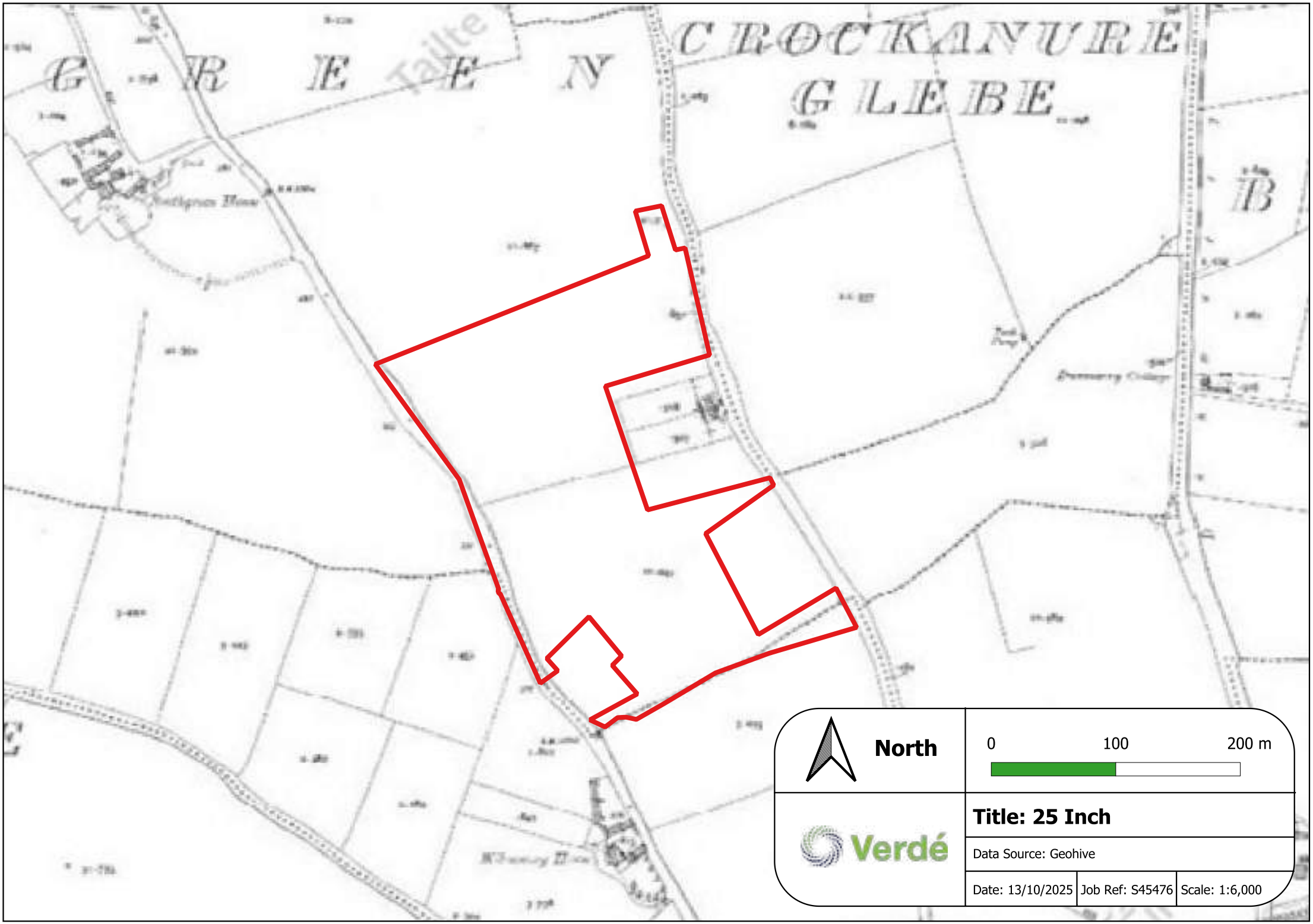
APPENDIX A

DESKTOP MAPS

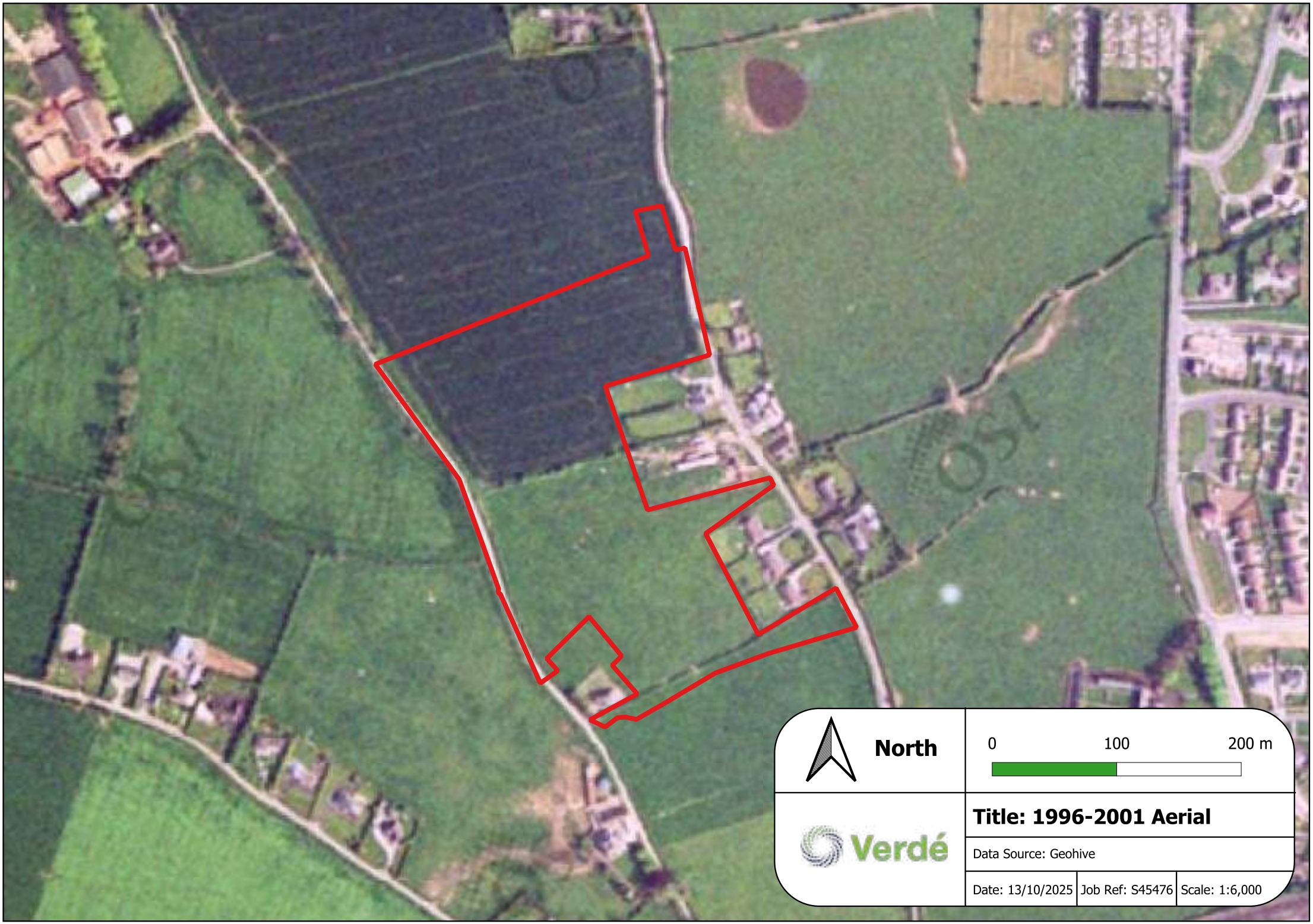

North
0
100
200 m
Verdé
Title: 6 Inch First Edtion Black
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000


North
0
100
200 m
Verdé
Title: 6 Inch First Edtion
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000


CROCKANURE
GLEBE
GREEN
Southgreen House
B.M.397·0
Dunmurry Cottage
Electricity Station
Kilcummey House
North
0
100
200 m
Title: 6 Inch last Edtion Black
Verdé
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000


GREEN
CROCKANURE
GLEBE
North
0
100
200 m
Title: 25 Inch
Verdé
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000

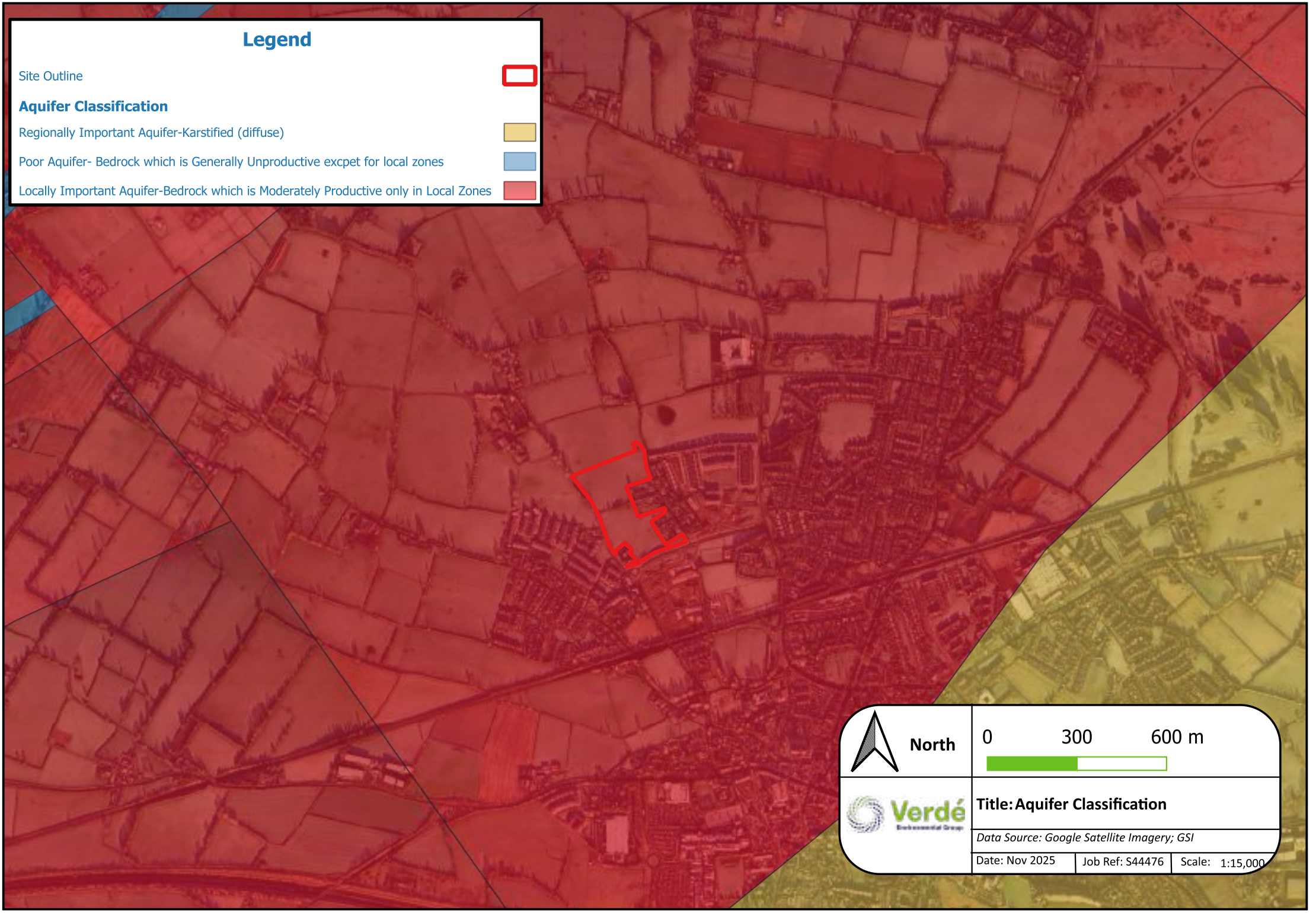

North
0
100
200 m
Verdé
Title: 1995 Aerial
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000

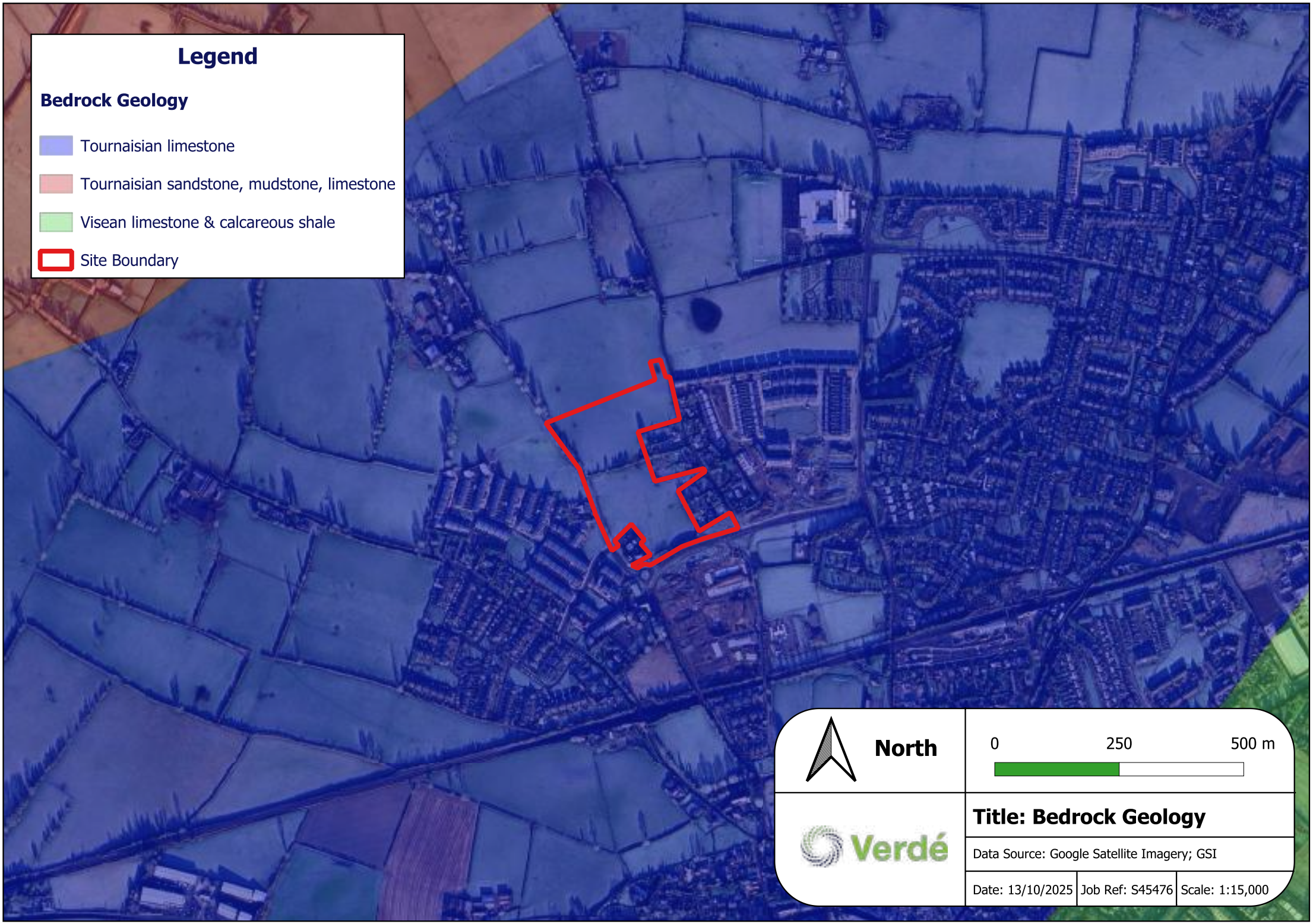

North
0
100
200 m
Verdé
Title: 1996-2001 Aerial
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000

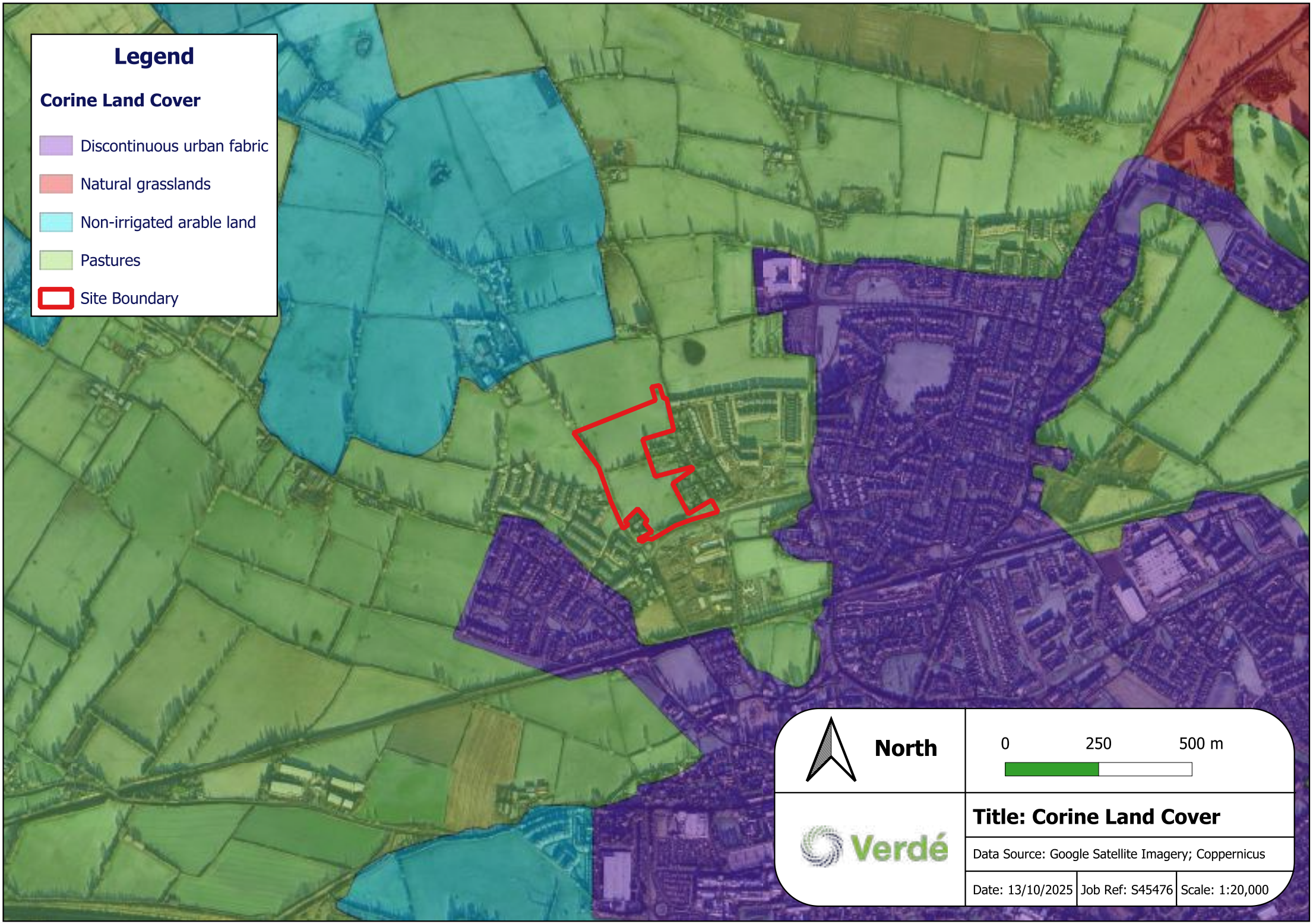

North
0
100
200 m
Verdé
Title: 2001-2005 Aerial
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000

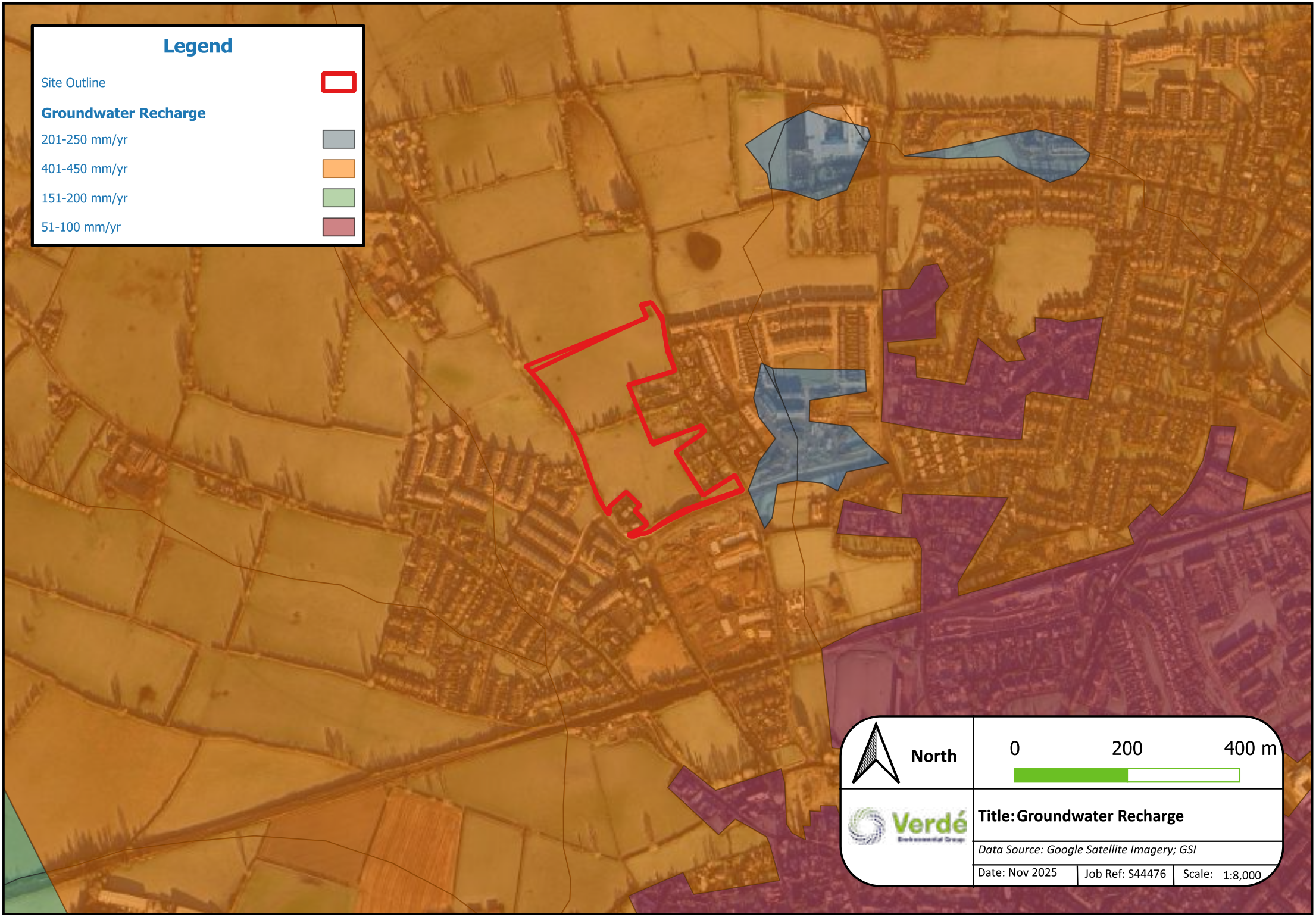

North
0
100
200 m
Verdé
Title: 2006-2012 Aerial
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000


North
0
100
200 m
Verdé
Title: 2013-2018 Aerial
Data Source: Geohive
Date: 13/10/2025
Job Ref: S45476
Scale: 1:6,000

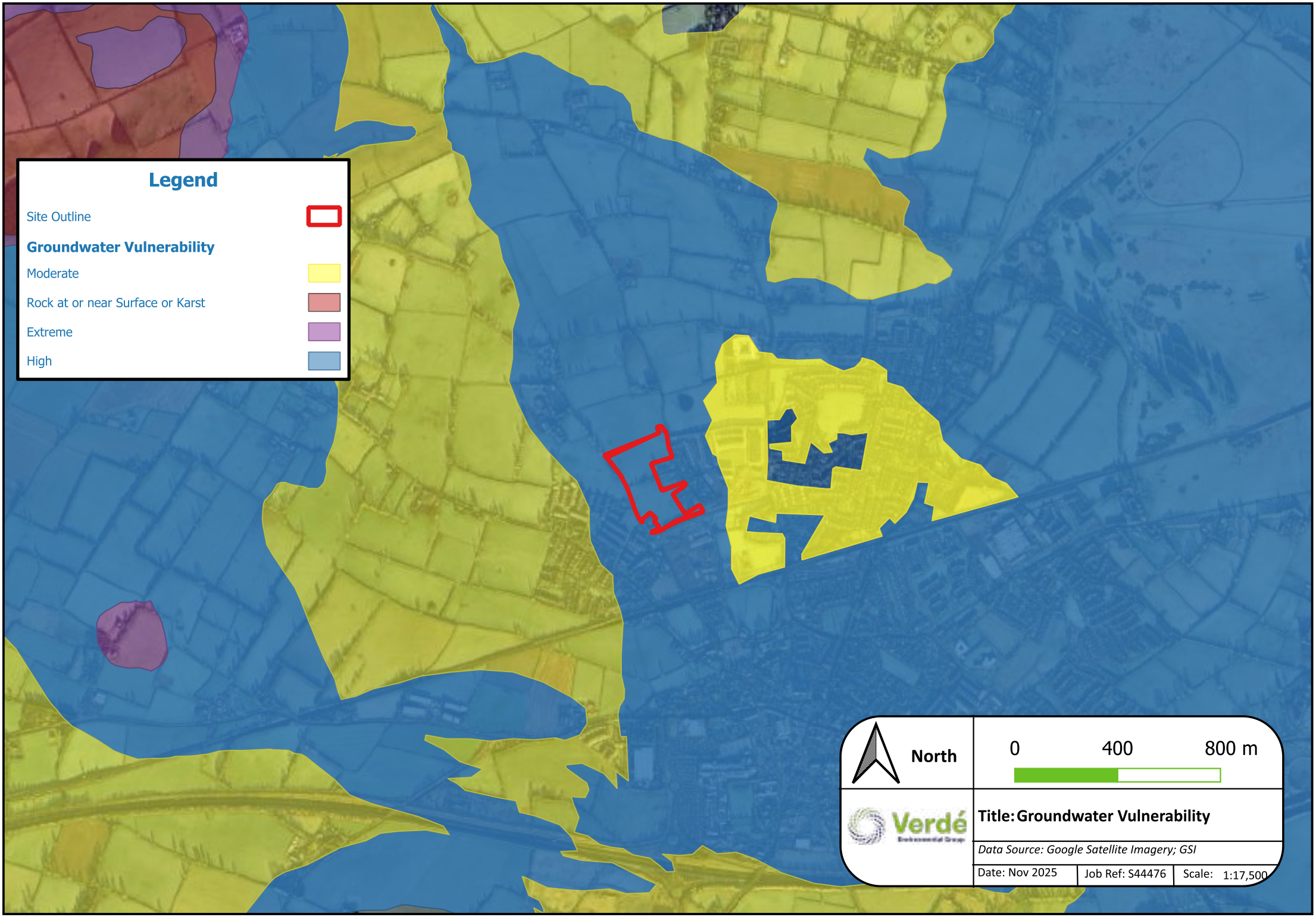

Legend
Site Outline
Aquifer Classification
Regionally Important Aquifer-Karstified (diffuse)
Poor Aquifer- Bedrock which is Generally Unproductive excpet for local zones
Locally Important Aquifer-Bedrock which is Moderately Productive only in Local Zones
North
0
300
600 m
Verdé
Title: Aquifer Classification
Data Source: Google Satellite Imagery; GSI
Date: Nov 2025
Job Ref: S44476
Scale: 1:15,000

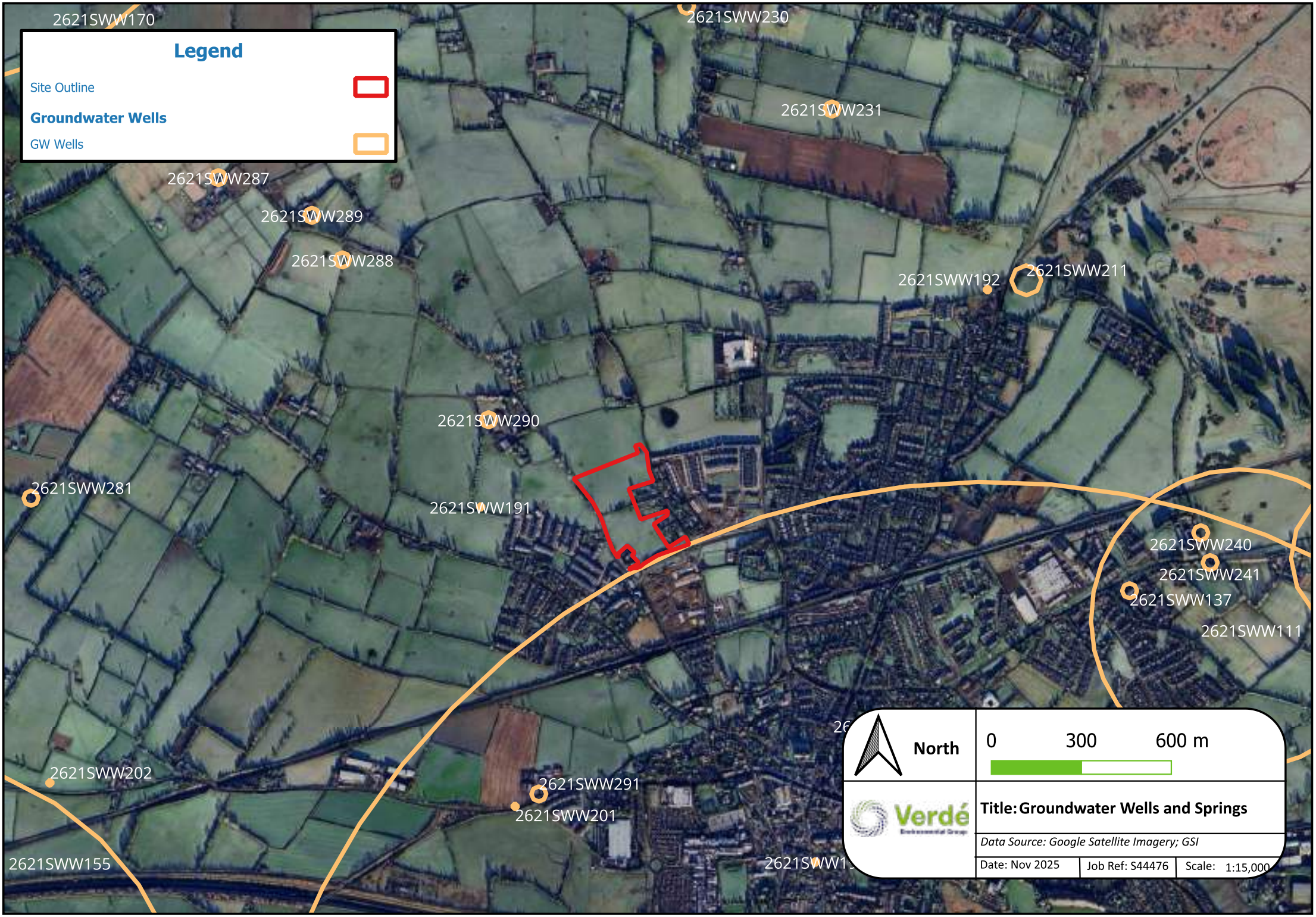

Legend
Bedrock Geology
Tournaisian limestone
Tournaisian sandstone, mudstone, limestone
Visean limestone & calcareous shale
Site Boundary
North
0
250
500 m
Verdé
Title: Bedrock Geology
Data Source: Google Satellite Imagery; GSI
Date: 13/10/2025
Job Ref: S45476
Scale: 1:15,000

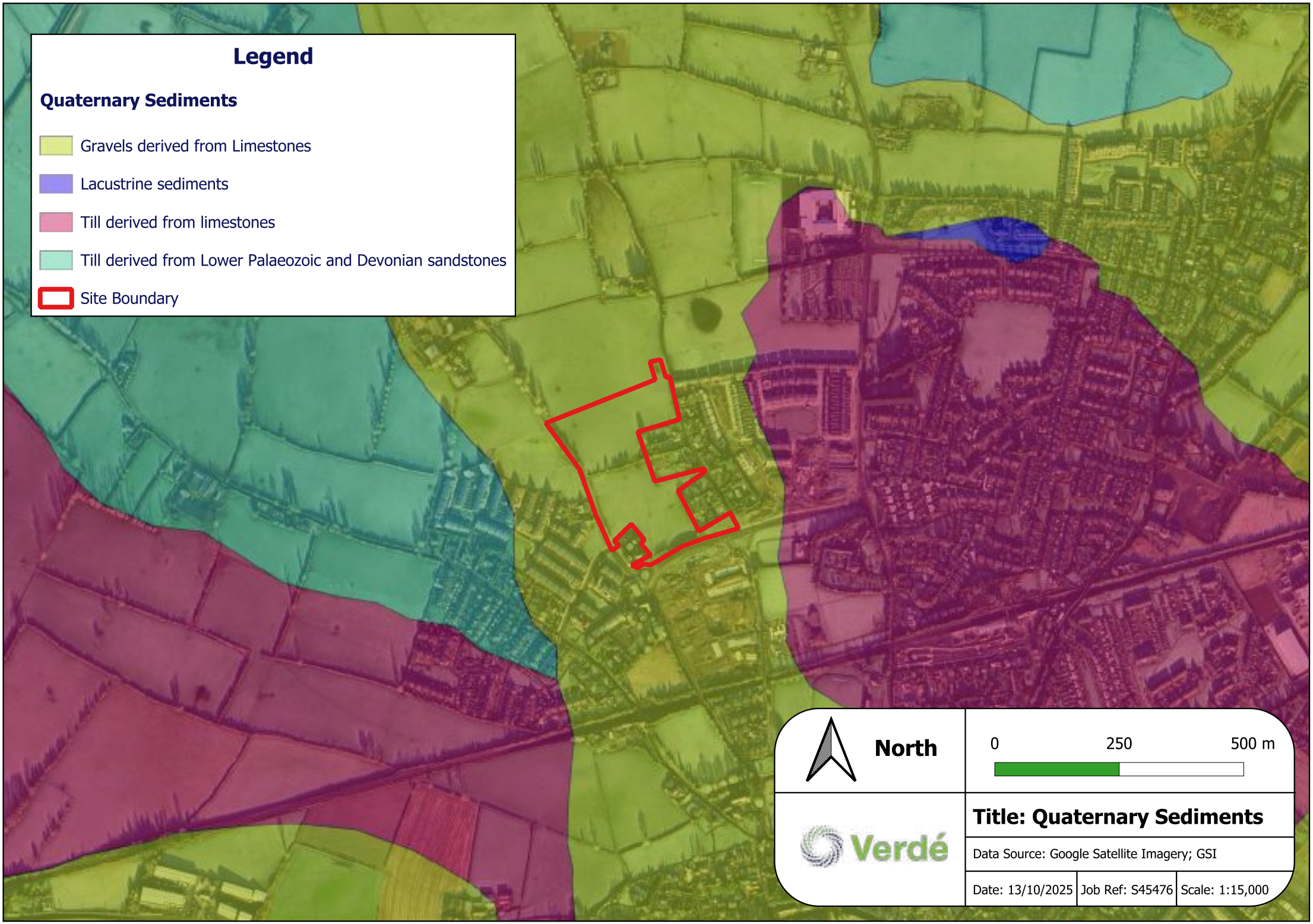

Legend
Corine Land Cover
Discontinuous urban fabric
Natural grasslands
Non-irrigated arable land
Pastures
Site Boundary
North
0
250
500 m
Verdé
Title: Corine Land Cover
Data Source: Google Satellite Imagery; Coppernicus
Date: 13/10/2025
Job Ref: S45476
Scale: 1:20,000

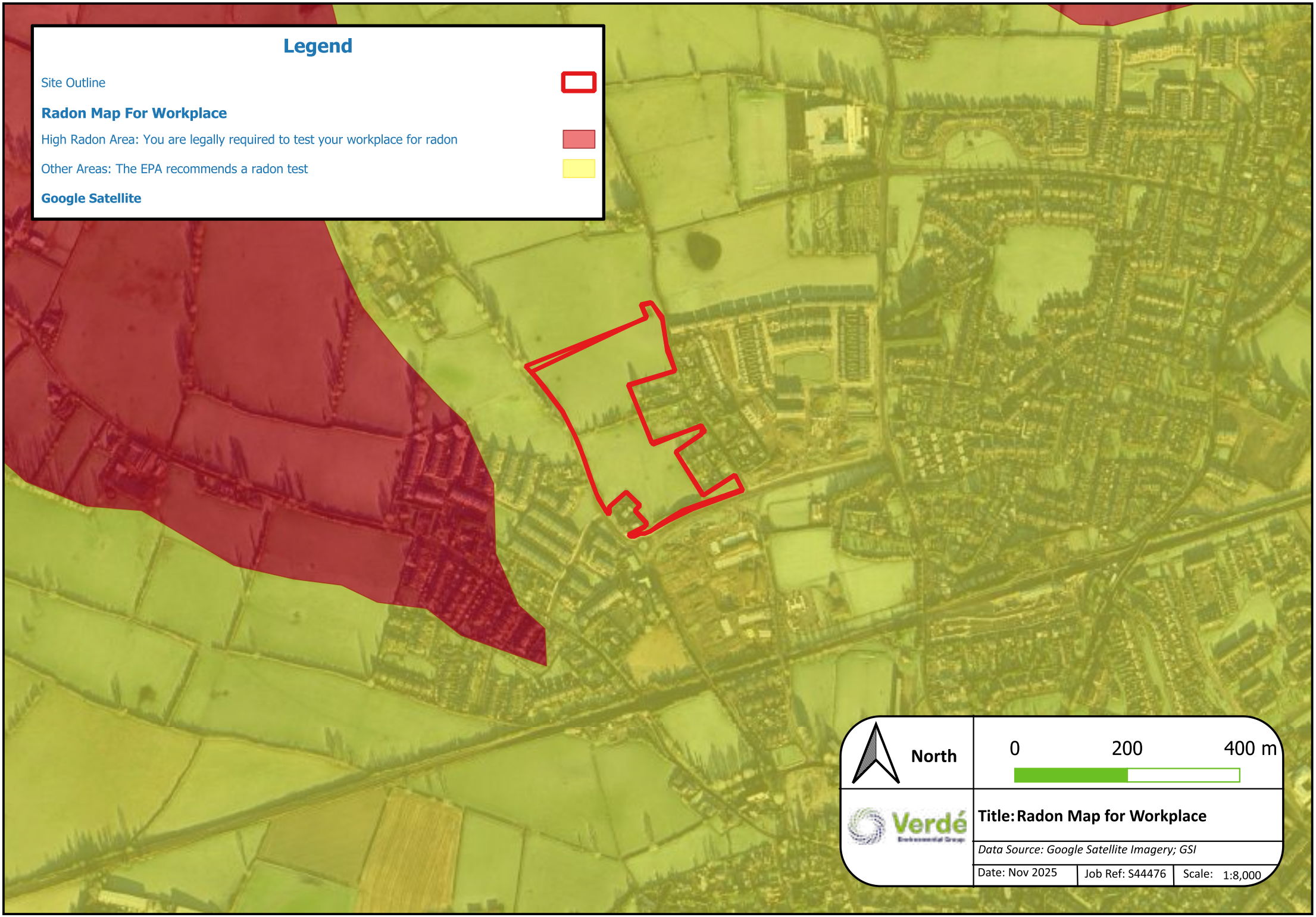

Legend
Site Outline
Groundwater Recharge
201-250 mm/yr
401-450 mm/yr
151-200 mm/yr
51-100 mm/yr
North
0
200
400 m
Verdé
Title: Groundwater Recharge
Data Source: Google Satellite Imagery; GSI
Date: Nov 2025
Job Ref: S44476
Scale: 1:8,000


Legend
Site Outline
Groundwater Status
Good- Ground waterbody WFD Status 2016-2021
Bagenalstown Upper
Kildare
GWDTE-Pollardstown Fen (SAC000396)
Curragh Gravels West
North
0
1,000
2,000 m
Verdé
Title: Groundwater Status
Data Source: Google Satellite Imagery; EPA
Date: Nov 2025
Job Ref: S44476
Scale: 1:40,000


Legend
Site Outline
Groundwater Vulnerability
Moderate
Rock at or near Surface or Karst
Extreme
High
North
0
400
800 m
Verdé
Title: Groundwater Vulnerability
Data Source: Google Satellite Imagery; GSI
Date: Nov 2025
Job Ref: S44476
Scale: 1:17,500

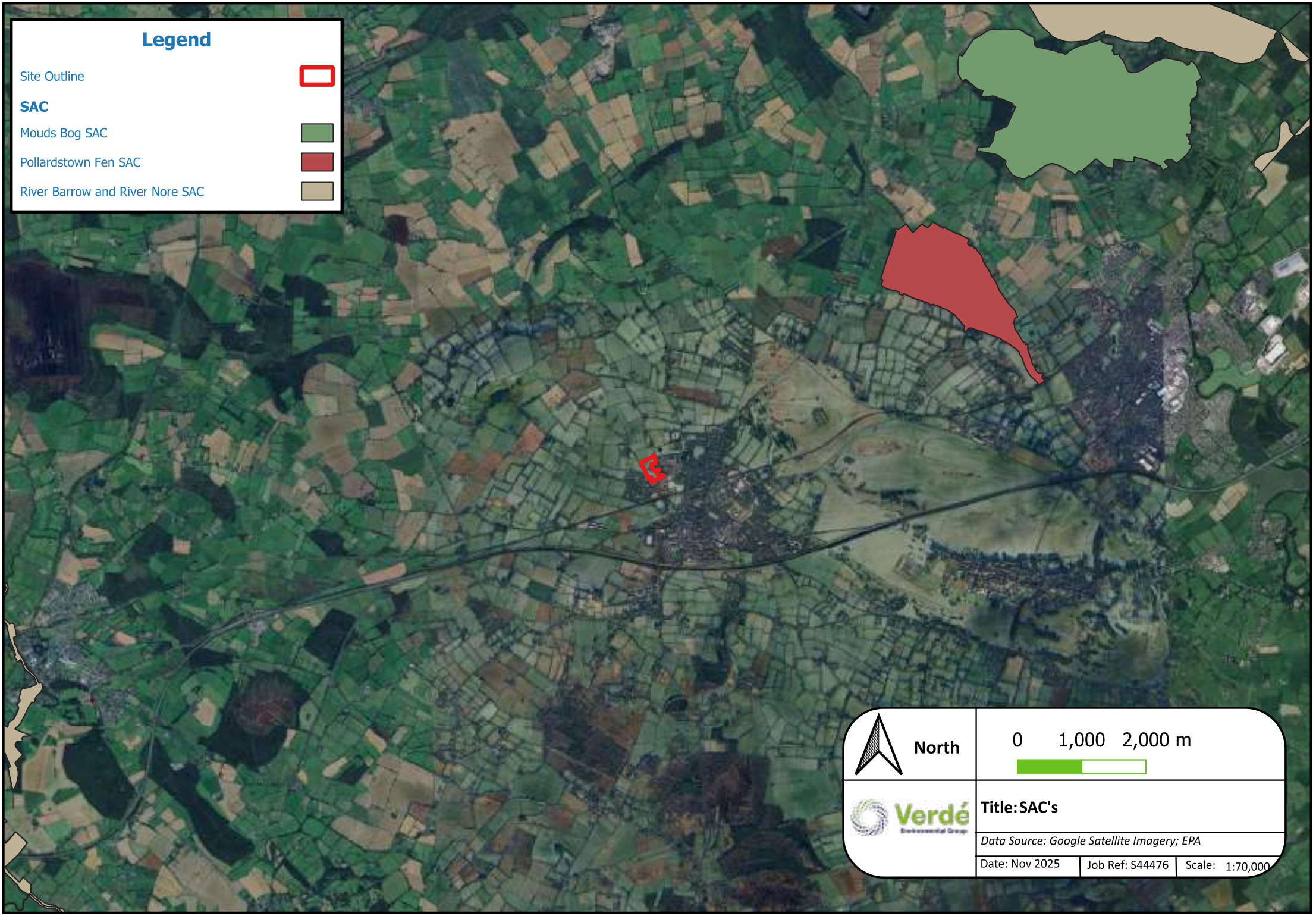

Legend
Site Outline
Groundwater Wells
GW Wells
2621SWW170
2621SWW230
2621SWW231
2621SWW287
2621SWW289
2621SWW288
2621SWW192
2621SWW211
2621SWW290
2621SWW281
2621SWW191
2621SWW240
2621SWW241
2621SWW137
2621SWW111
2621SWW202
2621SWW291
2621SWW201
2621SWW155
North
0
300
600 m
Verdé
Title: Groundwater Wells and Springs
Data Source: Google Satellite Imagery; GSI
Date: Nov 2025
Job Ref: S44476
Scale: 1:15,000

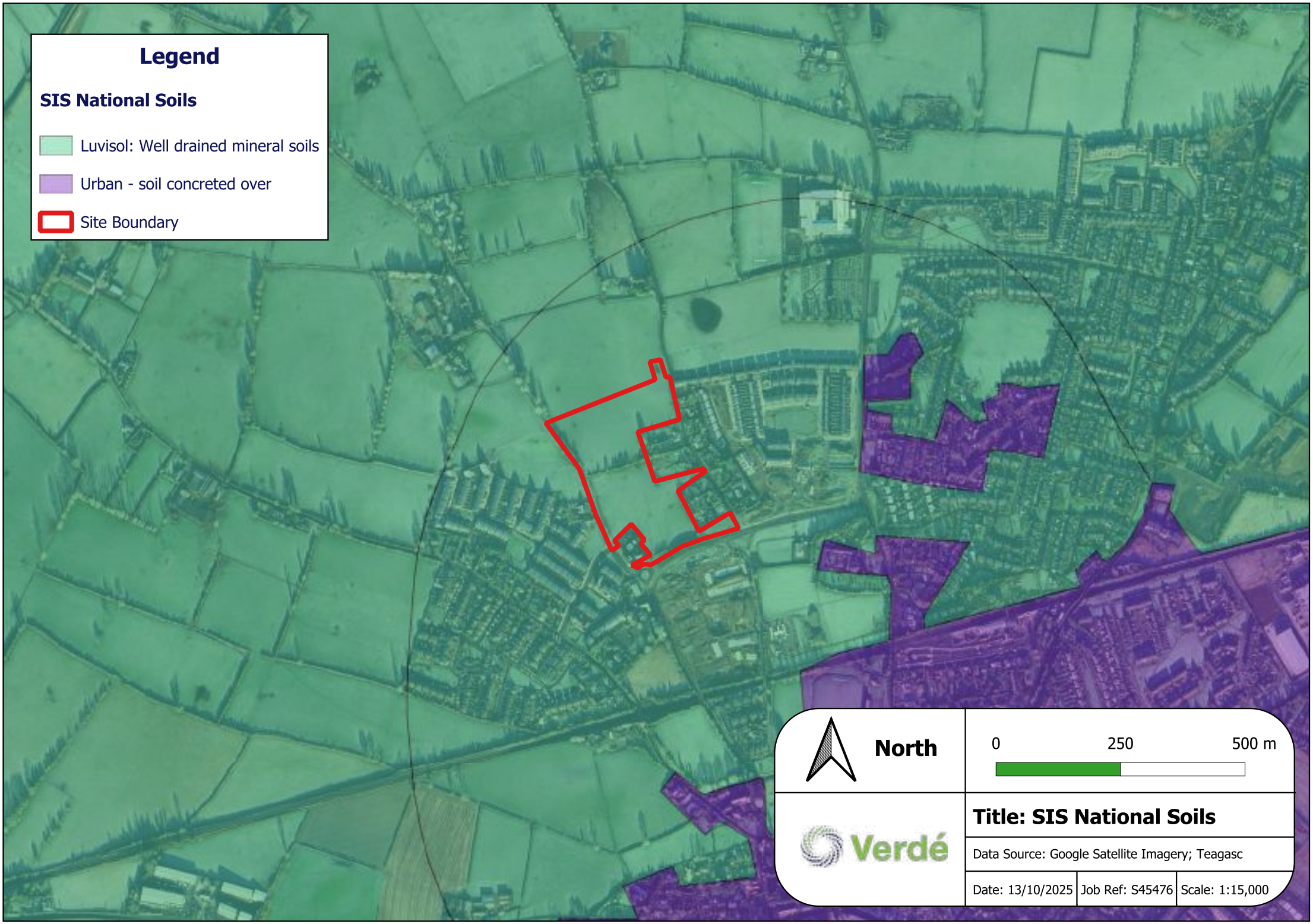

Legend
Quaternary Sediments
Gravels derived from Limestones
Lacustrine sediments
Till derived from limestones
Till derived from Lower Palaeozoic and Devonian sandstones
Site Boundary
North
0
250
500 m
Verdé
Title: Quaternary Sediments
Data Source: Google Satellite Imagery; GSI
Date: 13/10/2025
Job Ref: S45476
Scale: 1:15,000

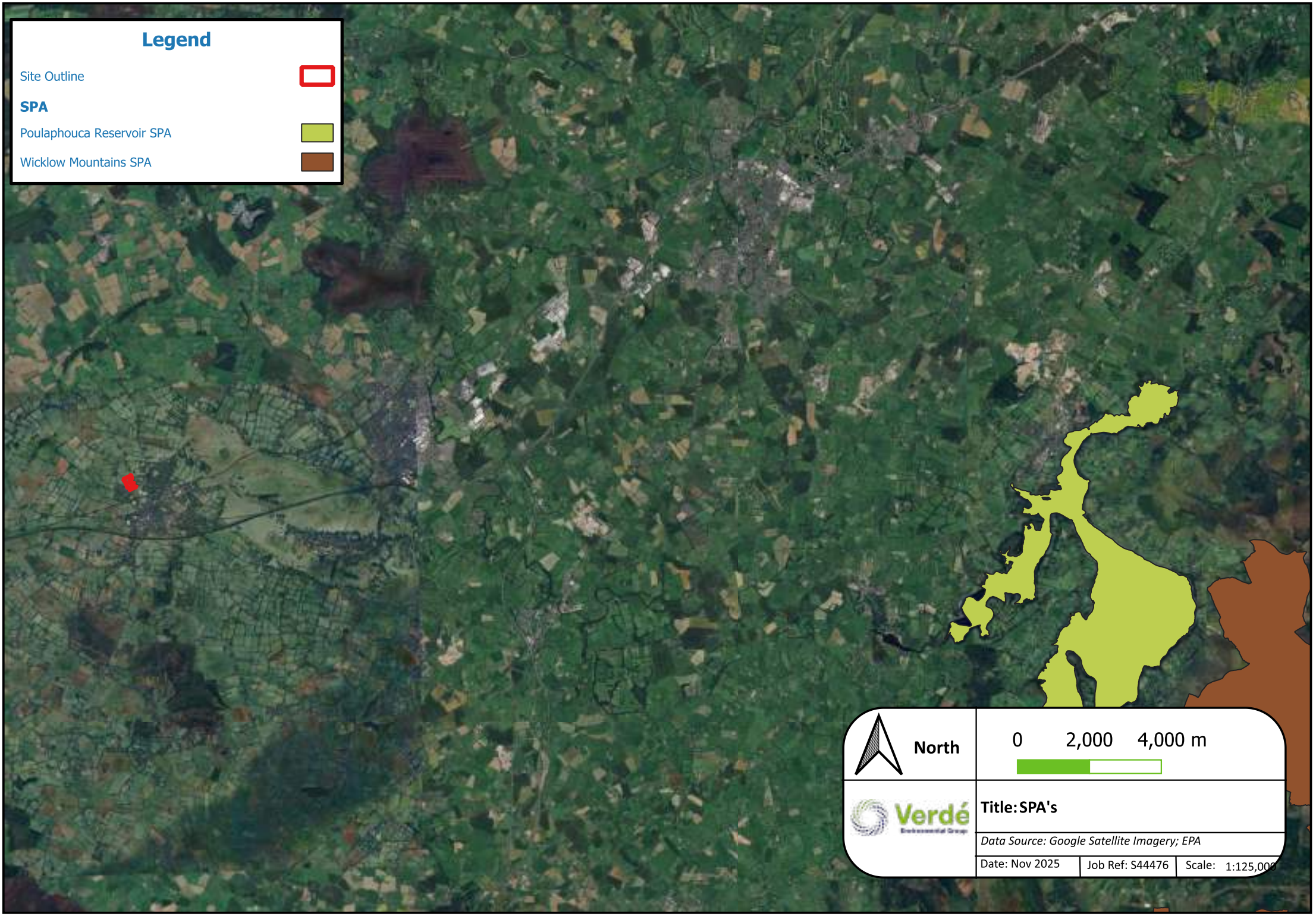

Legend
Site Outline
Radon Map For Workplace
High Radon Area: You are legally required to test your workplace for radon
Other Areas: The EPA recommends a radon test
Google Satellite
North
0
200
400 m
Verdé
Title: Radon Map for Workplace
Data Source: Google Satellite Imagery; GSI
Date: Nov 2025
Job Ref: S44476
Scale: 1:8,000


Legend
Site Outline
WFD RiverWaterbodies
Poor Status
Good Status
Moderate status
River Waterbodies
LOWER_010
FIGILE_080
Grand Canal Barrow Line (Barrow)
BARROW_100
BARROW_120
TULLY STREAM_030
TULLY STREAM_020
CLONCUMBER STREAM_010
Grand Canal Milltown Feeder (Barrow)
LIFFEY_090
LIFFEY_080
LIFFEY_070
North
0
2,000
4,000 m
Verdé
Title: River Waterbody Status
Data Source: Google Satellite Imagery; EPA
Date: Nov 2025
Job Ref: S44476
Scale: 1:70,000


Legend
Site Outline
WFD RiverWaterbodies
River Waterbodies
SLATE_070
KILNANTOGE_LOWER_010
Grand Canal Barrow Line (Barrow)
FIGILE_080
BARROW_100
BARROW_120
TULLY STREAM_030
TULLY STREAM_020
CLONCUMBER STREAM_010
Grand Canal Milltown Feeder (Barrow)
LIFFEY_090
LIFFEY_080
LIFFEY_070
North
0
2,000
4,000 m
Verdé
Title: River Waterbodies
Data Source: Google Satellite Imagery; EPA
Date: Nov 2025
Job Ref: S44476
Scale: 1:70,000


Legend
Site Outline
SAC
Mouds Bog SAC
Pollardstown Fen SAC
River Barrow and River Nore SAC
North
0 1,000 2,000 m
Verdé
Title: SAC's
Data Source: Google Satellite Imagery; EPA
Date: Nov 2025
Job Ref: S44476
Scale: 1:70,000


Legend
SIS National Soils
Luvisol: Well drained mineral soils
Urban - soil concreted over
Site Boundary
North
0
250
500 m
Verdé
Title: SIS National Soils
Data Source: Google Satellite Imagery; Teagasc
Date: 13/10/2025
Job Ref: S45476
Scale: 1:15,000


Legend
Site Outline
SPA
Poulaphouca Reservoir SPA
Wicklow Mountains SPA
North
0
2,000
4,000 m
Verdé
Title: SPA's
Data Source: Google Satellite Imagery; EPA
Date: Nov 2025
Job Ref: S44476
Scale: 1:125,000

ESB Networks

TITLE: 20250918-051_A3

COLOUR CODE:

- BLACK - 38KV & HIGHER VOLTAGE OVERHEAD LINES
- GREEN - MV(10KV/20KV) OVERHEAD LINES
- BLUE - LV (400V/230V) OVERHEAD LINES
- CYAN - 38KV & HIGHER VOLTAGE UNDERGROUND CABLE ROUTES
- RED - MV/LV (10KV/20KV/400V/230V) UNDERGROUND CABLE ROUTES

DATE: 18-Sep-2025

** SCALE: 1:2500

** SCALE WHEN PRINTED ON AN A3 PAGE
XY COORDINATES DISPLAYED IN IRISH GRID COORDINATE SYSTEM

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WARNING

THIS MAP INDICATES THE APPROXIMATE LOCATION OF ESB TRANSMISSION (400KV, 220KV, 110KV, 38KV) AND DISTRIBUTION (20KV, 10KV, 230V/400V) UNDERGROUND CABLES AND OVERHEAD LINES IN THE GENERAL AREA OF THE PROPOSED WORKS. ESB NETWORKS TAKES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE MAP. IT IS THE USER'S RESPONSIBILITY TO INDEPENDENTLY VERIFY THE INFORMATION AND THE LOCATION OF UNDERGROUND CABLES AND OVERHEAD LINES. LOW VOLTAGE (230V/400V) SERVICE CABLES (E.G. HOUSE SERVICES, FACTORY/SHOP SERVICES, PUBLIC LIGHTING LAMP SERVICES, ETC) ARE NOT INCLUDED BUT THEIR PRESENCE SHOULD BE ANTICIPATED. THE DEPTHS OF UNDERGROUND CABLES MUST NEVER BE ASSUMED. BEFORE ANY MECHANICAL EXCAVATION IS UNDERTAKEN, THE ACTUAL LOCATION OF ALL UNDERGROUND ELECTRICITY CABLES MUST BE ESTABLISHED AND VERIFIED ON THE SITE USING:

(A) UP-TO-DATE MAP RECORDS;
(B) CABLE LOCATER EQUIPMENT OPERATED IN BOTH POWER AND RADIO MODES;
(C) CAREFUL HAND DIGGING OF TRIAL HOLES USING 'SAFE DIGGING PRACTICE'.

REFER ALSO TO 'HSA CODE OF PRACTICE FOR AVOIDING DANGER FROM UNDERGROUND SERVICES'.
ESB TAKES NO RESPONSIBILITY FOR AND SHALL BEAR NO LIABILITY, HOWSOEVER ARISING, IN RELATION TO ANY DAMAGE, INJURY/DEATH OR LOSS OF SUPPLY AS A RESULT OF DAMAGE OR INTERFERENCE WITH ITS NETWORKS.

X,Y: 271734 , 213625

ESB NETWORKS HAS ISSUED THIS MAP AS A PDF DOCUMENT. IF VIEWING A PAPER VERSION OF THIS MAP, THE VIEWER MUST ENSURE THAT IT HAS BEEN PRINTED IN COLOUR TO FIT TO AN A3 (OR LARGER) PAGESIZE AND THAT EACH OF THE COLOURS INDICATED ON THE COLOUR CODE LEGEND ABOVE ARE CLEAR AND DISTINCT FROM EACH OTHER TO MAINTAIN A CORRECT REPRESENTATION OF THE ELECTRICAL NETWORK INFORMATION.

X,Y: 272754 , 213625

SOUTHGREENTOWER

SOUTHGREEN SOUTH

SOUTH GREEN DEMPSEY

SOUTHGREEN S'E

SIRO KILDARE STN

KILDARE
014000

OAK CHURCH 1

OAK CHURCH 2

WALKERS GATE2

WALKERS GATE1

WALKERS GATE KIOSK

70/50 AYCY

3X1/185 XLP

3X1X630

UG2596

UG2

4X185 XLP

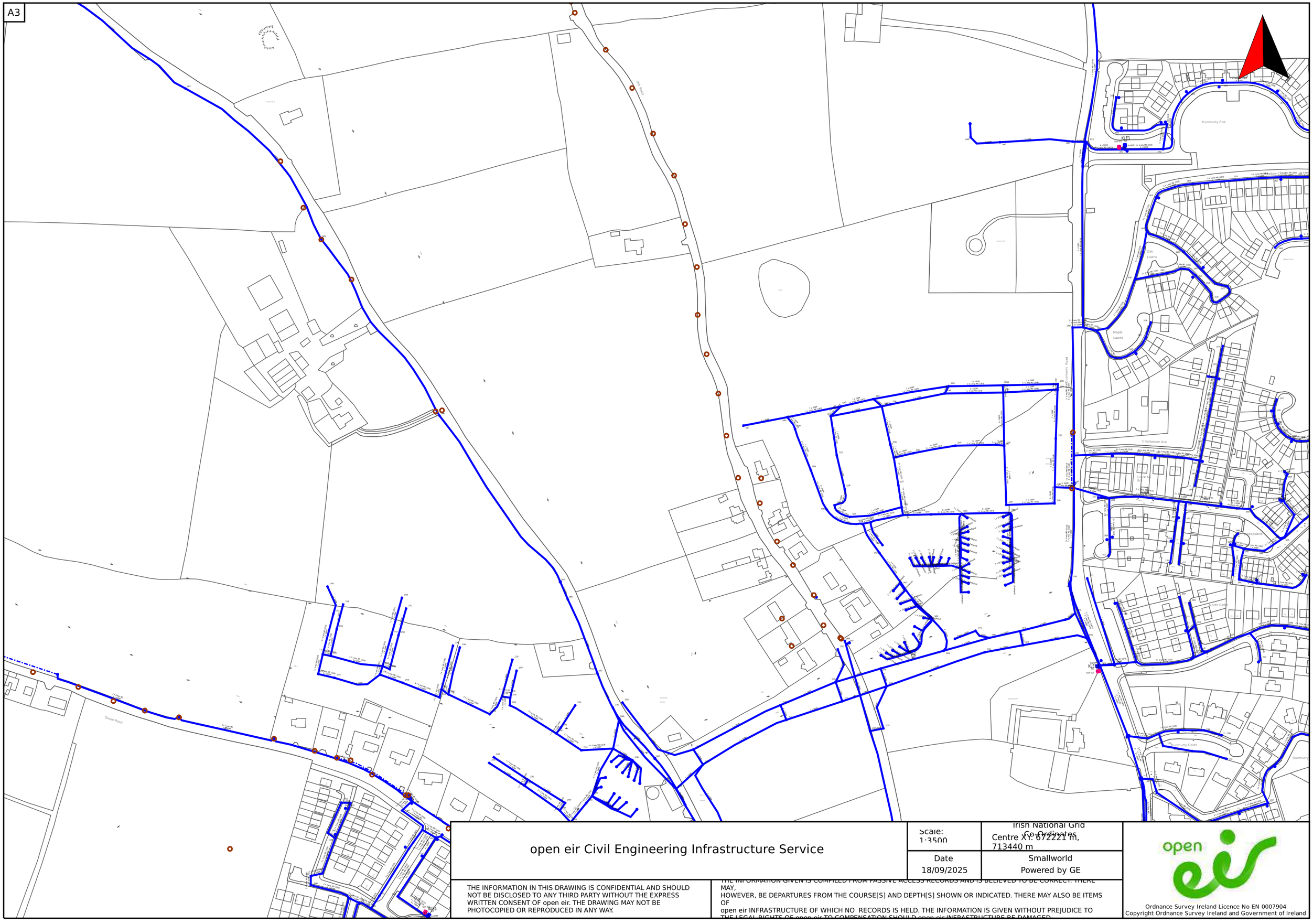
3X1X400 XLP

HIGH VOLTAGE

IF YOU INTEND WORKING, OR UNDERTAKING DEVELOPMENT WITHIN A CORRIDOR EXTENDING 40 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE OVERHEAD LINES OR WITHIN A CORRIDOR EXTENDING 5 METRES ON EITHER SIDE OF ANY HIGH VOLTAGE UNDERGROUND CABLES YOU MUST CONTACT ESB NETWORKS IN ADVANCE OF WORKS AT 1800 372 757 OR EMAIL DIG@ESB.IE TO AGREE SAFE WORKING PROCEDURES AND NECESSARY CLEARANCES BETWEEN THE LINES AND THE DEVELOPMENT IN ADVANCE OF ANY EXCAVATION.

X,Y: 272754 , 213020

A3



open eir Civil Engineering Infrastructure Service

Scale: 1:3500

Irish National Grid Co-Ordinates
Centre X: 372221 m, 713440 m

Date 18/09/2025

Smallworld Powered by GE

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Irish Water



18/09/2025

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox

Lamphole
Hydrobrake
Other; Unknown

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains

Surface Water Pressurised Mains Private
Storm Culverts
Storm Open Drains

Sewer Manholes
- Standard
- Backdrop
- Cascade

Catchpit
Bifurcation
Hatchbox
Lamphole
Hydrobrake
Other; Unknown

Sewer Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Waste Water Treatment plant
- Waste Water Pump station

Sewer Chambers

Sewer Mains
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Gravity - Unknown
- Pumping - Combined

Pumping - Foul
Pumping - Overflow
Pumping - Unknown
Syphon - Combined
Syphon - Foul
Syphon - Overflow
Overflow

Sewer Mains (Private)
- Gravity - Combined
- Gravity - Foul
- Gravity - Overflow
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul

Pumping -
Pumping -
Syphon -
Syphon - Foul
Syphon - Overflow
Overflow
Sewer Detention

1:7,871

0 0.04 0.08 0.16 mi

0 0.05 0.1 0.2 km

Maxar, Microsoft, Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community



Important Safety Notice: Damage to gas pipelines can result in serious injury or death. Gas network information is provided as a general guide. The exact location and depth of medium or low pressure distribution gas pipes must be verified on site by carrying out necessary investigations, including, for example, hand digging trial holes along the route of the pipe. Service pipes are not generally shown but their presence should always be anticipated.

High pressure transmission pipelines are shown in red. If a transmission pipeline is identified within 10m of any intended excavations then work must not proceed before GNI has been consulted. The true location and depth of a transmission pipeline must be verified on site by a representative of GNI. Contact can be made through 1800 427 747.

All work in the vicinity of the gas network must be completed in accordance with the current edition of the Health and Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (0818 289 389) or can be downloaded at www.hsa.ie.

Legal Notice: Gas Networks Ireland (GNI) and its affiliates, accept no responsibility for the accuracy of any information contained in this document including data concerning location and technical designation of the gas distribution and transmission network (the "Information"). The Information should not be relied on for accurate distance or depth of cover measurements.

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 or consequential loss, arising out of or in connection with the use or re-use of the Information.

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- Aurora Telecom Duct
- Aurora Telecom Sub Duct
- Aurora Telecom Inserted Gas Pipe

Aurora TELECOM

Aurora Telecom Queries - 01-8926166 (Office Hours)
Aurora_Network_Queries@gasnetworks.ie
Aurora Telecom Emergency Only 1800 427399 / 01 2030120

- Transmission Pipe (High Pressure)
- Transmission Pipe (Construction Issue)
- Distribution Pipe (Medium Pressure)
- Distribution Pipe (Low Pressure)
- Service Pipe (Medium Pressure)
- Service Pipe (Low Pressure)
- Strategic Pipe (Medium Pressure)
- Strategic Pipe (Low Pressure)
- Inserted
- Abandoned Pipe

C=?	Cover (depth in metres)		Pressure Monitor
CP	CP Test Point		Protection (Slabbing)
	End Cap		Protection (Sleeve)
	Hot Tap		Reducer
	Installation		Service Terminator
	Valve		Tee
	Mains Verification**		Transition

** Please contact GNI on 1800-427747 for specific information

DIAL BEFORE YOU DIG 1800 42 77 47

Gas Networks Ireland

GAS NETWORK INFORMATION

Description: South Green, Kildare

Location: 672344.713430

Plot Date: 23/09/2025 10:09	Scale: 2500 @ A3
Plotted By: 9864	Ref ID: 9864_23092025100952

APPENDIX B

CAUSEWAY GEOTECHNICAL LTD FACTUAL REPORT

CAUSEWAY GEOTECH







25-0802

KILDARE
GROUND INVESTIGATION REPORT

Client:
VERDE

Date:
NOVEMBER 2025

Status:
FINAL

CAUSEWAY GEOTECH LTD
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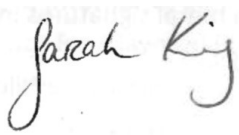
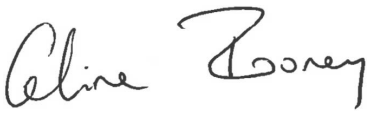
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DOCUMENT CONTROL SHEET

REPORT NO:		**25-0802**			
PROJECT TITLE:		**KILDARE**			
CLIENT:		**VERDE**			
REVISION:	**A00**	**STATUS**	**FINAL**	**ISSUE DATE**	**01/10/2025**
REVISION:	**A01**	**STATUS**	**FINAL**	**ISSUE DATE**	**17/10/2025**
REVISION:	**A02**	**STATUS**	**FINAL**	**ISSUE DATE**	**24/11/2025**
PREPARED BY:		**REVIEWED BY:**		**APPROVED BY:**	
 Sarah King BA Msc		 Gabriella Horan BSc Earth Science		 Celine Rooney BSc MSc PGeo (EurGeol)	

This report presents a factual account of the ground investigation in accordance with the Specification and Related Documents for Ground Investigation in Ireland 2nd Edition, published by Engineers Ireland (2016).

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.
SB	Sonic 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	Uncorrected in situ hand shear vane test. Peak (HVP) and remoulded (HVR) results presented in kPa. Vane calibration factor has been applied, but no correction made for soil type.
c_{fv} / c_{rv}	Borehole shear vane test. Undisturbed (c_{fv}) and remoulded (c_{rv}) shear strengths presented in kPa.
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.

1 AUTHORITY

On the instructions of Verde (the "Client"), a ground investigation was undertaken at the site to provide geotechnical information for input to the design and construction of a proposed residential development.

This report details the work carried out both on site; it contains a description of the site, the works undertaken, and the exploratory hole logs.

All information given in this report is based upon the ground conditions encountered during the ground investigation works, and on the results of the 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 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 PURPOSE, RATIONALE & SCOPE OF THE INVESTIGATION

The purpose of this investigation is to assess the ground conditions and to allow an evaluation of the geotechnical issues with the current site and proposed development.

The rationale has been determined by the Client, with the extent of the investigation including boreholes, trial pits, soil sampling, in-situ testing, and the preparation of a factual account of the ground investigation findings. A subsequent visit to site was conducted to carry out additional in-situ testing as well as an additional borehole.

3 DESCRIPTION OF SITE

The site is located at Irish Transverse Mercator 672219, 713306. The site was located over two fields found to the northeast of Kildare town. The site location is presented in Appendix A and a summary of the surrounding land uses is provided in Table 1.

Table 1: Summary of surrounding land uses

Location	Description
North	Residential property, L7016, agricultural land.
East	Residential properties, L7016, land under development, residential estate.
South	Local road, land under development, Southgreen Rd, railway tracks, agricultural land.
West	Residential estate, agricultural lands, Green Rd.

4 SITE OPERATIONS

4.1 SUMMARY OF SITE WORKS

Site operations, conducted between 24/09/2025 and 26/09/2025 as well as the subsequent site operations, conducted between 18/11/2025 and 20/11/2025 comprised of:

- four rotary drilled boreholes
- a standpipe installation in four boreholes
- three machine-dug trial pits
- in-situ testing, including:
    - Standard Penetration Tests
    - three infiltration tests
    - Variable Head Permeability testing in four boreholes
- GPS survey of all completed locations

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

4.2 BOREHOLES

Four boreholes (BH01-04) were put to their completion by rotary drilling techniques only. The boreholes were completed using a Comacchio 205 and Comacchio 601 tracked rotary drilling rig.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to their completion depths. SPTs were carried out at standard intervals throughout the overburden in BH01-03, with small disturbed samples obtained where possible through the soil strata.

Appendix B presents the borehole logs.

4.3 STANDARD PENETRATION TESTS

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 (BSI, 2011) at standard depth intervals using the split spoon sampler ($SPT_{(S)}$) or solid cone attachment ($SPT_{(C)}$) in BH01-03. The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible.

The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix H.

4.4 STANDPIPE INSTALLATIONS

A groundwater monitoring standpipe was installed in boreholes BH01-04.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.5 TRIAL PITS

Three trial pits (TP01-03) were excavated using an 3t tracked excavator fitted with a 400mm wide bucket, to depths of 1.50m. Trial pits TP01-03 were excavated to allow completion of infiltration test.

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

Any water strikes encountered during excavation were recorded and the stability of the trial pit walls was noted on completion.

Appendix C presents the trial pit logs with photographs of the pits and arisings provided in Appendix D.

4.6 INFILTRATION TESTS

Three infiltration/soakaway tests (TP01-03) were carried out in accordance with DG 365 Soakaway Design (BRE, 2016). The absence of the outflow from the pits precluded calculation of infiltration coefficients.

Appendix E presents the results and analysis of the infiltration tests.

4.7 VARIABLE HEAD PERMEABILITY TESTING

Three in-situ permeability tests were carried out in BH01-04 by variable head permeability methods, following development of the wells. Testing was carried out in accordance with the guidance as set out in BS EN ISO 22282-2: 2012 (BSI, 2012).

Appendix F presents the results and analysis of the variable head permeability tests.

4.8 SURVEYING

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R10 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole location plan presented in Appendix A shows these as-built positions.

5 LABORATORY WORK

Laboratory testing was carried out between 10/10/2025 and 17/10/2025.

5.1 GEOTECHNICAL LABORATORY TESTING OF SOILS

Laboratory testing of soils comprised:

- **soil classification:** particle size distribution analysis.

Laboratory testing of soils samples was carried out in accordance with BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (BSI, 2016), and Part 2 (BSI, 2022).

The test results are presented in Appendix G.

6 GROUND CONDITIONS

6.1 GENERAL GEOLOGY OF THE AREA

Published geological mapping from the online Geological Survey Ireland spatial resources database indicate the superficial deposits underlying the site comprise gravels derived from limestones. These deposits are shown to be underlain by limestone and shale of the Boston Hill 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:

- **Topsoil:** encountered typically in 200mm thickness across the site.
- **Glacial Till:** sandy gravelly silt, frequently with low to medium cobble content in the upper strata. Typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Fluvioglacial deposits:** dense sandy gravels.

Further details of these ground types, including their specific depths and descriptions, can be found on the individual exploratory hole logs accompanying this report.

6.3 GROUNDWATER

Groundwater was encountered at varying depths in BH04. Details of individual strikes, and any relative changes in level during the works, are presented on the exploratory hole logs.

No groundwater was observed during drilling at the remaining locations. However, the temporary casing used to support the borehole walls may have sealed out additional strikes, and the possibility of encountering groundwater during excavation in these areas cannot be ruled out.

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

7 REFERENCES

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British Research Establishment (BRE). (2016) DG 365 Soakaway Design

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Construction Industry Research and Information Association (CIRIA). (2015) Report C753 – The SUDS Manual.

Geotechnical Society of Ireland. (2016) Specification and Related Documents for Ground Investigation in Ireland. 2nd Edition. Engineers Ireland.

APPENDIX A – SITE AND EXPLORATORY HOLE LOCATION PLANS



Legend Key

Project No.	25-0802
Client	Verde
Client's Rep	N/A

Site Location Plan

Kildare

CAUSEWAY GEOTECH

Last Revision	01/10/2025
Scale	1:12000



Legend Key

- Locations By Type - RO
- Locations By Type - TP

Project No.	25-0802
Client	Verde
Client's Rep	N/A

Exploratory Hole Location Plan

Kildare

CAUSEWAY GEOTECH

Last Revision	24/11/2025
Scale	1:2000

APPENDIX B – BOREHOLE LOGS



CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH01
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 7.20 m	Start Date: 25/09/2025	Driller: PJ	Sheet 1 of 1
Rotary Percussion	Comacchio 205	0.00	7.20	672269.32 E				Scale: 1:40
				713469.18 N	Elevation: 107.67 mOD	End Date: 25/09/2025	Logger: SK	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					107.56	0.10		TOPSOIL
								Firm becoming stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to medium. Cobbles are subangular.
1.20	D1							
1.20 - 1.65	SPT (S)	N=14 (1,1/1,4,5,4) Hammer SN = 1515	1.20					
					105.66	2.00		Stiff becoming very stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to medium. Cobbles are subangular.
2.40	D2							
2.40 - 2.85	SPT (S)	N=16 (3,2/3,4,4,5) Hammer SN = 1515	2.40					
3.90	D3							
3.90 - 4.35	SPT (S)	N=33 (3,3/3,7,10,13) Hammer SN = 1515	3.90					
					103.46	4.20		Dense brown slightly sandy slightly clayey subangular fine to medium GRAVEL. Sand is fine to coarse.
5.40	D4							
5.40 - 5.82	SPT (S)	50 (7,8/50 for 265mm) Hammer SN = 1515	5.40					
					100.46	7.20		End of Borehole at 7.20m

Water: Backfill

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details		Water Added	
To (m)	Diam (mm)	From (m)	To (m)
7.20	125		

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated on Engineer's instruction.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH02
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 8.40 m	Start Date: 25/09/2025	Driller: PJ	Sheet 1 of 2
Rotary Percussion	Comacchio 205	0.00	8.40	672203.68 E 713312.81 N	Elevation: 107.47 mOD	End Date: 26/09/2025	Logger: SK	Scale: 1:40 FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					107.27	0.20		TOPSOIL
								Soft becoming firm brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
					106.67	0.80		Soft becoming very stiff brown slightly gravelly silty CLAY. Gravel is subangular fine.
1.20 1.20 - 1.65	D1 SPT (S)	N=5 (1,2/1,1,2,2,1) Hammer SN = 1515	1.20					
2.40 2.40 - 2.85	D2 SPT (S)	N=22 (9,9/5,5,6,6) Hammer SN = 1515	2.40		105.07	2.40		Stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
3.90 3.90 - 4.35	D3 SPT (S)	N=36 (3,6/6,9,9,12) Hammer SN = 1515	3.90					
					102.57	4.90		Dense brown very sandy slightly clayey subrounded fine to coarse GRAVEL. Sand is fine to coarse.
5.40 5.40 - 5.62	D4 SPT (S)	50 (25 for 120mm/50 for 105mm) Hammer SN = 1515	5.40					

Water | Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)
8.40	125

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated on Engineer's instruction.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
25-0802	Kildare	BH02
	Client: Verde	
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Rotary Percussion	Comacchio 205	0.00	8.40	672203.68 E 713312.81 N	8.40 m	25/09/2025	PJ	Scale: 1:40
					Elevation: 107.47 mOD	End Date: 26/09/2025	Logger: SK	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					99.07	8.40		End of Borehole at 8.40m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)
8.40	125

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated on Engineer's instruction.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH03
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 6.90 m	Start Date: 24/09/2025	Driller: PJ	Sheet 1 of 1
Rotary Percussion	Comacchio 205	0.00	6.90	672311.97 E				Scale: 1:40
				713212.22 N	Elevation: 103.97 mOD	End Date: 25/09/2025	Logger: SK	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					103.87	0.10		TOPSOIL		
								Firm becoming stiff brown slightly sandy CLAY. Sand is fine to medium.		
1.20	D1									
1.20 - 1.65	SPT (S)	N=14 (2,2/2,4,4,4) Hammer SN = 1515	1.20							
2.40	D2									
2.40 - 2.85	SPT (S)	N=16 (3,2/2,4,5,5) Hammer SN = 1515	2.40							
					100.87	3.10		Medium dense brown slightly sandy slightly clayey subangular fine to coarse GRAVEL. Sand is fine to coarse.		
3.90	D3				100.07	3.90		Dense brown slightly sandy subangular fine to coarse GRAVEL. Sand is fine to coarse.		
3.90 - 4.23	SPT (S)	40 (9,11/40 for 180mm) Hammer SN = 1515	3.90							
5.40 - 5.82	SPT (C)	50 (7,9/50 for 270mm) Hammer SN = 1515	5.40							
					97.07	6.90		End of Borehole at 6.90m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)
6.90	125

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.
No groundwater encountered.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated on Engineer's instruction.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH04
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 20.25 m	Start Date: 19/11/2025	Driller: TA	Sheet 1 of 3
Rotary Percussion	Comacchio 601	0.00	20.25	672257.23 E				Scale: 1:40
				713510.90 N	Elevation: 105.54 mOD	End Date: 20/11/2025	Logger: SK	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					105.34	0.20		TOPSOIL.
								Firm brown slightly sandy CLAY. Sand is fine to medium.
					104.44	1.10		Dark brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
					102.84	2.70		Brown sandy subangular fine to medium GRAVEL. Sand is fine to coarse.
					101.54	4.00		Brown sandy clayey subangular fine to medium GRAVEL. Sand is fine to coarse.
					98.54	7.00		Brown sandy subangular fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular.

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.50			
7.50			
13.80			
18.50			

Casing Details

To (m)	Diam (mm)
20.25	146

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated at scheduled depth.	24/11/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH04
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 20.25 m	Start Date: 20/11/2025	Driller: TA	Sheet 2 of 3
Rotary Percussion	Comacchio 601	0.00	20.25	672257.23 E				Scale: 1:40
				713510.90 N	Elevation: 105.54 mOD	End Date: 21/11/2025	Logger: SK	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					91.44	14.10		Brown slightly sandy clayey subangular fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular.

Water

Backfill

7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.50			
7.50			
13.80			
18.50			

Casing Details

To (m)	Diam (mm)
20.25	146

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated at scheduled depth.	24/11/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name: Kildare	Borehole ID
25-0802	Client: Verde	BH04
	Client's Rep: N/A	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth: 20.25 m	Start Date: 20/11/2025	Driller: TA	Sheet 3 of 3
Rotary Percussion	Comacchio 601	0.00	20.25	672257.23 E 713510.90 N	Elevation: 105.54 mOD	End Date: 21/11/2025	Logger: SK	Scale: 1:40 FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					87.04	18.50		Brown slightly sandy clayey subangular fine to coarse GRAVEL. Sand is fine to coarse.	▼	
					85.29	20.25		End of Borehole at 20.25m		

15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5 20.0 20.5 21.0 21.5

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.50			
7.50			
13.80			
18.50			

Casing Details

To (m)	Diam (mm)
20.25	146

Water Added

From (m)	To (m)

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
		Terminated at scheduled depth.	24/11/2025

AGS

APPENDIX C – TRIAL PIT LOGS



CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
25-0802	Kildare	TP01
Coordinates	**Client:**	
672269.64 E 713462.59 N	Verde	
Method:	**Client's Representative:**	Sheet 1 of 1 Scale: 1:25
Trial Pitting	N/A	
Plant:	**Elevation** / **Date:** / **Logger:**	FINAL
3t Tracked Excavator	108.08 mOD / 24/09/2025 / AL	

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL with rootlets.	
			107.88	0.20		Firm brown slightly sandy gravelly CLAY with medium cobble content. Sand is fine to course, Gravel is subrounded fine to course. Cobbles are subrounded.	
0.50 - 0.50 0.50 - 0.50	B2 D1						
1.00 - 1.00 1.00 - 1.00	D3 D4		107.08	1.00		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to course, Gravel is subrounded fine to course.	
			106.58	1.50		End of trial pit at 1.50m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.50
Width: 0.40
Length: 1.90

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated at scheduled depth.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
25-0802	Kildare	TP02
Coordinates	**Client:**	
672205.64 E 713308.42 N	Verde	
Method:	**Client's Representative:**	Sheet 1 of 1 Scale: 1:25
Trial Pitting	N/A	
Plant:	**Elevation** / **Date:** / **Logger:**	FINAL
3t Tracked Excavator	107.11 mOD / 24/09/2025 / AL	

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			106.91	0.20		TOPSOIL with rootlets.	
0.50 - 0.50 0.50 - 0.50	B1 D2					Firm brown slightly gravelly sandy CLAY with medium cobble content. Sand is fine to course. Gravel is subrounded fine to course. Cobbles are subrounded.	
			106.31	0.80			
1.00 - 1.00 1.00 - 1.00	B3 D4					Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to course. Gravel is subrounded fine to course.	
			105.61	1.50		End of trial pit at 1.50m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.50
Width: 0.40
Length: 1.60

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated at scheduled depth.	01/10/2025

AGS

CAUSEWAY GEOTECH

Project No. 25-0802	**Project Name:** Kildare		**Trial Pit ID** TP03
Coordinates 672308.52 E 713210.10 N	**Client:** Verde		
Method: Trial Pitting	**Client's Representative:** N/A		Sheet 1 of 1 Scale: 1:25
Plant: 3t Tracked Excavator	**Elevation** 104.01 mOD	**Date:** 24/09/2025	**Logger:** AL	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			103.81	0.20		TOPSOIL with rootlets.	
0.50 - 0.50 0.50 - 0.50	B2 D1					Firm brown slightly sandy gravelly CLAY. Sand is fine to course. Gravel is subrounded fine to course.	
			103.01	1.00		Firm organish brown slightly sandy slightly gravelly CLAY. Sand is fine to course. Gravel is subrounded fine to course.	
1.20 - 1.20 1.20 - 1.20	B4 D3						
			102.51	1.50		End of trial pit at 1.50m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.50
Width: 0.40
Length: 1.50

Remarks:
No groundwater encountered.

Stability:
Stable

Termination Reason
Terminated at scheduled depth.

Last Updated
01/10/2025

AGS

APPENDIX D – TRIAL PIT PHOTOGRAPHS



TP01



TP01


CAUSEWAY
GEOTECH
Project Name
KILDARE
Date
24-9-25
Project Number
25-0802
EH Number
SA01

TP01



TP01


CAUSEWAY
GEOTECH
Project Name
KILDARE
Project Number
25-0802
Date
24-9-25
SA01
(m) 0.1 0.2 0.3 0.4 0.5

TP01



TP01



TP02


CAUSEWAY
GEOTECH
Project Name
KILDARE
Date
24-9-25
Project Number
25-0802
TP Number
S402

TP02


CAUSEWAY
GEOTECH
Project Name
KILDARE
Project Number
25-0802
Date
24-9-25
TP Number
SA02

TP02


CAUSEWAY
GEOTECH
Project Name
KILDARE
Date
24-9-25
Project Number
25-0802
EH Number
SA02

TP02



TP02



TP02



TP03



TP03



TP03



TP03



TP03

APPENDIX E – INFILTRATION TEST RESULTS



Soakaway Infiltration Test

Project No.: 25-0802
Site: Kildare
Test Location: TP01
Test Date: 24 September 2025

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

Analysis using method as described in BRE DG 365 (2016) and CIRIA Report C753-The SUDS Manual (2015)

depth to groundwater before adding water (m) = DRY

Time (mins)	Depth to water surface (m)	Head of water in pit (m)
0	0.00	1.50
1	0.02	1.48
2	0.04	1.46
5	0.06	1.44
10	0.10	1.40
15	0.12	1.38
20	0.14	1.36
25	0.16	1.34
30	0.18	1.32
35	0.20	1.30
45	0.22	1.28
60	0.24	1.26
75	0.25	1.25
90	0.26	1.24
120	0.27	1.23

#

RESULTS (FROM GRAPH BELOW)

Test start
75% head of water at 1.13 m
depth to water surface (target) 0.38 m
time to reach target depth not reached

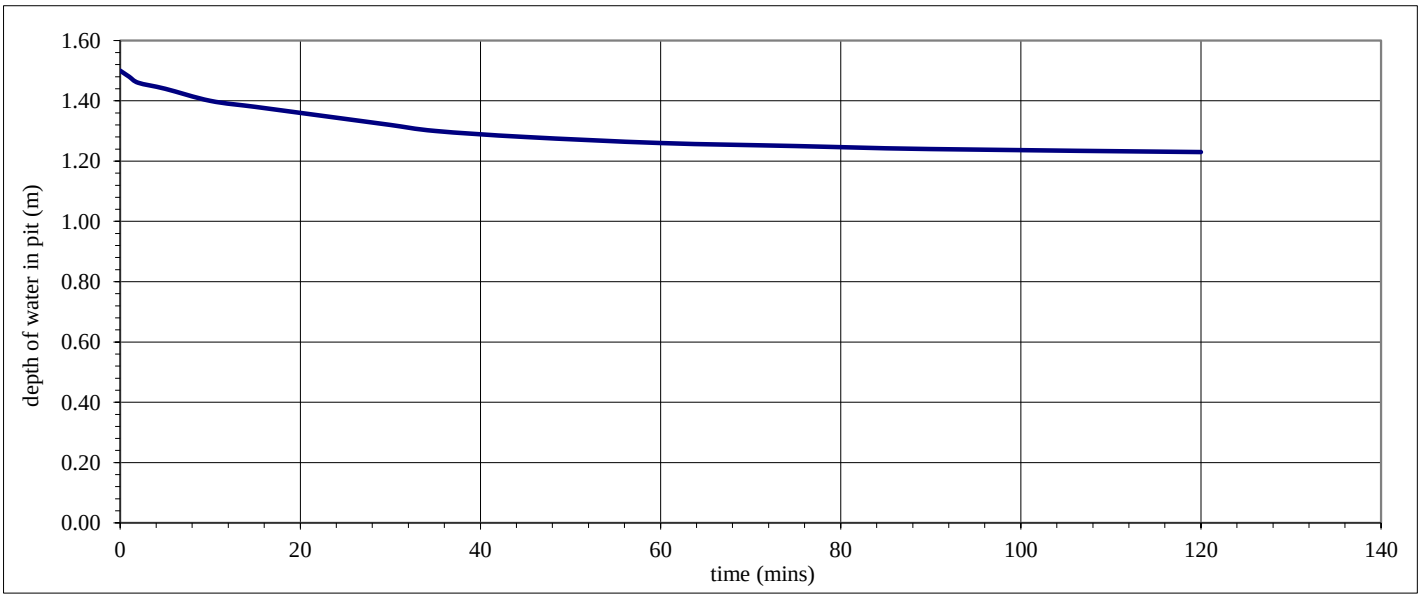
Test end
25% head of water at 0.38 m
depth to water surface (target) 1.13 m
time to reach target depth not reached

soil infiltration rate $f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$

Infiltration rate (f) is very low

TARGET DEPTHS AND CALCULATED VALUES

Time (mins)	Depth to water surface (m)	Head of water in pit (m)	Time elapsed, t_{p75-25} (mins)	Volume of water lost, V_{p75-25} (m^3)	Area of walls and base at 50% drop, a_{s50} (m^2)	Soil infiltration rate, f (m/min)	Soil infiltration rate, f (m/h)



Soakaway Infiltration Test

Project No.: 25-0802
Site: Kildare
Test Location: TP02
Test Date: 24 September 2025

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

Analysis using method as described in BRE DG 365 (2016) and CIRIA Report C753-The SUDS Manual (2015)

depth to groundwater before adding water (m) = DRY

Time (mins)	Depth to water surface (m)	Head of water in pit (m)
0	0.00	1.50
1	0.00	1.50
3	0.02	1.48
5	0.03	1.48
10	0.04	1.47
15	0.05	1.46
20	0.06	1.45
25	0.07	1.44
30	0.08	1.43
35	0.08	1.42
40	0.09	1.42
45	0.09	1.42
60	0.11	1.39
75	0.14	1.37
90	0.16	1.35
120	0.17	1.33
150	0.18	1.32

RESULTS (FROM GRAPH BELOW)

Test start

75% head of water at 1.13 m
depth to water surface (target) 0.38 m
time to reach target depth not reached

Test end

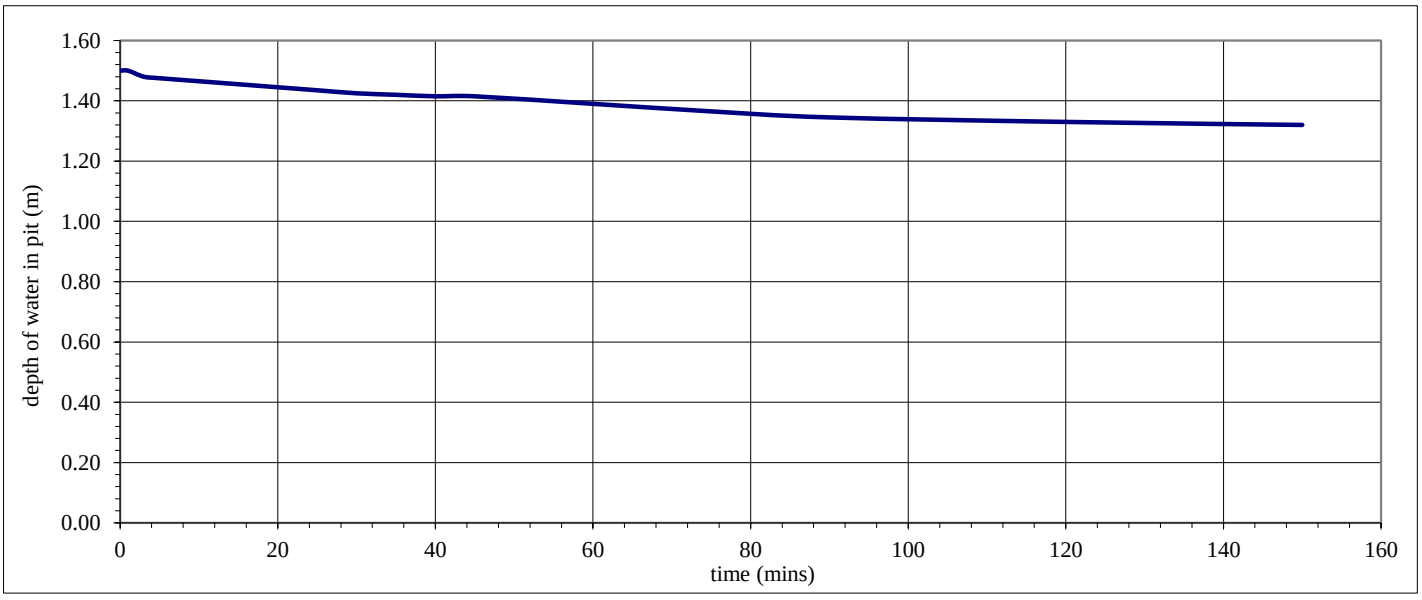
25% head of water at 0.38 m
depth to water surface (target) 1.13 m
time to reach target depth not reached

soil infiltration rate $f = \frac{V_{p75-25}}{a_{s50} \times t_{p75-25}}$

Infiltration rate (f) is very low

TARGET DEPTHS AND CALCULATED VALUES

Time (mins)	Depth to water surface (m)	Head of water in pit (m)	Time elapsed, t_{p75-25} (mins)	Volume of water lost, V_{p75-25} (m^3)	Area of walls and base at 50% drop, a_{s50} (m^2)	Soil infiltration rate, f (m/min)	Soil infiltration rate, f (m/h)



Soakaway Infiltration Test

Project No.: 25-0802
Site: Kildare
Test Location: TP03
Test Date: 24 September 2025

Analysis using method as described in BRE DG 365 (2016) and CIRIA Report C753-The SUDS Manual (2015)

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

depth to groundwater before adding water (m) = DRY

Time (mins)	Depth to water surface (m)	Head of water in pit (m)
0	0.00	1.50
1	0.00	1.50
2	0.00	1.50
5	0.01	1.49
10	0.02	1.49
15	0.02	1.48
20	0.03	1.48
25	0.03	1.47
30	0.04	1.47
40	0.04	1.46
45	0.05	1.46
50	0.05	1.45
55	0.06	1.45
60	0.06	1.44
75	0.07	1.43
90	0.08	1.43

RESULTS (FROM GRAPH BELOW)

Test start

75% head of water at 1.13 m
depth to water surface (target) 0.38 m
time to reach target depth not reached

Test end

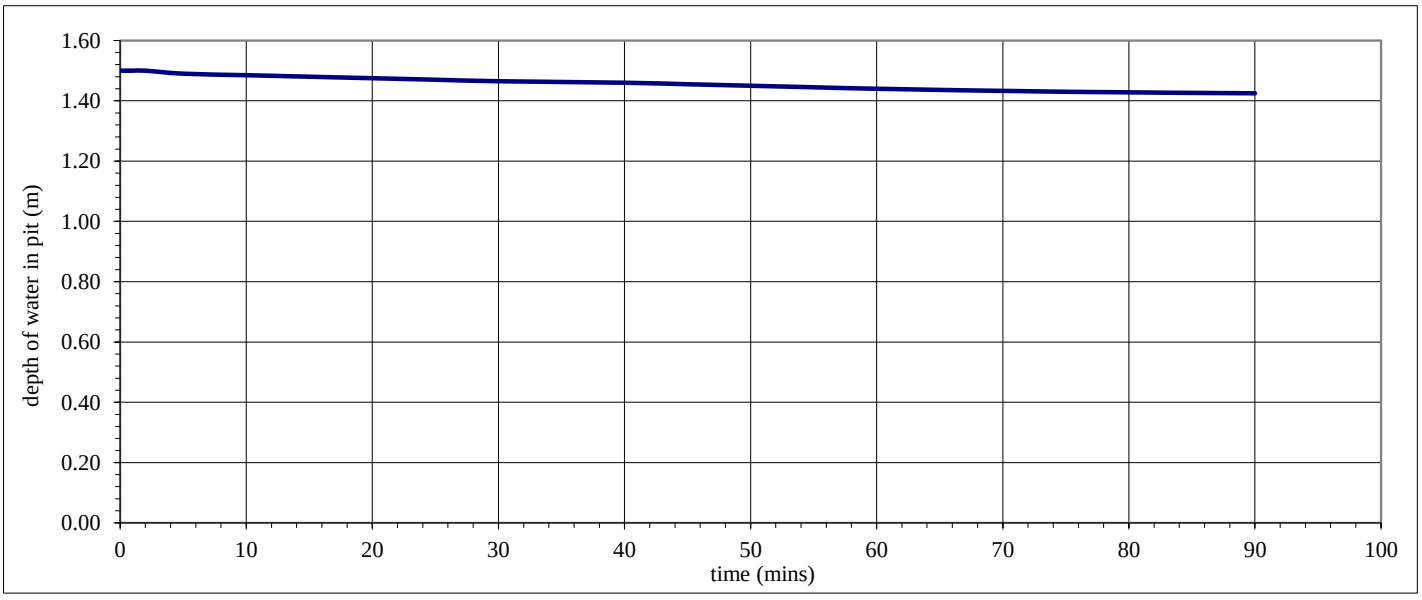
25% head of water at 0.38 m
depth to water surface (target) 1.13 m
time to reach target depth not reached

soil infiltration rate $f = \frac{V_{p75-25}}{a_{s50} \; x \; t_{p75-25}}$

Infiltration rate (f) is very low

TARGET DEPTHS AND CALCULATED VALUES

Time (mins)	Depth to water surface (m)	Head of water in pit (m)	Time elapsed, t_{p75-25} (mins)	Volume of water lost, V_{p75-25} (m^3)	Area of walls and base at 50% drop, a_{s50} (m^2)	Soil infiltration rate, f (m/min)	Soil infiltration rate, f (m/h)



APPENDIX F – VARIABLE HEAD PERMIABILITY TEST RESULTS



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: Kildare
Project No.: 25-0802
Test Date: 25/09/2025

Borehole No.: BH01
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.13m
Height of top of casing above ground level:	0.20m
Depth to bottom of casing below ground level:	5.40m
Depth to bottom of borehole below ground level:	5.60m
Length of the test section (L):	0.20m
Standing ground water level (SWL) below ground level	Dry

DATUM: Water level measured from top of casing, i.e. SWL is 5.80m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.30	5.50	1.00
2	0.31	5.49	1.00
4	0.33	5.47	0.99
6	0.35	5.45	0.99
8	0.37	5.43	0.99
10	0.38	5.42	0.99
15	0.43	5.37	0.98
20	0.46	5.34	0.97
25	0.51	5.29	0.96
30	0.54	5.26	0.96
40	0.58	5.22	0.95
50	0.61	5.19	0.94
60	0.65	5.15	0.94
75	0.68	5.12	0.93
90	0.72	5.08	0.92
120	0.75	5.05	0.92

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

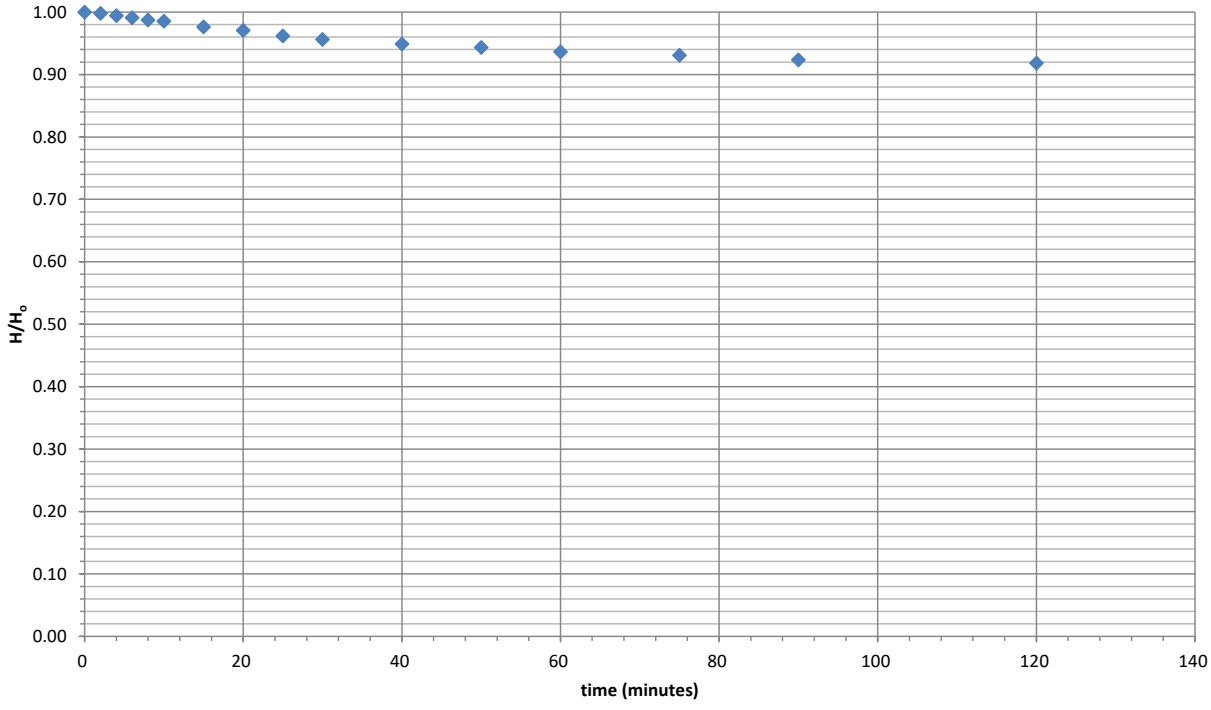
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 1.6, so Case D is assumed, therefore:

*=(2*π*L)/(LN((L/D)+√((L/D)^2)+1)*

i.e. F =	1.01	(m)
A =	0.012	(m^2)
h_1 =	5.50	(m)
h_2 =	2.04	(m)
t_1 =	0	(s)
t_2 =	N/A	(s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: Kildare
Project No.: 25-0802
Test Date: 26/09/2025

Borehole No.: BH02
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.13m
Height of top of casing above ground level:	0.20m
Depth to bottom of casing below ground level:	5.40m
Depth to bottom of borehole below ground level:	5.60m
Length of the test section (L):	0.20m
Standing ground water level (SWL) below ground level	Dry

DATUM: Water level measured from top of casing, i.e. SWL is 5.80m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho	
0	0.45	5.35	1.00	
2	0.50	5.30	0.99	
4	0.61	5.19	0.97	
6	0.70	5.10	0.95	
8	0.78	5.02	0.94	
10	0.85	4.95	0.93	
15	1.04	4.76	0.89	
20	1.23	4.57	0.85	
25	1.39	4.41	0.82	
30	1.58	4.22	0.79	
35	1.71	4.09	0.76	
40	1.82	3.98	0.74	
50	2.10	3.70	0.69	
60	2.36	3.44	0.64	
75	2.69	3.11	0.58	
90	2.99	2.81	0.53	
120	3.45	2.35	0.44	
160	3.84	1.96	0.37	Extrapolated

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

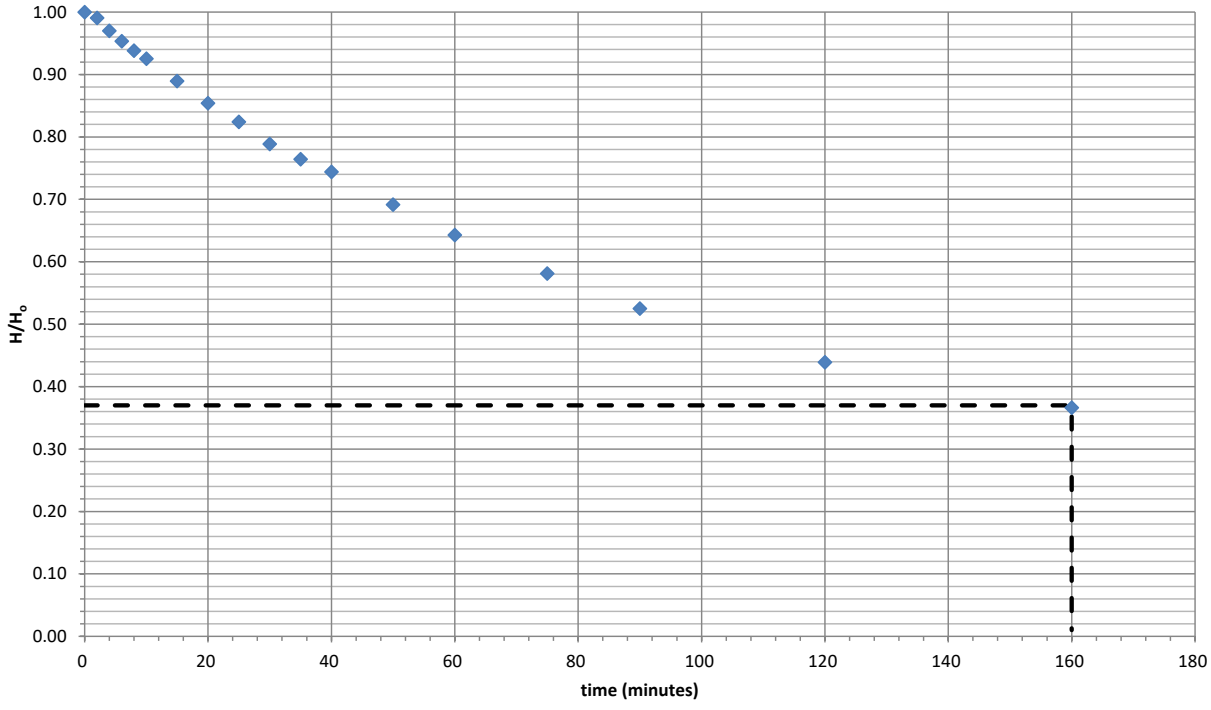
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 1.6, so Case D is assumed, therefore:

*=(2*π*L)/(LN((L/D)+√((L/D)^2)+1)*

i.e. F = 1.01 (m)
A = 0.012 (m^2)
h_1 = 5.35 (m)
h_2 = 1.98 (m)
t_1 = 0 (s)
t_2 = 9600 (s)

hence, k = 1.26E-06 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: Kildare
Project No.: 25-0802
Test Date: 25/09/2025

Borehole No.: BH03
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.13m
Height of top of casing above ground level:	0.20m
Depth to bottom of casing below ground level:	3.90m
Depth to bottom of borehole below ground level:	3.90m
Length of the test section (L):	0.00m
Standing ground water level (SWL) below ground level	Dry

DATUM: Water level measured from top of casing, i.e. SWL is 4.10m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.30	3.80	1.00
2	0.51	3.59	0.94
4	0.58	3.52	0.93
6	0.65	3.45	0.91
8	0.71	3.39	0.89
10	0.77	3.33	0.88
15	0.93	3.17	0.83
20	1.06	3.04	0.80
25	1.20	2.90	0.76
30	1.32	2.78	0.73
40	1.57	2.53	0.67
50	1.74	2.36	0.62
60	1.98	2.12	0.56
75	2.26	1.84	0.48
90	2.49	1.61	0.42
120	2.86	1.24	0.33

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

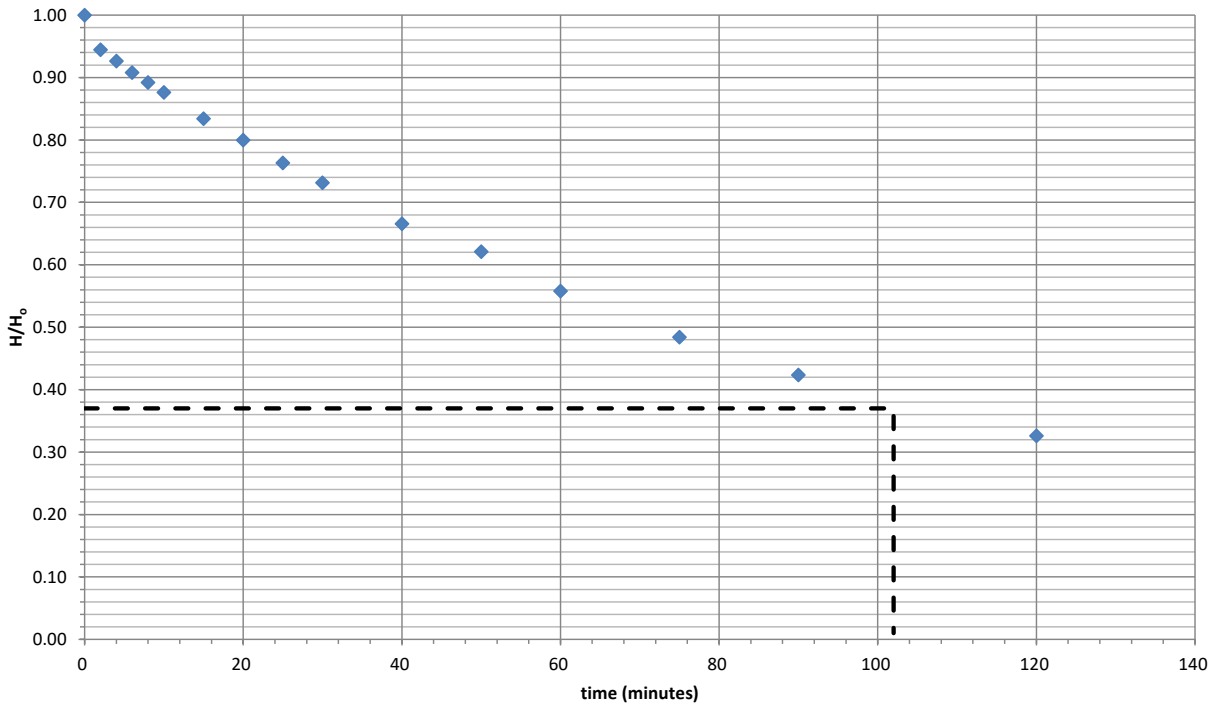
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 0.0, so Case C is assumed, therefore:

$$F=\pi*D*\sqrt{(4*(L/D))+1}$$

i.e. F = 0.39 (m)
A = 0.012 (m^2)
h_1 = 3.80 (m)
h_2 = 1.41 (m)
t_1 = 0 (s)
t_2 = 6120 (s)

hence, k = 5.07E-06 m/s



VARIABLE HEAD PERMEABILITY TEST (STANDPIPE)

Project Name: Kildare - Phase 2 **Borehole No.:** BH01

Project No.: 25-0802 **Test No.:** 1

Date: 18/11/2025 **Type of test:** Falling Head

Diameter of standpipe: *0.05* (m)

Depth to top of filter below ground level: *4.20* (m)

Depth to bottom of filter below ground level: *7.20* (m)

Diameter of filter (D): *0.13* (m)

Standing ground water level (SWL) below ground level: *7.20* (m)

TIME ELAPSED (s)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	4.70	2.50	1.00
30	5.15	2.05	0.82
60	5.78	1.42	0.57
90	5.98	1.22	0.49
120	6.27	0.93	0.37
180	6.53	0.67	0.27
240	6.67	0.53	0.21
300	6.76	0.44	0.18
450	6.92	0.28	0.11
540	6.98	0.22	0.09
630	7.01	0.19	0.08
750	7.04	0.16	0.06
900	7.09	0.11	0.04
1080	7.14	0.06	0.02

CALCULATION OF PERMEABILITY

Employing Horslev Method (1951) as shown in BS EN ISO 22282:2 2012

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_o}$$

where:

k is the coefficient of permeability (m/s)

r is the radius of the measuring tube (m)

R is the radius of the test section (m)

L is the length of the test section (m)

t_o is the time it takes for the water level to fall to 37% of the initial change in head (s)

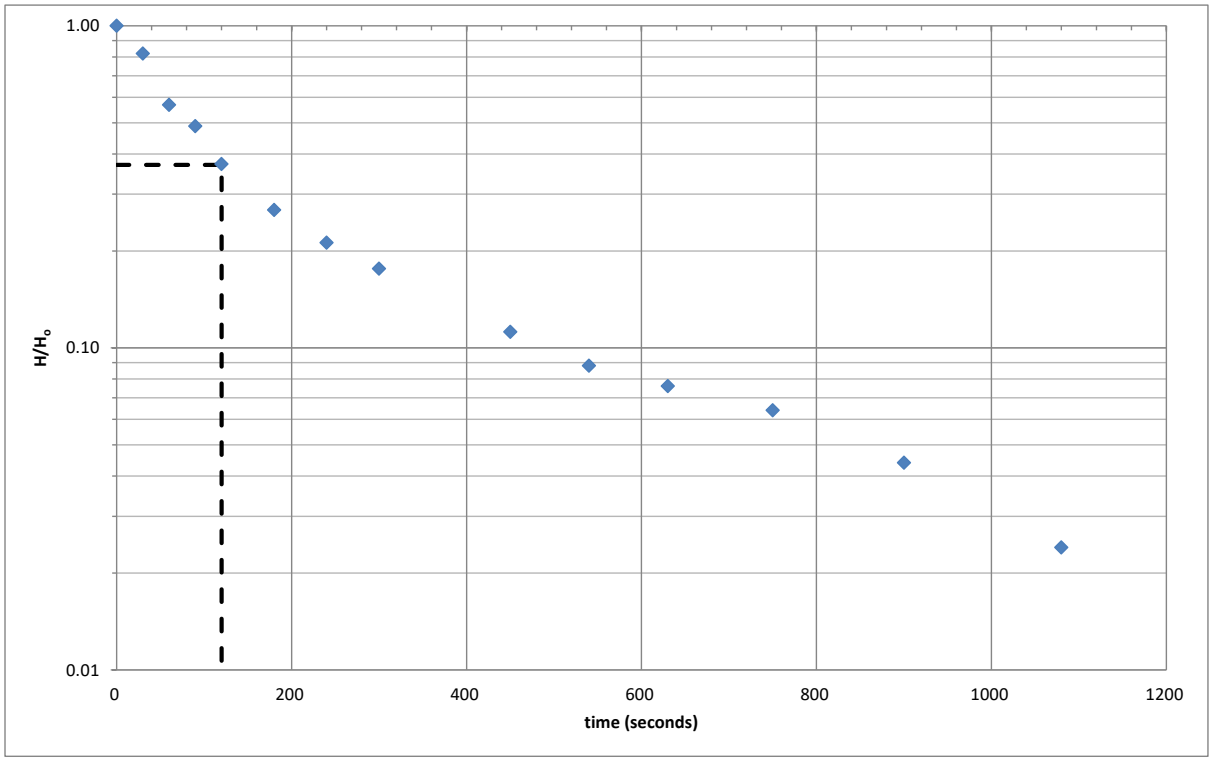
r = *0.03* (m)

and L = *3.00* (m)

and R = *0.06* (m)

and t_o = *120* (s)

hence, k = 3.36E-06 m/s



VARIABLE HEAD PERMEABILITY TEST (STANDPIPE)

Project Name: Kildare - Phase 2 **Borehole No.:** BH02

Project No.: 25-0802 **Test No.:** 1

Date: 18/11/2025 **Type of test:** Falling Head

Diameter of standpipe: *0.05* (m)

Depth to top of filter below ground level: *5.40* (m)

Depth to bottom of filter below ground level: *8.40* (m)

Diameter of filter (D): *0.13* (m)

Standing ground water level (SWL) below ground level: *7.65* (m)

Note: 30L of water added to borehole, hydraulic head did not rise above 5.88m.

TIME ELAPSED (s)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	5.88	1.77	1.00
30	5.96	1.69	0.95
60	5.99	1.66	0.94
150	6.05	1.60	0.90
240	6.06	1.59	0.90
300	6.09	1.56	0.88
480	6.12	1.53	0.86
540	6.12	1.53	0.86
600	6.13	1.52	0.86
900	6.17	1.48	0.84
1200	6.21	1.44	0.81
1500	6.26	1.39	0.79
1800	6.29	1.36	0.77
2100	6.32	1.33	0.75
2400	6.38	1.27	0.72
2700	6.40	1.25	0.71
3000	6.42	1.23	0.69
3600	6.44	1.21	0.68

CALCULATION OF PERMEABILITY

Employing Horslev Method (1951) as shown in BS EN ISO 22282:2 2012

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_o}$$

where:

k is the coefficient of permeability (m/s)

r is the radius of the measuring tube (m)

R is the radius of the test section (m)

L is the length of the test section (m)

t_o is the time it takes for the water level to fall to 37% of the initial change in head (s)

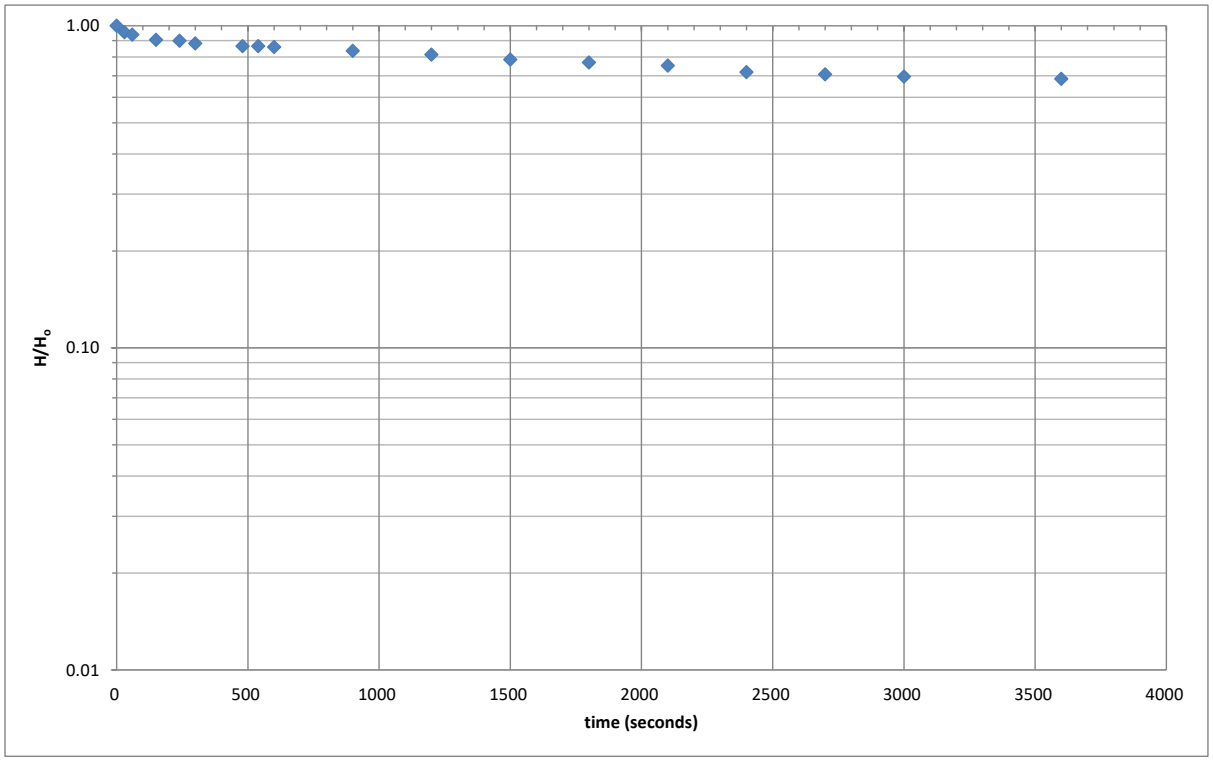
r = *0.03* (m)

and L = *3.00* (m)

and R = *0.06* (m)

and t_o = *N/A* (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (STANDPIPE)

Project Name: Kildare - Phase 2 **Borehole No.:** BH03

Project No.: 25-0802 **Test No.:** 1

Date: 18/11/2025 **Type of test:** Falling Head

Diameter of standpipe: *0.05* (m)

Depth to top of filter below ground level: *3.90* (m)

Depth to bottom of filter below ground level: *6.90* (m)

Diameter of filter (D): *0.13* (m)

Standing ground water level (SWL) below ground level: *6.75* (m)

TIME ELAPSED (s)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.00		0.01

CALCULATION OF PERMEABILITY

Employing Horslev Method (1951) as shown in BS EN ISO 22282:2 2012

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_o}$$

where: k is the coefficient of permeability (m/s)

r is the radius of the measuring tube (m)

R is the radius of the test section (m)

L is the length of the test section (m)

t_o is the time it takes for the water level to fall to 37% of the initial change in head (s)

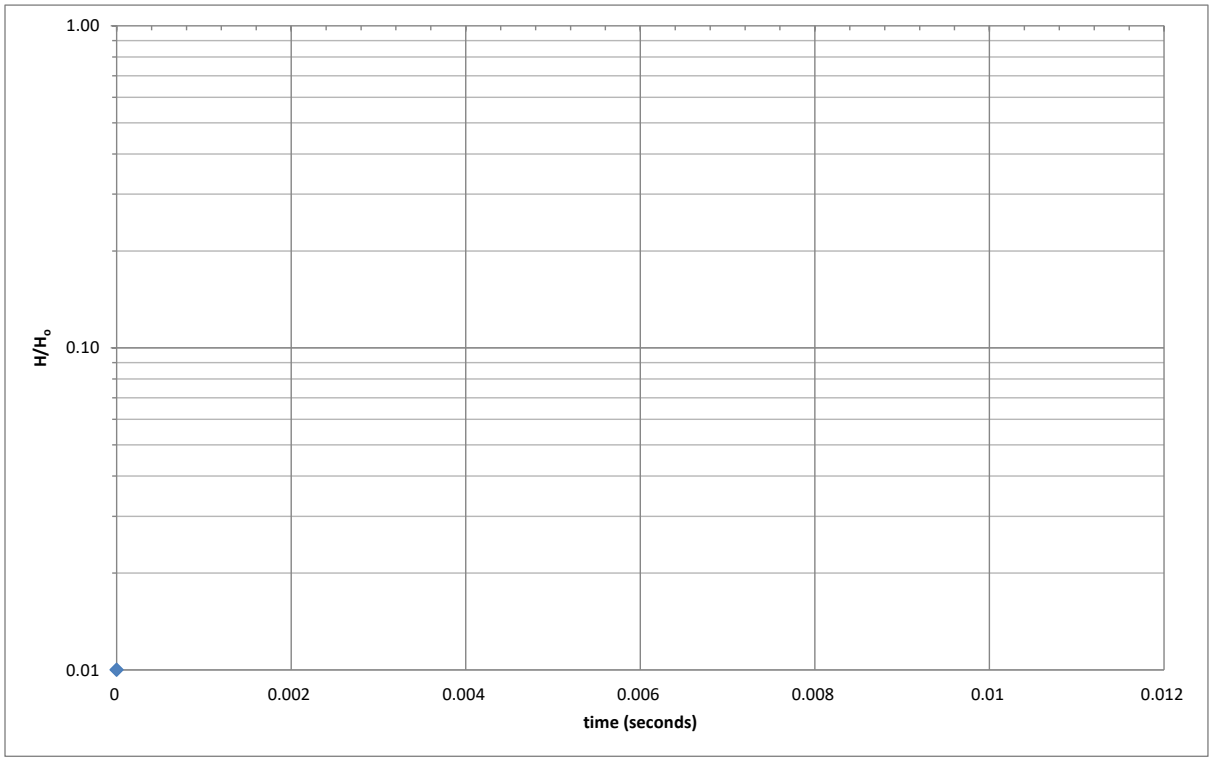
r = *0.03* (m)

and L = *3.00* (m)

and R = *0.06* (m)

and t_o = *N/A* (s)

Engineer added 30L of water to the standpipe, water level did not rise, unable to achieve a hydraulic head, test cancelled.



VARIABLE HEAD PERMEABILITY TEST (STANDPIPE)

Project Name: Kildare - Phase 2 **Borehole No.:** BH04

Project No.: 25-0802 **Test No.:** 1

Date: 20/11/2025 **Type of test:** Falling Head

Diameter of standpipe: *0.05* (m)

Depth to top of filter below ground level: *10.25* (m)

Depth to bottom of filter below ground level: *20.25* (m)

Diameter of filter (D): *0.15* (m)

Standing ground water level (SWL) below ground level: *16.90* (m)

Note: 1000L of water added to borehole, hydraulic head did not rise above 11.30m.

TIME ELAPSED (s)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0.5	11.30	5.60	1.00
60	1.81	15.09	2.69
90	12.90	4.00	0.71
120	13.33	3.57	0.64
150	13.63	3.27	0.58
180	13.84	3.06	0.55
240	14.20	2.70	0.48
300	14.49	2.41	0.43
360	14.80	2.10	0.38
420	15.71	1.19	0.21
480	15.87	1.03	0.18
540	16.04	0.86	0.15
600	16.40	0.50	0.09
660	16.45	0.45	0.08
720	16.50	0.40	0.07
780	16.56	0.34	0.06
900	16.58	0.32	0.06
1020	16.60	0.30	0.05
1140	16.62	0.28	0.05
1440	16.64	0.26	0.05

CALCULATION OF PERMEABILITY

Employing Horslev Method (1951) as shown in BS EN ISO 22282:2 2012

$$k = \frac{r^2 \cdot \ln(L/R)}{2 \cdot L \cdot t_o}$$

where:

k is the coefficient of permeability (m/s)

r is the radius of the measuring tube (m)

R is the radius of the test section (m)

L is the length of the test section (m)

t_o is the time it takes for the water level to fall to 37% of the initial change in head (s)

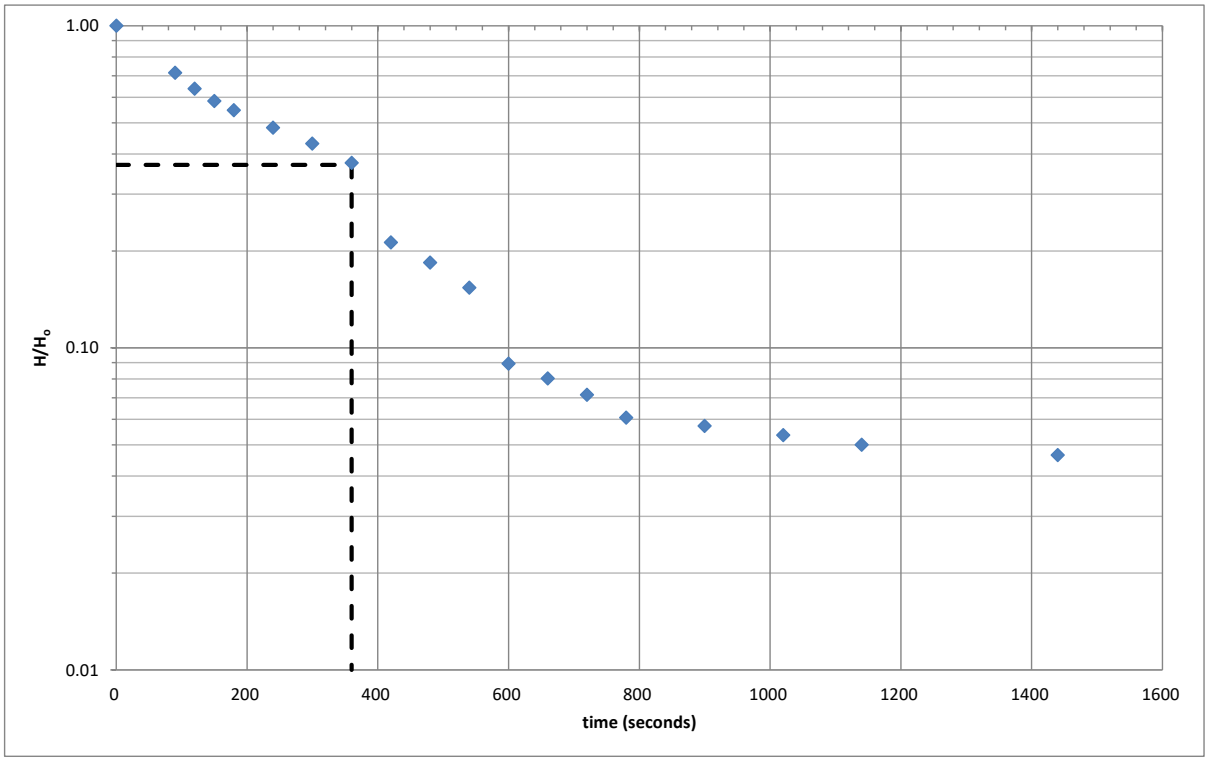
r = *0.03* (m)

and L = *10.00* (m)

and R = *0.07* (m)

and t_o = *360* (s)

hence, k = 4.27E-07 m/s



APPENDIX G – GEOTECHNICAL LABORATORY RESULTS



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SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

17 October 2025

PROJECT NAME	Kildare
PROJECT NUMBER	25-0802
CLIENT	Verde
ENGINEER	N/A

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 10/10/2025 and 17/10/2025.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

CAUSEWAY GEOTECH

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www.causewaygeotech.com

PROJECT NAME: Kildare

REPORT REFERENCE: Schedule 1

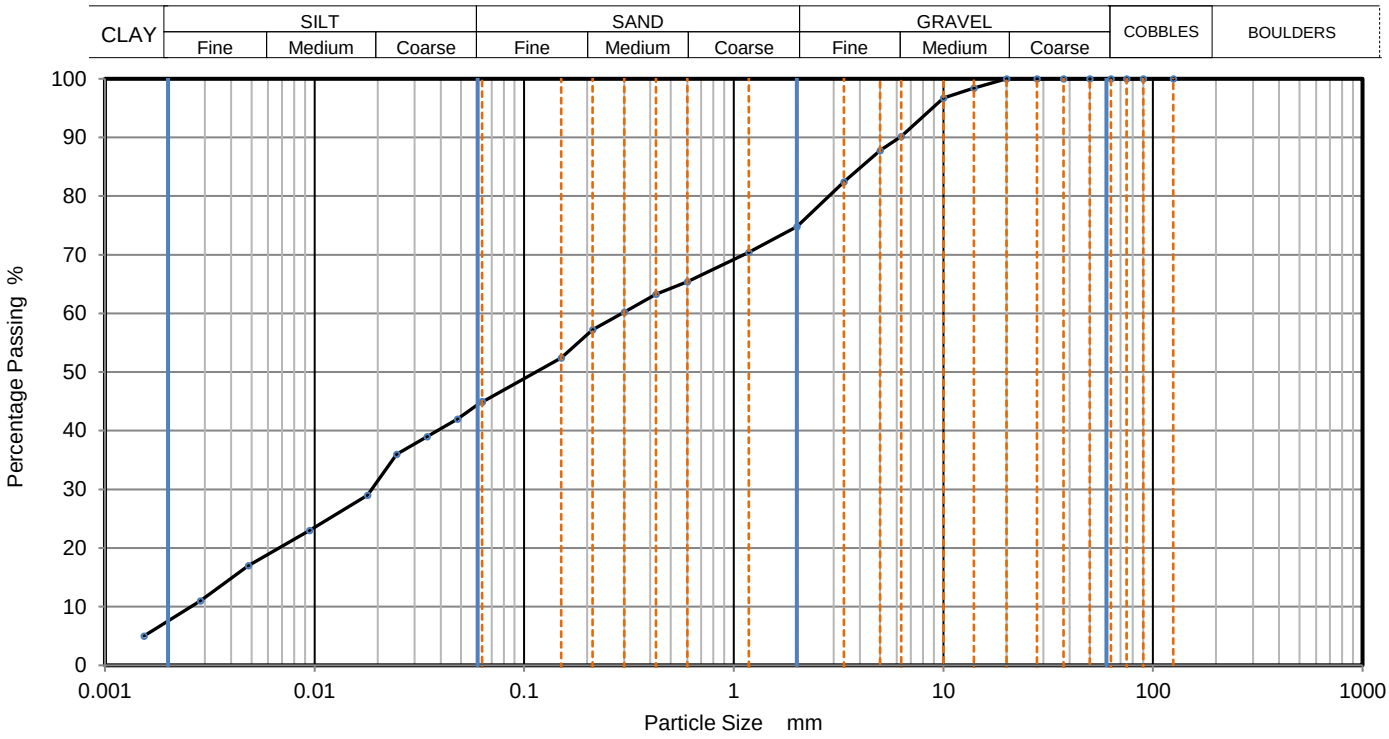
The table below details the tests carried out, the specifications used, and the number of tests included in this report. Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests.

The results contained in this report relate to the sample(s) as received. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report shall not be reproduced other than in full, without the prior written approval of the laboratory.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Particle size distribution - wet sieving	*BS 1377-2: 2022: Cl 10 in accordance with ISO 17892-4:2016, Cl 5.2*	3
SOIL	Particle size distribution - sedimentation hydrometer method	*BS 1377-2: 2022: Cl 10 in accordance with ISO 17892-4:2016, Cl 5.3*	3

PARTICLE SIZE DISTRIBUTION

Job Ref					**25-0802**
Borehole/Pit No.					TP01
Site Name	Kildare			Sample No.	2
Specimen Description	Brown sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	0.50
				Base	0.50
Specimen Reference	2	Specimen Depth	0.5 m	Sample Type	B
Test Method	BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016			KeyLAB ID	Caus20251006269



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	45
90	100	0.04803	42
75	100	0.03443	39
63	100	0.02466	36
50	100	0.01789	29
37.5	100	0.00946	23
28	100	0.00484	17
20	100	0.00286	11
14	98	0.00153	5
10	97		
6.3	90		
5	88		
3.35	82		
2	75		
1.18	70		
0.6	65	Particle density	(assumed)
0.425	63	2.65	Mg/m3
0.3	60		
0.212	57		
0.15	52		
0.063	45		

Dry Mass of sample, g: 342

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	25.2
Sand	29.9
Silt	37.6
Clay	7.3

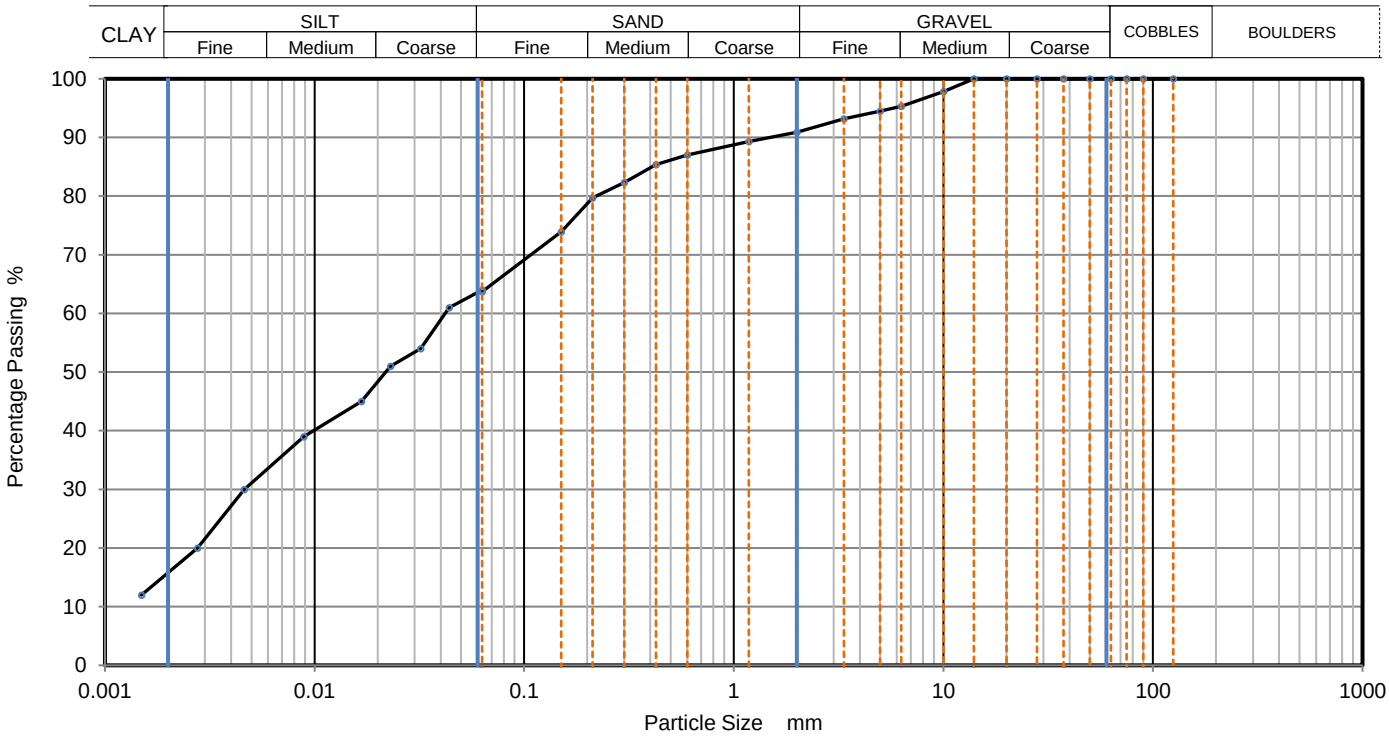
Grading Analysis		
D100	mm	
D60	mm	0.293
D30	mm	0.0184
D10	mm	0.00263
Uniformity Coefficient		110
Curvature Coefficient		0.44

Remarks

Preparation and testing to BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016

Approved
Stephen Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**25-0802**
				Borehole/Pit No.	TP02
Site Name	Kildare			Sample No.	3
Specimen Description	Brown sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	1.00
				Base	1.00
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016			KeyLAB ID	Caus20251006270



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	64
90	100	0.04393	61
75	100	0.03206	54
63	100	0.02301	51
50	100	0.01675	45
37.5	100	0.00889	39
28	100	0.00462	30
20	100	0.00276	20
14	100	0.00149	12
10	98		
6.3	95		
5	95		
3.35	93		
2	91		
1.18	89		
0.6	87	Particle density	(assumed)
0.425	85	2.65	Mg/m3
0.3	82		
0.212	80		
0.15	74		
0.063	64		

Dry Mass of sample, g: 306

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	9.1
Sand	27.2
Silt	47.6
Clay	16.1

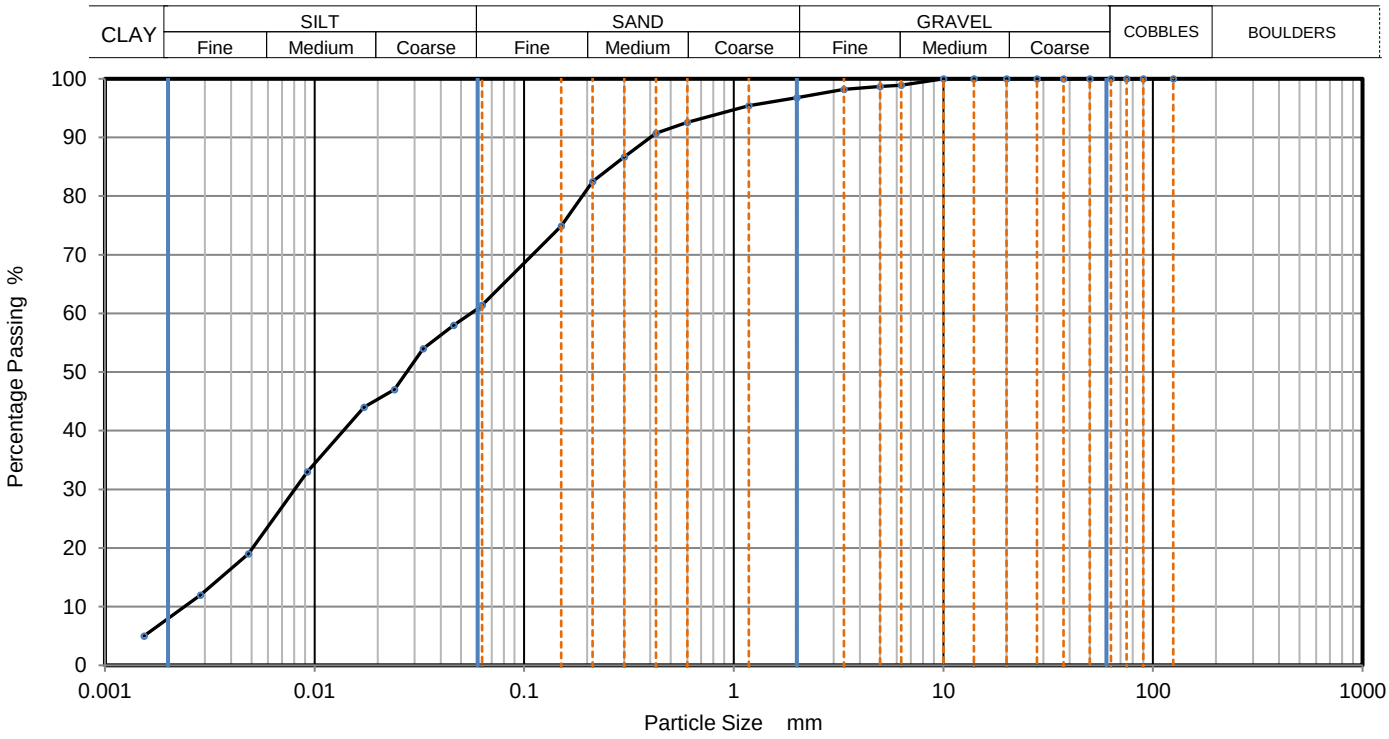
Grading Analysis		
D100	mm	
D60	mm	0.0426
D30	mm	0.00478
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing to BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016

Approved
Stephen Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**25-0802**
				Borehole/Pit No.	TP03
Site Name	Kildare			Sample No.	4
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	1.20
				Base	1.20
Specimen Reference	2	Specimen Depth	1.2 m	Sample Type	B
Test Method	BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016			KeyLAB ID	Caus20251006271



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06097	61
90	100	0.04603	58
75	100	0.03303	54
63	100	0.02402	47
50	100	0.01721	44
37.5	100	0.00924	33
28	100	0.00484	19
20	100	0.00286	12
14	100	0.00153	5
10	100		
6.3	99		
5	99		
3.35	98		
2	97		
1.18	95		
0.6	93	Particle density	(assumed)
0.425	91	2.65	Mg/m3
0.3	87		
0.212	83		
0.15	75		
0.063	61		

Dry Mass of sample, g: 326

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	3.2
Sand	35.4
Silt	53.1
Clay	8.3

Grading Analysis		
D100	mm	
D60	mm	0.0545
D30	mm	0.00792
D10	mm	0.00233
Uniformity Coefficient		23
Curvature Coefficient		0.49

Remarks

Preparation and testing to BS 1377-2 :2022 Cl 10 in accordance with ISO 17892-4:2016

Approved
Stephen Watson

UKAS TESTING 10122

APPENDIX H – SPT HAMMER ENERGY MEASUREMENT REPORT



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Causeway Geotech LTD
8 Drumahiskey Road
Ballymoney
Co Antrim
BT53 7QL

SPT Hammer Ref: 1515
Test Date: 21/10/2024
Report Date:
File Name: 1515.spt
Test Operator: CD

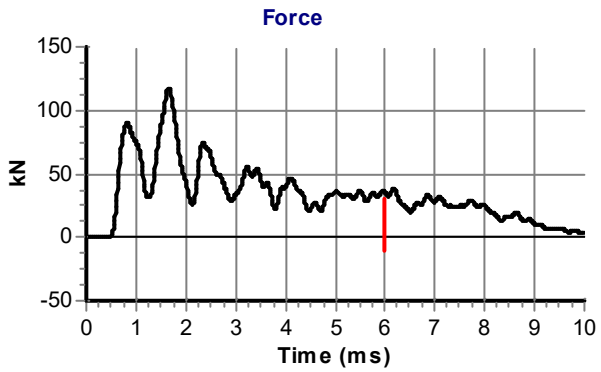
Instrumented Rod Data

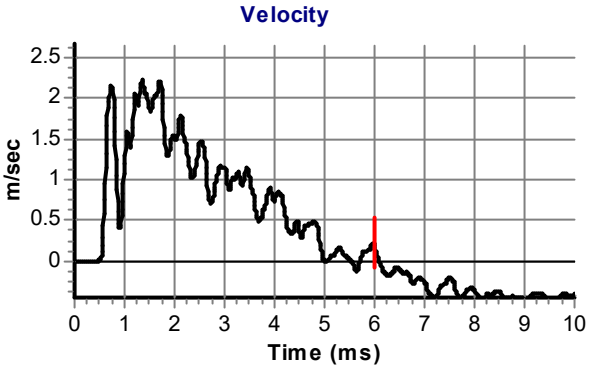
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.4
Rod Length l_r (m):	1.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	78855
Accelerometer No.2:	78856

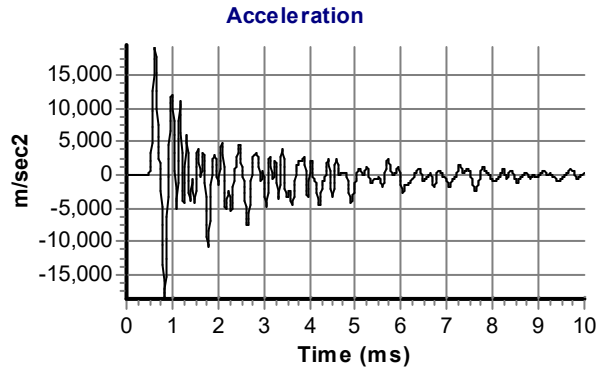
SPT Hammer Information

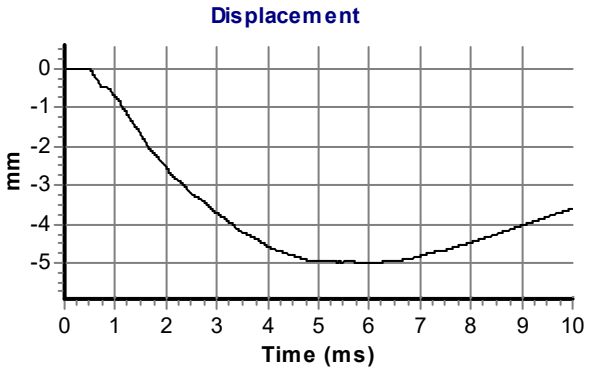
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

Comments / Location









Calculations

Area of Rod A (mm2):	957
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	285

Energy Ratio E_r (%): 60

Signed: Colin Dunlop
Title: Plant Manager

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CAUSEWAY GEOTECH

Causeway Geotech Limited has made its commitment to health and safety of people, the environment and the quality of its services an integral part of our strategy.

Whether it be ensuring people's safety or meeting the challenges of operating in an ecologically diverse environment, we aim to act in a sustainable and responsible manner at all times.

CERTIFICATIONS /ACCREDITATIONS

Constructionline Gold Member

SCS UKAS

MEMBERSHIPS

AGS

BRITISH DRILLING ASSOCIATION

BGA THE BRITISH GEOTECHNICAL ASSOCIATION

INTERNATIONAL JACK-UP BARGE OPERATORS ASSOCIATION

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APPENDIX C

SITE PHOTOGRAPHS

Plate 1 – View of the site from the west looking east. Location of TP02/SA02 and BH02/FHT02.



Plate 2 – View of the site from the north looking south.



Plate 3 – View of the site from the northern corner of the site boundary facing east. Location of TP01/SA01 and BH01/FHT01.



Plate 4 – View of the site from the southern corner of the site boundary facing west. Location of TP03/SA03 and BH03/FHT03.



Plate 5a, 5b & 5c– TP01/SA01 View of TP01 terminated at 1.5mBGL. The ground encountered was TOPSOIL to 0.30mBGL followed by light brown, very sandy, very gravelly, loose CLAY with frequent sub- rounded, cobbles. Clay becomes very silty and firm at 1mBGL.







Plate 6a, 6b & 6c– TP02/SA02 View of TP02 terminated at 1.5mBGL. The ground encountered was TOPSOIL to 0.30mBGL followed by brown, very sandy, very gravelly, loose CLAY with frequent sub- rounded, gravel. Clay becomes very silty and firm at 0.80mBGL







Plate 7a, 7b & 7c– TP03/SA03 View of TP03 terminated at 1.4mBGL. The ground encountered was TOPSOIL to 0.20mBGL followed by brown, sandy, slightly gravelly, firm CLAY with rare cobbles. Clay becomes very silty at 0.50mBGL







Plate 8a & 8b– BH01/FHT01 View of BH01 terminated at 7.2mBGL. The ground encountered was TOPSOIL to 0.30mBGL followed by light brown, very sandy, very gravelly, loose CLAY with frequent sub- rounded, cobbles. Clay became firm at 1.0mBGL. At 1.5mBGL to 2.4mBGL fragments of cobbles in drill arisings.





Plate 8c & 8d– BH01/FHT01 Plate 8c shows the very sandy, GRAVELS at 4.2mBGL. Plate 8d shows groundwater monitoring well installed with an upright casing.





Plate 9a– BH02/FHT02 View of BH02 terminated at 8.4mBGL. The ground encountered was TOPSOIL to 0.30mBGL followed by brown, very sandy, very gravelly, loose CLAY. At 0.80mBGL the clay became very silty and firm. At 3.9mBGL cobble fragments visible within drilling arisings.



Plate 9b & 9c– BH02/FHT02 Plate 9b shows the very sandy, very silty, GRAVELS at 4.9mBGL. Plate 9c shows groundwater monitoring well installed with an upright casing.





Plate 10a– BH03/FHT03 View of BH03 terminated at 6.8mBGL. The ground encountered was TOPSOIL to 0.20mBGL followed by brown, sandy, slightly gravelly, firm CLAY with rare cobbles. Clay becomes very silty at 0.50mBGL.



Plate 10b & 10c– BH03/FHT03 Plate 10b shows the very sandy, GRAVELS at 3.9mBGL. Plate 10c shows groundwater monitoring well installed with an upright casing.





Plate 11 – BH01/FHT01(2) Plate 11 shows the second falling head test carried out within the groundwater monitoring well BH01 on the 18th of November 2025. The well was dry before initiating the test, where 50 litres of de-ionised water was put into the well to gain a stable hydraulic head.



Plate 12 – BH02/FHT02(2) Plate 12 shows the second falling head test carried out within the groundwater monitoring well BH02 on the 18th of November 2025. The well had 33cm of standing water before initiating the test, where 25 litres of de-ionised water was put into the well to gain a stable hydraulic head.



Plate 13 – BH03/FHT03(2) Plate 13 shows the second falling head test carried out within the groundwater monitoring well BH03 on the 18th of November 2025. The well was dry before initiating the test, where 25 litres of de-ionised water was put into the well, which all drained before measurements could be taken. Unable to maintain a hydraulic head within the well.



Plate 14a & 14b– Plate 14a Indicates the location of BH04 facing east, approximately 50m north of BH01 within the site boundary and the completion of CAT scan of the area. Plate 14b is taken from BH01 facing north, indicating the location of BH04.





Plate 14c – BH04 Plate 14 shows the setting up of the rotary drilling rig at BH04, facing northeast on the 19th of November 2025.



Plate 14d– BH04 shows the silty, very sandy, GRAVELS encountered at 4mBGL.



Plate 14e– BH04 shows a change in colour to a reddish brown and increase in sand content and reduction in silt within the sandy, GRAVELS encountered at 8.5mBGL.



Plate 14f– BH04 Completion of permeability test (falling head test) within the groundwater monitoring well. Groundwater at 16.9mBGL. Unable to maintain hydraulic head with input of 1000 litres of water. Test initiated at 11.30mBGL. Water drained quickly. within the sandy, GRAVELS.



Plate 14g – Illustrates groundwater sampling at BH04 on the 26th of November 2025.





APPENDIX D

TRIAL PIT LOGS

Test Pit Record: TP01

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672270.00	**Date Drilled:** 24/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713463.00	**Excavator** 26U Hitachi 3t excavator
Loc Comment: Sunny and dry conditions.	**Elevation:** 108(m)	**Excavator Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: Sample: PSD sample taken. SA01 test undertaken.

Water	Samples	PID (ppm)	Observations	STRATA RECORD		
				Depth (m)	Key	Description
			No PEC			Brown, loose, with frequent roots. TOPSOIL.
	TP01- PSD Grab Sample		No PEC	0.5		Light brown, loose, very sandy, very gravelly CLAY. With frequent sub-rounded cobbles. Sand is medium to coarse. Gravels are medium to fine, sub- rounded. Cobbles are sub- rounded 6- 17cm.
Not Encountered			No PEC	1.0		Brown, firm, very silty, gravelly CLAY. Gravel is medium to fine, sub-rounded.
						TP01 Terminated at 1.5 m

Test Pit Record: TP02

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672205.00	**Date Drilled:** 24/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713307.00	**Excavator** 26U Hitachi 3t excavator
Loc Comment: Sunny and dry conditions.	**Elevation:** 107(m)	**Excavator Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: Sample: PSD sample taken. SA02 test undertaken.

Water	Samples	PID (ppm)	Observations	STRATA RECORD		
				Depth (m)	Key	Description
Not Encountered	TP02- PSD Grab Sample		No PEC			Brown, loose, with frequent roots. TOPSOIL.
			No PEC	0.5		Brown, loose, very sandy, very gravelly CLAY. With frequent sub- rounded cobbles. Sand is medium to coarse. Gravels are frequent, medium to fine, sub- rounded 3- 5cm. Sand is fine.
			No PEC	1.0		Brown, firm, very silty, gravelly CLAY. With frequent rootlets. Gravel is fine, sub- rounded.
						TP02 Terminated at 1.5 m

Test Pit Record: TP03

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672307.00	**Date Drilled:** 24/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713211.00	**Excavator** 26U Hitachi 3t excavator
Loc Comment: Sunny and dry conditions.	**Elevation:** 104(m)	**Excavator Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: Sample: PSD sample taken. SA03 test undertaken.

Water	Samples	PID (ppm)	Observations	STRATA RECORD		
				Depth (m)	Key	Description
Not Encountered	TP03- PSD Grab Sample		No PEC			Brown, loose, with frequent rootlets. TOPSOIL.
			No PEC	0.5		Brown, firm, very sandy, slightly gravelly CLAY. With rare sub- rounded cobbles. Sand is fine. Gravels are fine to medium, sub- angular. Cobbles are sub- rounded 4- 5cm.
			No PEC	1.0		Brown, firm, silty, gravelly CLAY. Gravel is fine to medium, sub- angular.
						TP03 Terminated at 1.4 m

APPENDIX E

BOREHOLE LOGS

Borehole Record: BH01

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672269.32	**Date Drilled:** 25/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713469.18	**Drill Rig** Rotary Drill Rig
Loc Comment: Sunny and dry conditions	**Elevation:** 107.67(m)	**Drill Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: FHT01 completed at borehole location.

GROUNDWATER		SAMPLES AND IN-SITU TESTING				STRATA RECORD	
Well MW01	Water Observation	PID. (ppm)	Observations	Sample ID	Depth (m)	Key	Description
50mm PVC Solid	Not Encountered		No PEC		1.0		Brown, loose, with roots and rootlets. TOPSOIL.
			SPT 1				Light brown, moist, loose, very sandy, very gravelly CLAY. With frequent cobbles. Sand is medium to coarse. Gravel is fine to medium, sub- rounded. Cobbles are sub- rounded. Cobbles are 6- 17cm.
					2.0		Brown, moist, firm, very silty, very gravelly CLAY. Gravel is fine to medium, sub- rounded.
			SPT 2 (No sample recovery)				Light brown to brown, firm, very silty CLAY.
			Cobble fragments within the clay.		3.0		
			SPT 3 (Sample with cobble fragments)		4.0		
					5.0		Dark grey, loose, moist, very sandy, GRAVEL. Sand is fine to coarse. Gravel is coarse, sub- rounded. Gravel is 2 - 4cm.
			SPT 4 (Refusal)				
50mm PVC Slotted			No PEC		6.0		
					7.0		
							BH01 Terminated at 7.2 m

Borehole Record: BH02

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672203.68	**Date Drilled:** 25/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713313.81	**Drill Rig** Rotary Drill Rig
Loc Comment: Sunny and dry conditions	**Elevation:** 107.47(m)	**Drill Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: FHT02 completed at borehole location.

GROUNDWATER		SAMPLES AND IN-SITU TESTING				STRATA RECORD	
Well MW02	**Water Observation**	**PID. (ppm)**	**Observations**	**Sample ID**	**Depth (m)**	**Key**	**Description**
50mm PVC Solid	Not Encountered		No PEC		1.0		Brown, loose, with roots and rootlets. TOPSOIL.
			SPT 1				Brown, moist, loose, very sandy, very gravelly CLAY. With rare cobbles. Sand is fine. Gravel is coarse, sub- rounded. Gravel is 3- 5cm. Cobbles are sub- rounded.
					2.0		Brown, moist, firm, very silty, gravelly CLAY. Gravel is fine, sub- rounded. With frequent rootlets.
			SPT 2				Brown, loose, moist, very silty, very sandy, slightly gravelly CLAY. Sand is medium to coarse. Gravels are dark grey, coarse, sub- rounded.
			Slight odour (possible Hydrogen Sulphide)		3.0		
			SPT 3		4.0		Brown, firm, moist, very silty, CLAY.
			Cobble fragments in drilling arisings				
			SPT 4		5.0		Dark grey, loose, moist, very sandy, very silty GRAVEL. Sand is coarse. Gravel is fine to coarse, sub- rounded.
50mm PVC Slotted			No PEC		6.0		
					7.0		
					8.0		
							BH02 Terminated at 8.4 m

Borehole Record: BH03

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672311.97	**Date Drilled:** 24/09/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713211.00	**Drill Rig** Rotary Drill Rig
Loc Comment: Sunny and dry conditions	**Elevation:** 103.97(m)	**Drill Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

General comments: FHT03 completed at borehole location.

GROUNDWATER		SAMPLES AND IN-SITU TESTING				STRATA RECORD	
Well MW03	Water Observation	PID. (ppm)	Observations	Sample ID	Depth (m)	Key	Description
50mm PVC Solid	Not Encountered		No PEC		1.0		Brown, loose, with roots. TOPSOIL.
			SPT 1				Brown, moist, firm, sandy, slightly gravelly CLAY. With rare cobbles. Sand is fine. Gravel is medium, sub- angular. Cobbles are sub- rounded.
					2.0		Brown, moist, firm, very silty gravelly CLAY. Gravel is fine to medium, sub- angular.
			Slight odour (possible Hydrogen Sulphide)		3.0		Brown, firm, slightly sandy, gravelly CLAY. Sand is fine to medium. Gravel is fine to medium, sub- angular.
			SPT 2		4.0		Brown, loose, moist, very silty, GRAVEL. With frequent cobbles. Gravel is dark grey coarse, sub- rounded. Cobbles are coarse, sub- rounded.
50mm PVC Slotted			No PEC		5.0		Light to dark grey, very sandy GRAVEL. Sand is coarse, sub- rounded. Gravel is medium to coarse 2- 3cm, sub- rounded.
					6.0		BH03 Terminated at 6.8 m

Borehole Record: BH04

Project: South Green Tier 2 Hydrogeological Assessment
Location: Southgreen Rd, Kildare, Ireland
Loc Comment: Sunny, freezing conditions
Job No: S45476

Position: Easting: 672257.23
Northing: 713510.90
Elevation: 105.54(m)
Inclination:

Date Drilled: 19/11/2025
Drill Rig GEO 601 Comacchio Rotary Rig
Drill Supplier Causeway Geotech Ltd
Logged/Checked: NM

GROUNDWATER		SAMPLES AND IN-SITU TESTING				STRATA RECORD	
Well MW04	Water Observation	PID. (ppm)	Observations	Sample ID	Depth (m)	Key	Description
							Brown, loose, with roots and rootlets. TOPSOIL.
							Brown, soft, moist, very silty, gravelly CLAY. Gravel is fine to coarse, sub- angular.
					1.0		Black, soft, moist, CLAY. Organic, no odour.
							Brown, soft, moist, very silty, very gravelly CLAY. Gravel is fine to medium and sub- angular.
					2.0		
			Perched groundwater seeped in to borehole.		3.0		Brown, soft, moist becoming wet, very silty, sandy, very gravelly CLAY. Gravel is fine to medium and sub- angular.
			Eggy odour encountered in the GRAVELS.		4.0		Brown, loose, moist, very silty, sandy, GRAVEL. Sand is medium. Gravel is dark grey, fine and sub- angular.
50mm PVC Solid					5.0		
					6.0		
					7.0		
			Damp spot within the GRAVELS		8.0		
					9.0		Brown to reddish brown, loose, moist, very sandy, GRAVEL. Sand is coarse. Gravel is dark grey to black, fine to coarse and sub- angular.
					10.0		
50mm PVC Slotted							

Borehole Record: BH04

Project: South Green Tier 2 Hydrogeological Assessment	**Position:** Easting: 672257.23	**Date Drilled:** 19/11/2025
Location: Southgreen Rd, Kildare, Ireland	Northing: 713510.90	**Drill Rig** GEO 601 Comacchio Rotary Rig
Loc Comment: Sunny, freezing conditions	**Elevation:** 105.54(m)	**Drill Supplier** Causeway Geotech Ltd
Job No: S45476	**Inclination:**	**Logged/Checked:** NM

GROUNDWATER		SAMPLES AND IN-SITU TESTING				STRATA RECORD	
Well	Water Observation	PID. (ppm)	Observations	Sample ID	Depth (m)	Key	Description
							Brown to reddish brown, loose, moist, very sandy, GRAVEL. Sand is coarse. Gravel is dark grey to black, fine to coarse and sub- angular.
			Eggy odour encountered.				Brown to reddish brown, loose, moist, very sandy, GRAVEL. Sand is coarse. Gravel is dark grey to black, fine and sub-angular. Bands of silt noted within the gravels.
					12.0		
					13.0		
	▶						Grey to black, loose, becoming wet, GRAVEL. Gravel is fine to medium, sub- angular.
					14.0		Brown, loose, moist, very sandy, GRAVEL. Sand is coarse. Gravel is dark grey to black, fine and sub- angular.
			Encountering inflow of groundwater while drilling				
					15.0		
50mm PVC Slotted							
					16.0		
			Eggy odour encountered.				
					17.0		
					18.0		Grey to black, loose, becoming wet, GRAVEL. Gravel is fine to medium, sub- angular.
	▼		Groundwater Strike				Brown, loose, moist, very sandy, GRAVEL. Sand is coarse. Gravel is dark grey to black, fine and sub- angular.
					19.0		
					20.0		
							BH04 Terminated at 20.25 m

APPENDIX F

GROUNDWATER SAMPLING LOGS

Groundwater Monitoring Well Sampling Logs				
Well Name	BH01		**Site**	Southgreen, Kildare
Static Water Level (meters below refrence point)	Dry		**Project Reference**	S45476
Water Level Reference Point	Top of Casing		**Coordinates**	-
Well Depth (m)	7.485		**Sampler**	Natalie Molloy
Well Diamter (m)	0.05		**Date**	26/11/2025
Screen Interval (m)	-		**Sampling Method**	Bailer
Well Volume (litres)	-		**Containers Used**	1x500ml Glass, 1x40ml Glass Vial, 1x500ml Plastic, 1xHNO3 Plastic, 1x H2SO4 Plastic, 1x Sterile 500ml
Purge Volume (litres)	-		**Preservative Used**	-
Well Head Condition	Good		**Weather**	Wet & cool conditions

Physical Observations		Field Water Quality Readings	
Colour	-	**pH**	-
Odour	-	**EC (µS/cm)**	-
Well Recovery Rate	-	**Temperature (°C)**	-
Comments	-	**DO (mg/L)**	-
		Redox (mV)	-

PEC = Physical Evidence of Contamination

Field readings were not recorded due to PEC present.

Groundwater Monitoring Well Sampling Logs			
Well Name	BH02	**Site**	Southgreen, Kildare
Static Water Level (meters below refrence point)	8.64	**Project Reference**	S45476
Water Level Reference Point	Top of Casing	**Coordinates**	-
Well Depth (m)	8.775	**Sampler**	Natalie Molloy
Well Diamter (m)	0.05	**Date**	26/11/2025
Screen Interval (m)	-	**Sampling Method**	Bailer
Well Volume (litres)	0.26	**Containers Used**	1x500ml Glass, 1x40ml Glass Vial, 1x500ml Plastic, 1xHNO3 Plastic, 1x H2SO4 Plastic, 1x Sterile 500ml
Purge Volume (litres)	1	**Preservative Used**	-
Well Head Condition	Good	**Weather**	Wet & cool conditions

Physical Observations		Field Water Quality Readings	
Colour	Light brown	**pH**	-
Odour	No odour	**EC (µS/cm)**	-
Well Recovery Rate	Slow	**Temperature (°C)**	-
Comments	High suspended sediment	**DO (mg/L)**	-
		Redox (mV)	-

PEC = Physical Evidence of Contamination

Field readings were not recorded due to PEC present.

Groundwater Monitoring Well Sampling Logs				
Well Name	BH03		**Site**	Southgreen, Kildare
Static Water Level (meters below refrence point)	Dry		**Project Reference**	S45476
Water Level Reference Point	Top of Casing		**Coordinates**	-
Well Depth (m)	7.15		**Sampler**	Natalie Molloy
Well Diamter (m)	0.05		**Date**	26/11/2025
Screen Interval (m)	-		**Sampling Method**	Bailer
Well Volume (litres)	-		**Containers Used**	1x500ml Glass, 1x40ml Glass Vial, 1x500ml Plastic, 1xHNO3 Plastic, 1x H2SO4 Plastic, 1x Sterile 500ml
Purge Volume (litres)	-		**Preservative Used**	-
Well Head Condition	Good		**Weather**	Wet & cool conditions

Physical Observations		Field Water Quality Readings	
Colour	-	**pH**	-
Odour	-	**EC (µS/cm)**	-
Well Recovery Rate	-	**Temperature (°C)**	-
Comments	-	**DO (mg/L)**	-
		Redox (mV)	-

PEC = Physical Evidence of Contamination

Field readings were not recorded due to PEC present.

Groundwater Monitoring Well Sampling Logs				
Well Name	BH04		**Site**	Southgreen, Kildare
Static Water Level (meters below refrence point)	1.26		**Project Reference**	S45476
Water Level Reference Point	Top of Casing		**Coordinates**	-
Well Depth (m)	2.082		**Sampler**	Natalie Molloy
Well Diamter (m)	0.05		**Date**	26/11/2025
Screen Interval (m)	-		**Sampling Method**	Bailer
Well Volume (litres)	1.61		**Containers Used**	1x500ml Glass, 1x40ml Glass Vial, 1x500ml Plastic, 1xHNO3 Plastic, 1x H2SO4 Plastic, 1x Sterile 500ml
Purge Volume (litres)	2		**Preservative Used**	HNO3 & H2SO4
Well Head Condition	Good		**Weather**	Wet & cool conditions

Physical Observations			Field Water Quality Readings	
Colour	Light brown		**pH**	7.07
Odour	No odour		**EC (µS/cm)**	908
Well Recovery Rate	Fast		**Temperature (°C)**	10.5
Comments	Moderate suspended sediment. No PEC.		**DO (%)**	81.3
			Redox (mV)	84.2

PEC = Physical Evidence of Contamination

Field readings were not recorded due to PEC present.

APPENDIX G

LABORATORY CERTIFICATES

ALS Laboratories (UK) Limited
Torrington Avenue
Coventry
CV4 9GU

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www.alsenvironmental.co.uk

Mr Jennings
Verde Environmental Consultants Ltd
E7 Network Enterprise Park
Kilcoole A63 KV04
Wicklow

03 December 2025

Test Report: COV/2919042/2025

Dear Mr Jennings

Analysis of your sample(s) submitted on 26 November 2025 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0) 2476 421213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, or to arrange container delivery or sample collection or information on our drop-off locations please contact Customer Services.

Thank you for using ALS Laboratories (UK) Limited and we look forward to receiving your next samples.

Yours Sincerely,

Signed: D. Lewis

Name: D. Lewis

Title: Technical Inorganic Manager

UKAS TESTING 1314

bsi ISO 14001 Environmental Management CERTIFIED EMS675527 ISO 45001 Occupational Health and Safety Management CERTIFIED OHS 542858

///CERTAS

This communication has been sent to you by ALS Laboratories (UK) Limited. Registered in England and Wales. Registration No.02391955.
Registered Office: ALS Laboratories (UK) Limited, Torrington Avenue, Coventry, CV4 9GU.

Report Summary

ANALYSED BY

Mr John Jennings
Verde Environmental Consultants Ltd
E7 Network Enterprise Park
Kilcoole
Wicklow
A63 KV04

Date of Issue: **03 December 2025**

Report Number: **COV/2919042/2025** Issue **1**

This issue replaces all previous issues

Job Description: Routine analysis

Job Location: 545416 Southgreen,Kildare

Number of Samples included in this report **1**

Job Received: **26 November 2025**

Number of Test Results included in this report **7**

Analysis Commenced: **01 December 2025**

Signed: D. Lewis

Name: **D. Lewis** Date: **03 December 2025**

Title: **Technical Inorganic Manager**

ALS Laboratories (UK) Limited was not responsible for sampling unless otherwise stated.

Information on the methods of analysis and performance characteristics are available on request.
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. The results relate only to the items tested and where relevant sampled. Information supplied by the customer may affect the validity of results.
Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.
This test report is not a statement of conformity to any specification or standard.

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Certificate of Analysis

ANALYSED BY

Report Number: **COV/2919042/2025** Issue 1

Laboratory Number: **25806699** Sample 1 of 1

Sample Source: **Verde Environmental Consultants Ltd**
Sample Point Description: **Verde**
Sample Description: **BH04**
Sample Matrix: **Ground Water**
Sample Date/Time: **26 November 2025** **12:00**
Sample Received: **26 November 2025**
Analysis Complete: **03 December 2025**

Test Description	Result	Units	Completed	Accreditation		Method
BOD + ATU	10	mg/l	03/12/2025	Y	S	SUBCON
Clostridium Perfringens	3	cfu/100ml	01/12/2025	N	S	SUBCON
E Coli (Colilert)	4	mpn/100ml	01/12/2025	N	S	SUBCON
Enterococci	18	cfu/100ml	01/12/2025	N	S	SUBCON
Total Coliforms (Colilert)	2	mpn/100ml	01/12/2025	N	S	SUBCON
TVC22 72H	>300	cfu/ml	01/12/2025	N	S	SUBCON
TVC37 48H	>300	cfu/ml	01/12/2025	N	S	SUBCON

Analyst Comments for 25806699: No Analyst Comment

This issue replaces all previous issues
Accreditation Codes: Y = UKAS / ISO17025 Accredited, N = Not UKAS / ISO17025 Accredited, M = MCERTS.
Analysed at: Che = Chester(CH5 3US), Cov = Coventry(CV4 9GU), S = Subcontracted, Trb = Subcontracted to Trowbridge(BA14 0XD), Wak = Wakefield(WF5 9TG), F = Data supplied by customer.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered.
See A/C = See Analyst Comment I/S=Insufficient sample For soil/sludge samples: AR=As received, DW=Dry weight.

Signed: D. Lewis

Name: **D. Lewis** Date: **03 December 2025**

Title: **Technical Inorganic Manager**

ANALYST COMMENTS FOR REPORT COV/2919042/2025 Issue 1

This issue replaces all previous issues

Date of Issue: **03 December 2025**

Sample No	Analysis Comments
25806699	

Signed: D. Lewis

Name: **D. Lewis** Date: **03 December 2025**

Title: **Technical Inorganic Manager**

DETERMINAND COMMENTS FOR REPORT COV/2919042/2025

ISSUE 1

This issue replaces all previous issues

Date of Issue: 03 December 2025

Sample No	Description	Determinand	Comments

Signed: D. Lewis

Name: **D. Lewis** Date: **03 December 2025**

Title: **Technical Inorganic Manager**

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Element Materials Technology
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Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

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W: www.element.com

Verde Environmental Consultants
E7 Network Enterprise Park
Kilcoole
Co Wicklow
Ireland
A63 KV04

Attention :	Barra Kunz
Date :	8th December, 2025
Your reference :	S45476
Our reference :	Test Report 25/20096 Batch 1
Location :	Southgreen Phase 2, Kildare
Date samples received :	1st December, 2025
Status :	Final Report
Issue :	202512081657

One sample was received for analysis on 1st December, 2025 and was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

The greenhouse gas emissions generated (in Carbon – Co2e) to obtain the results in this report are estimated as:

Scope 1&2 emissions - 2.896 kg of CO2

Scope 1&2&3 emissions - 6.844 kg of CO2

Authorised By:



Sean Anglish
Project Coordinator

Please include all sections of this report if it is reproduced

Client Name: Verde Environmental Consultants
Reference: S45476
Location: Southgreen Phase 2, Kildare
Contact: Barra Kunz
EMT Job No: 25/20096

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-4										LOD/LOR	Units	Method No.
Sample ID	BH04												
Depth													
COC No / misc													
Containers	V HN P G												
Sample Date	26/11/2025 12:00												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	01/12/2025												
Dissolved Calcium #	160.9										<0.2	mg/l	TM30/PM14
Total Dissolved Iron #	<20										<20	ug/l	TM30/PM14
Dissolved Magnesium #	9.4										<0.1	mg/l	TM30/PM14
Dissolved Manganese #	12										<2	ug/l	TM30/PM14
Dissolved Phosphorus #	56										<5	ug/l	TM30/PM14
Dissolved Sodium #	12.4										<0.1	mg/l	TM30/PM14
MTBE #	<5										<5	ug/l	TM36/PM12
Benzene #	<5										<5	ug/l	TM36/PM12
Toluene #	<5										<5	ug/l	TM36/PM12
Ethylbenzene #	<5										<5	ug/l	TM36/PM12
m/p-Xylene #	<5										<5	ug/l	TM36/PM12
o-Xylene #	<5										<5	ug/l	TM36/PM12
EPH (C8-C40) (EH_1D_Total) #	<10										<10	ug/l	TM5/PM30
TPH CWG													
Aliphatics													
>C5-C6 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C6-C8 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C8-C10 (HS_1D_AL) #	<10										<10	ug/l	TM36/PM12
>C10-C12 (EH_CU_1D_AL) #	<5										<5	ug/l	TM5/PM16/PM30
>C12-C16 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
>C16-C21 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
>C21-C35 (EH_CU_1D_AL) #	<10										<10	ug/l	TM5/PM16/PM30
Total aliphatics C5-35 (EH_CU+HS_1D_AL) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Aromatics													
>C5-EC7 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC7-EC8 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC8-EC10 (HS_1D_AR) #	<10										<10	ug/l	TM36/PM12
>EC10-EC12 (EH_CU_1D_AR) #	<5										<5	ug/l	TM5/PM16/PM30
>EC12-EC16 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
>EC16-EC21 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
>EC21-EC35 (EH_CU_1D_AR) #	<10										<10	ug/l	TM5/PM16/PM30
Total aromatics C5-35 (EH_CU+HS_1D_AR) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Total aliphatics and aromatics(C5-35) (EH_CU+HS_1D_Total) #	<10										<10	ug/l	TM5/TM36/PM12/PM16/PM30
Sulphate as SO4 #	16.4										<0.5	mg/l	TM38/PM0
Chloride #	40.8										<0.3	mg/l	TM38/PM0
Nitrate as NO3 #	29.7										<0.2	mg/l	TM38/PM0
Nitrite as NO2 #	<0.02										<0.02	mg/l	TM38/PM0
Total Oxidised Nitrogen as N #	6.7										<0.2	mg/l	TM38/PM0
MRP Ortho Phosphate as PO4	0.08										<0.06	mg/l	TM38/PM0

Element Materials Technology

Client Name: Verde Environmental Consultants
Reference: S45476
Location: Southgreen Phase 2, Kildare
Contact: Barra Kunz
EMT Job No: 25/20096

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
$H=H_2SO_4$, Z=ZnAc, N=NaOH, $HN=HN0_3$

EMT Sample No.	1-4												
Sample ID	BH04												
Depth													
COC No / misc													
Containers	V HN P G												
Sample Date	26/11/2025 12:00												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	01/12/2025												

Please see attached notes for all abbreviations and acronyms

											LOD/LOR	Units	Method No.
Total Ammonia as NH3 #	<0.03										<0.03	mg/l	TM38/PM0
Total Alkalinity as CaCO3 #	370										<1	mg/l	TM75/PM0
Free Ammonia as N	<0.006										<0.006	mg/l	TM176/PM0
pH #	7.70										<0.01	pH units	TM73/PM0
Total Organic Carbon #	<2										<2	mg/l	TM60/PM0
Total Dissolved Solids #	738										<35	mg/l	TM20/PM0
Total Suspended Solids #	65										<10	mg/l	TM37/PM0
True Colour	214										<15	mg/l PtCo	TM35/PM0

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: Verde Environmental Consultants
Reference: S45476
Location: Southgreen Phase 2, Kildare
Contact: Barra Kunz

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 25/20096						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating. Only analyses which are accredited are recorded as deviating if set criteria are not met.
It is a requirement under ISO 17025 that we inform clients if samples are deviating i.e. outside what is expected. A deviating sample indicates that the sample 'may' be compromised but not necessarily will be compromised. The result is still accredited and our analytical reports will still show accreditation on the relevant analytes.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 25/20096

SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 35°C ±5°C.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil is quoted, this refers to Total Aliphatics C10-C40.

STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a requirement of our Accreditation Body for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.
Laboratory records are kept for a period of no less than 6 years.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

Customer Provided Information

Sample ID and depth is information provided by the customer.

Age of Diesel

The age of release estimation is based on the nC17/pristane ratio only as prescribed by Christensen and Larsen (1993) and Kaplan, Galperin, Alimi et al., (1996).
Age estimation should be treated with caution as it can be influenced by site specific factors of which the laboratory are not aware.

Tentatively Identified Compounds (TICs)

Where Tentatively Identified Compounds (TICs) are reported, up to 10 Tentatively Identified Compounds will be listed where there is found to be a greater than 80% match with the NIST library. The reported concentration is determined semi-quantitively, with a matrix specific limit of detection. Note, other compounds may be present but are not reported.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above quantitative calibration range. The result should be considered the minimum value and is indicative only. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 25/20096

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details	Yes			
TM20	Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes			
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry): WATERS by Modified USEPA Method 200.7, Rev. 4.4, 1994; Modified EPA Method 6010B, Rev.2, Dec 1996; Modified BS EN ISO 11885:2009: SOILS by Modified USEP 6010B, Rev.2, Dec.1996; Modified EPA Method 3050B, Rev.2, Dec.1996	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes			
TM35	True and apparent colour by Hach Lange DR3800 spectrophotometer. Apparent colour includes dissolved and suspended matter. True colour is determinined after filtration of the sample.	PM0	No preparation is required.				
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM37	Modified methods - TSS: USEPA 160.2 (1985), EN872:2005 and APHA SMEWW 2540D:1999 22nd Edition; VSS: USEPA 1684 (Jan 2001), USEPA 160.4 (1971) and SMEWW 2540E:1999 22nd Edition. Gravimetric determination of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS). Sample is filtered through a 1.5um pore size glass fibre filter and the resulting residue is dried and weighed at 105°C for TSS and 550°C for VSS.	PM0	No preparation is required.	Yes			
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) - All anions comparable to BS ISO 15923-1: 2013I	PM0	No preparation is required.				
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) - All anions comparable to BS ISO 15923-1: 2013I	PM0	No preparation is required.	Yes			

EMT Job No: 25/20096

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			
TM75	Modified US EPA method 310.1 (1978). Determination of Alkalinity by Metrohm automated titration analyser.	PM0	No preparation is required.	Yes			
TM176	Free ammonia based on the pH and temperature dependent equilibrium calculated in accordance with NRA Water Quality Objectives 1994 using the ammoniacal nitrogen result.	PM0	No preparation is required.				

APPENDIX H

WATERMAN MOYLAN REPORTS



Engineering Assessment Report

Phase 2 of Proposed Residential Development at Southgreen, Co. Kildare

July 2025

Waterman Moylan Consulting Engineers Limited
Block S, EastPoint Business Park, Alfie Byrne Road, Dublin 3
www.waterman-moylan.ie

Client Name: Pousterle Limited
Document Reference: 25-003r.001
Project Number: 25-003

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
No. 1	11 July '25	C Maher	P Ingle	

Comments

Disclaimer

This report has been prepared by Waterman Moylan, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Terms and Condition of Business and taking account of the resources devoted to us by agreement with the Client.

We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report is confidential to the Client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

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Appendices

Appendix A: Uisce Éireann Confirmation of Feasibility Letter

Appendix B: Surface Water Attenuation Models (FLOW)

1. Introduction

This report has been prepared by Waterman Moylan Engineering Consultants, on behalf of the Client Pousterle Ltd, as part of a planning submission for a proposed 153 No. housing development at the proposed Phase 2 Development of Southgreen, Co. Kildare.

This report aims to provide a comprehensive overview of the engineering design criteria for the subject site at Southgreen, Co. Kildare.

Supplementary documentation referred to when compiling this report, includes:

- Uisce Éireann's Wastewater Code of Practice Rev 2 July 2020
- Uisce Éireann's Water Code of Practice Rev 2 July 2020
- Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Volume 2, for New Developments
- The SuDS Manual (CIRIA C753)
- Kildare Town Local Area Plan 2023-2029
- Kildare County Development Plan 2023-2029
- Strategic Flood Risk Assessment of the Kildare County Development Plan 2023-2029
- Kildare Town Surface Water Study Stage 1 (November 2022)
- Kildare Town Surface Water Study Stage 2 (January 2023)
- Kildare County Council (KCC) Sustainable Drainage Systems (SuDS) Guidance Document.

2. Subject Site

2.1 Existing Site Location

The site is located at Southgreen Road, approximately c. 750m northwest of Kildare Town in Co. Kildare (as the crow flies) as shown in Figure 2-1, below. The site is bound by Southgreen Road to the west, open lands to the north, Old Road (L7016) to the east, and by the Internal Link Road (SILR) and South Green Phase 1 to the south.

The lands, which are currently in agricultural use, slope generally from west to east. The site area, and area of the redline boundary, is approximately c. 5.74 hectares (ha).

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0010 – Site Location Map for the precise site location and surrounding lands.

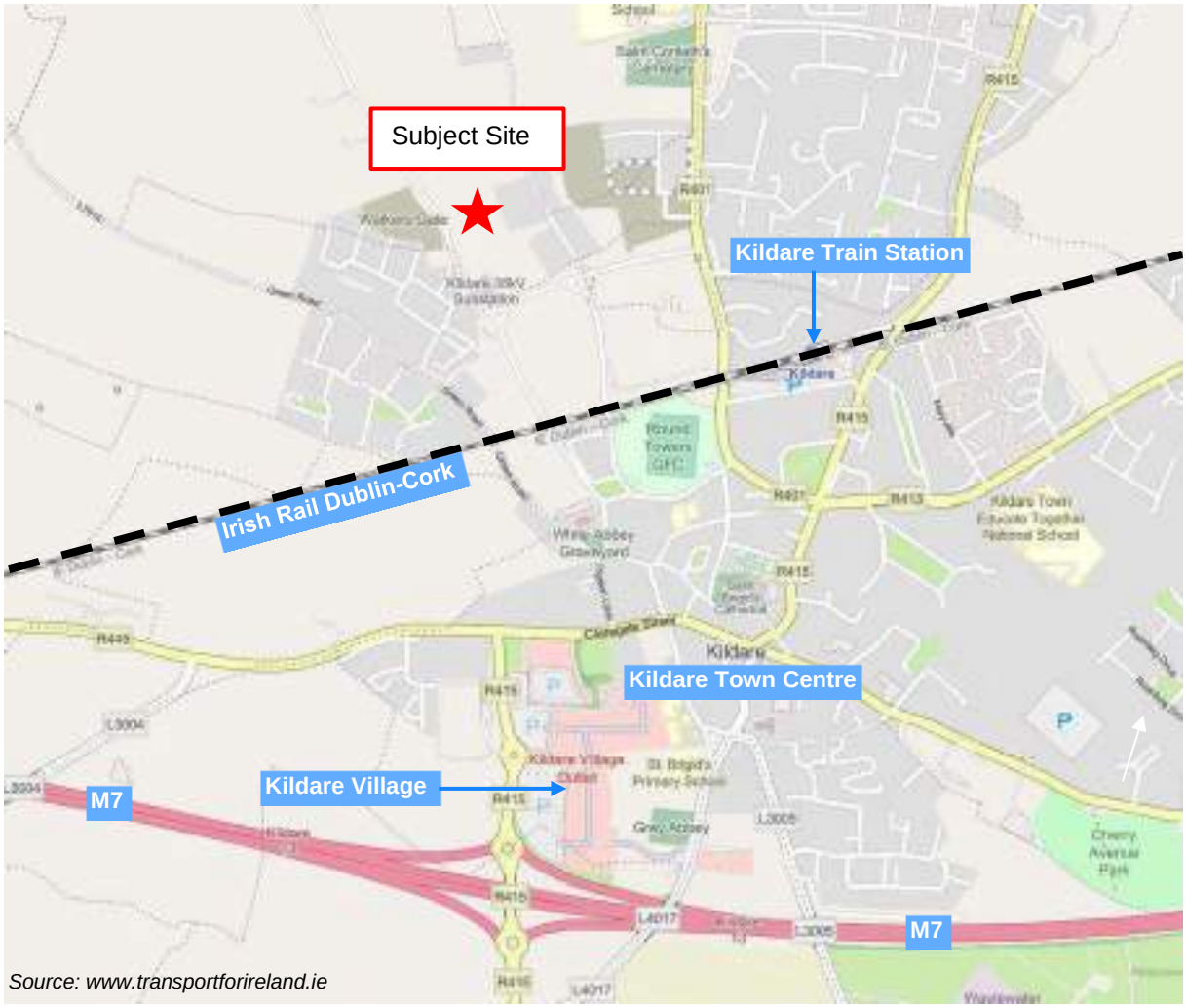


Figure 2-1: Site Location Map

An aerial view of the subject site can be seen in Figure 2-2, below.

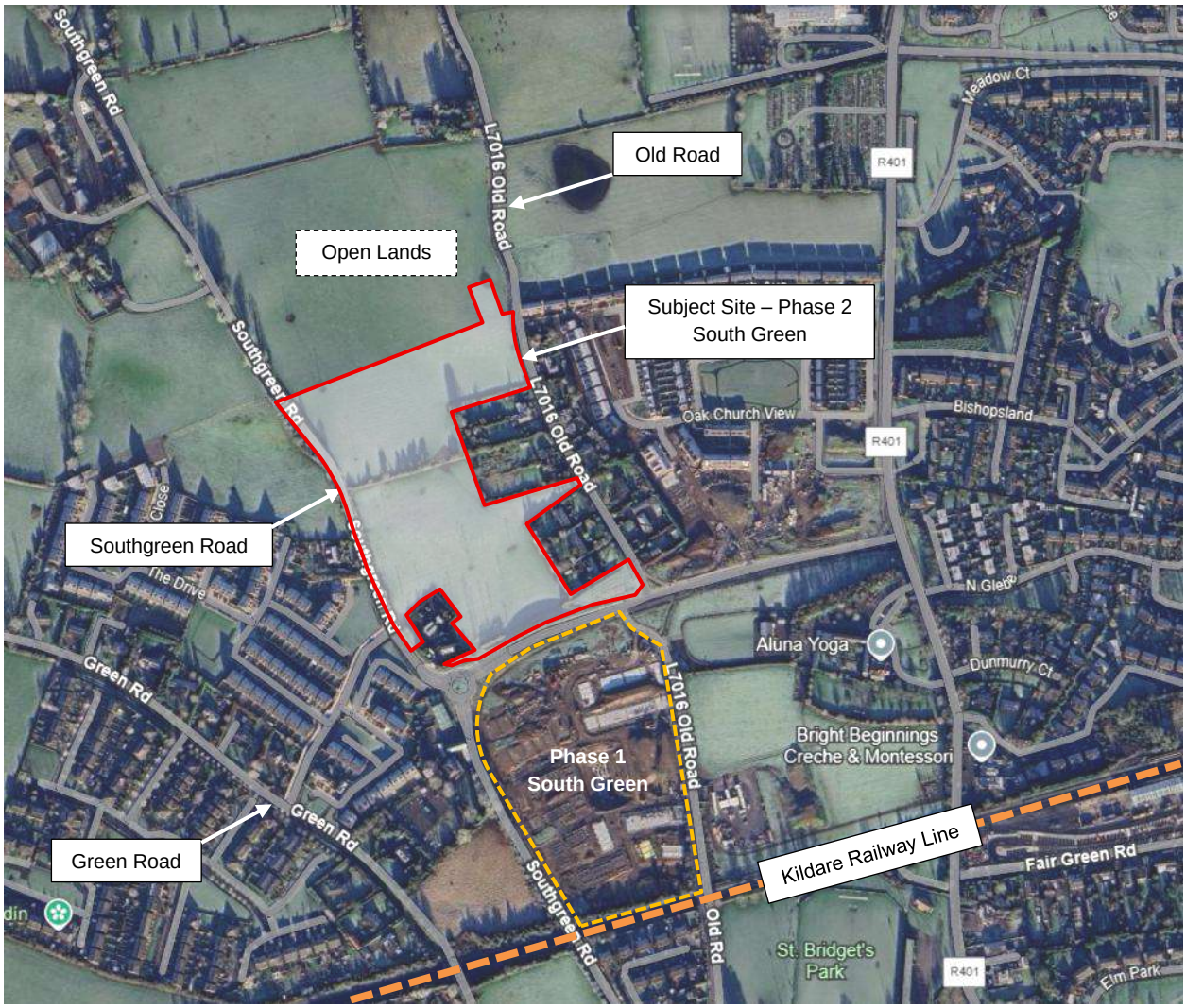


Figure 2-2: Aerial View of Subject Site (Google Maps)

2.2 Existing Site Description

The site has an area, and redline boundary, of c. 5.74 ha and is currently 100% greenfield. The site falls from west to east with a steep gradient of approximately 1 in 25, and less. The site is currently in greenfield condition and is used for agricultural purposes.

The existing topography consists of naturally high ground elevations along the western boundary of the site, with levels ranging from 111.19m OD Malin to 113.79m OD Malin. The site falls to the east where the lowest ground elevations are distributed, these levels range from 106.85m OD Malin to 104.03m OD Malin. The local high point on the site (113.79m OD Malin) is located in the northwest portion of the lands and the local low point (104.03m OD Malin) is located in the central far east area of the lands.

Refer to Figure 2-3 for an illustration of the subject site and existing ground elevations within same.

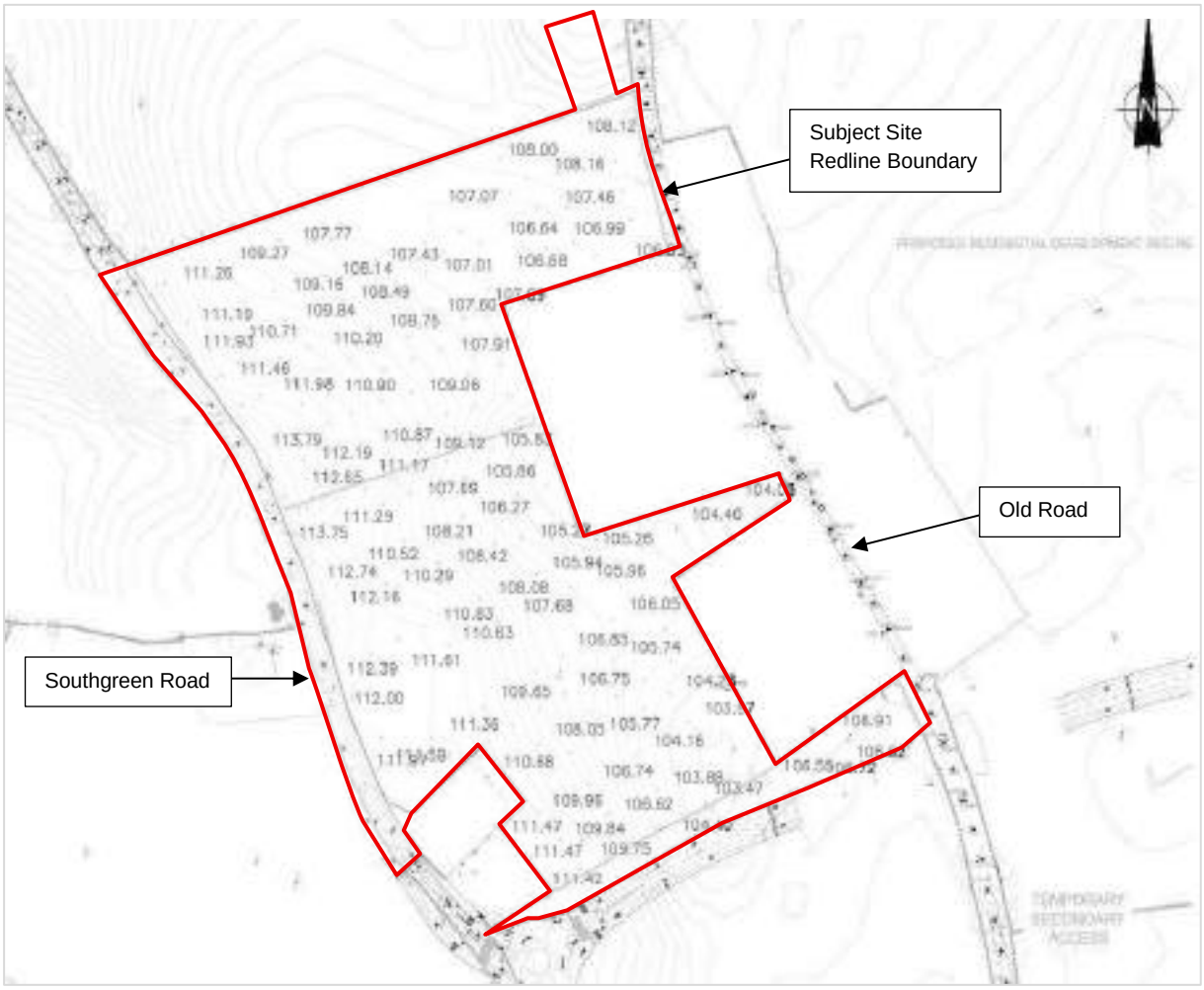


Figure 2-3: Subject Site Topography and Spot Elevations

2.3 Land Use – Zoning

According to Map 11. Land Use Zoning retrieved from the Kildare Town Local Area Plan (LAP) 2023-2029 Appendix Maps; the subject lands are zoned as C_{P2}, with 'C' denoting lands zoned for 'Phase 2 New Residential' developments. The current zoning map has taken effect from December of 2023 and will be valid until December of 2029.

The objective of this land use zoning, as taken from the Kildare Town LAP (2023-2029) in as follows:

"To protect future development lands from inappropriate forms of development which would impede the sequential expansion and consolidation of the town in terms of providing for new residential development for future plans."

Refer to Figure 2-4 for an extract of the Land—Use Zoning Map of Kildare Town and the subject lands.

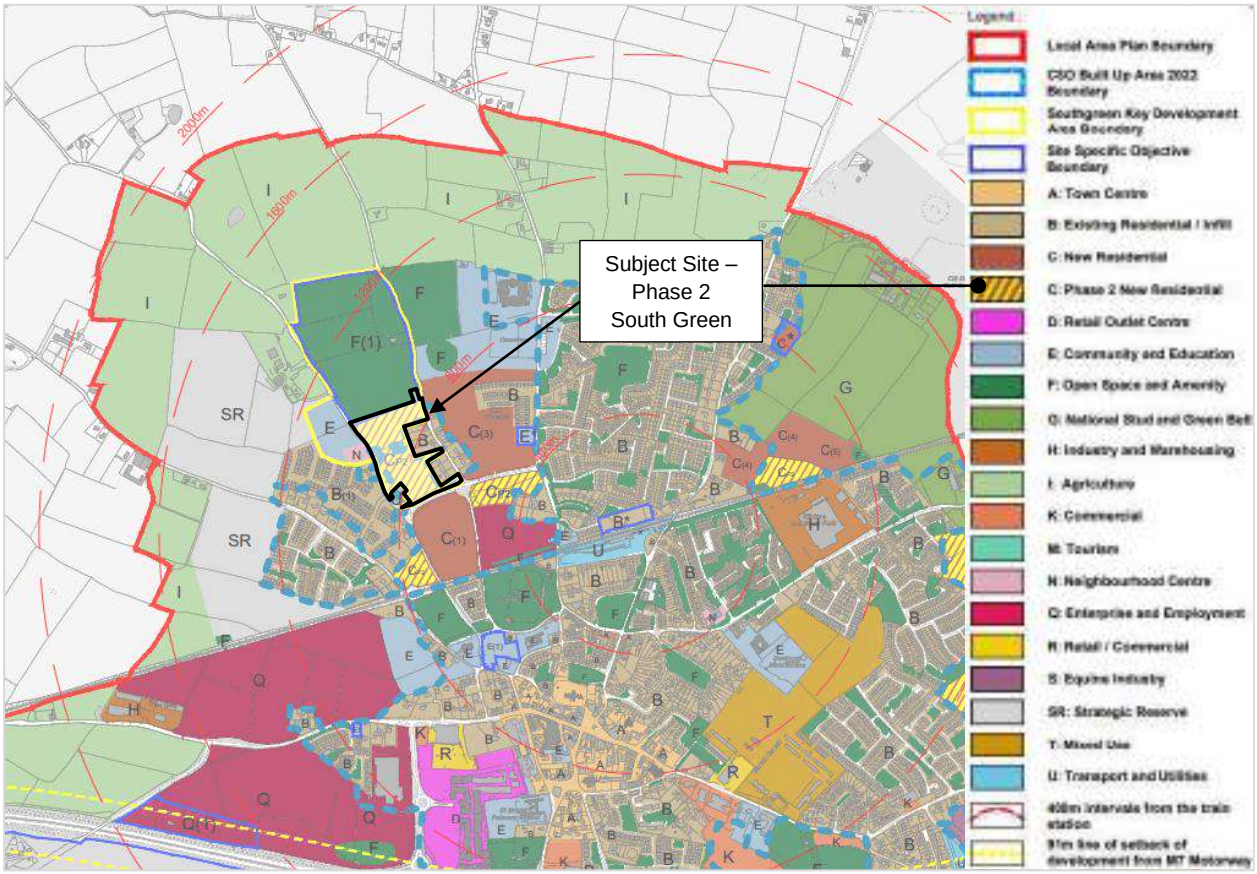


Figure 2-4: Extract of Land-Use Zoning Map (Kildare LAP Map 11.1)

2.4 Southgreen Key Development Area

As per the Kildare Town LAP (2023-2029), the Southgreen area falls under a design strategy seeking to implement the '10-minute settlement'. The following is extracted from Section 11.2 of the Kildare LAP:

"*The design strategy seeks to implement the '10-minute settlement' principle by providing for a range of complementary land uses (residential, open space and employment) within walkable distance of a centrally located neighbourhood centre and adjacent primary school site (see Figure 11-3). The neighbourhood centre will front onto a landscaped civic plaza which will provide a focal point for the expanding Southgreen area, imparting a sense of legibility and identity to residents and visitors alike. Crucially, the design framework incorporates key links and connections to future urban expansion lands to the west, which are zoned SR: Strategic Reserve in the Plan*."

Figure 11-3 of the Kildare Town LAP shows the Southgreen key development area design framework as intended and has been extracted to Figure 2-5, below. As per Figure 2-5, the subject lands are earmarked for several residential blocks, local routes, and strategic open spaces with a large open space proposed directly north of the subject lands. According to the Kildare Town LAP, the large quantum of strategic open space will provide for the long-term sporting and recreational of the growing community in Southgreen and also for the wider settlement. The indicative design / framework illustrates a layout of playing fields, five-aside pitches, and a playground.

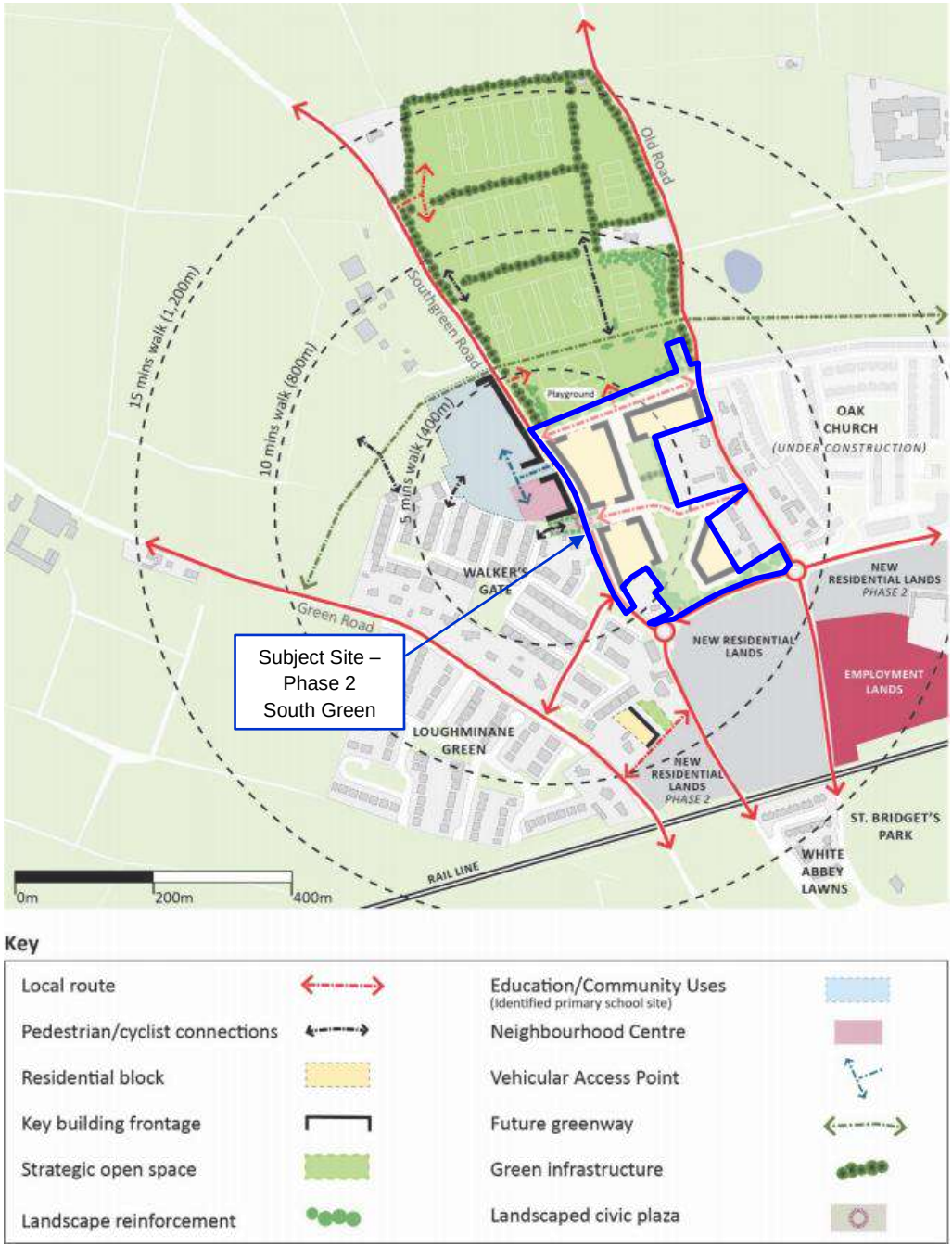


Figure 2-5: Southgreen Key Development Area Design Framework (Kildare Town LAP)

2.5 Proposed Development

Pousterle Limited intend to apply for permission for development of a Large - Scale Residential Development (LRD) on a site of approx. 5.74 ha at Southgreen Road, Kildare, Co. Kildare. The site is generally bounded to the north by agricultural fields; to the south by the recently constructed Southern

Internal Link Road; to the west by Southgreen Road and an existing Electricity Station; and to the east by Old Road and existing residential properties.

The proposed development will consist of:

- The construction of a new residential scheme of 153 no. house type units ranging in height from 1-2 storeys as follows:
  - 141 no. houses (4 no. 2 bed units; 107 no. 3 bed units; and 30 no. 4 bed units) in a mixture of bungalow, detached, semi-detached, and terrace style units.
  - 12 no. duplex apartment units (4 no. 1 beds and 8 no. 2 beds)
- Each residential unit will be afforded with private open space in the form of a front/rear/side garden.
- Public open space (approx. 7,214 sq m) is proposed in the form of 2 no. new large public open space areas within the site (approx. 3,401 sq m and 3,813 sq m respectively).
- A total of 332 no. car parking spaces (303 no. for residents and 29 no. for visitors). This provision includes 1 no. accessible visitor space and 29 no. standard visitor spaces. All residential spaces will be provided with EV charging on curtilage. Residential spaces off curtilage will also be provided with EV charging facilities. 4 no. EV visitor spaces will be provided.
- A total of 331 no. cycle parking spaces (260 no. for residents and 71 no. for visitors) are provided. Resident cycle parking is proposed in the form of secure bicycle store enclosures to the front of terraced units; on curtilage spaces to the rear of units with side access; and a bicycle store for duplex units. Visitor parking is proposed in the form of Sheffield stands.
- The development shall be served via a new vehicular access point from Southgreen Road. An additional private vehicular access point is proposed via Old Road to service 1 no. new bungalow 4 bed residential unit.
- Pedestrian and Cyclist access is also proposed via Southgreen Road and via a new secondary access point from the Southern Internal Link Road to the south of the site and Old Road to the east of the site.
- A double-lane cycle track and footpath are also proposed along Southgreen Road adjacent to the proposed scheme.
- The associated site and infrastructural works include provision for an ESB Sub Station; water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works; boundary treatment; internal roads and footpaths; waste storage areas, all electrical services and all associated site development works.

3. Foul Water Drainage

3.1 Introduction

The surrounding area in Kildare is serviced by Uisce Éireann with foul water infrastructure.

A Pre-Connection Enquiry (PCE) form with the proposed developments foul water demand requirements was submitted by Waterman Moylan to Uisce Éireann in December of 2024. A response in the form of a Confirmation of Feasibility (COF) Letter, with ref. CDS24010462, was received from Uisce Éireann on the 7th of February 2025. The COF stated the following regarding the foul water drainage connection for the proposed development:

"*Feasible without infrastructure upgrade by Uisce Éireann.*

- *Proposed connection to Uisce Éireann network is via Phase 1 of Southgreen Development Zone, south of the site. All the relevant Phase 1 wastewater infrastructure must be completed, of adequate capacity and connected to Dunmurray Road Pumping station, prior the connection*."

Given the requirement for planning submissions to include up-to-date COF's (within the past six months) from Uisce Éireann and that the schedule of accommodation at the time of submitting the original PCE was c. 150 No. units, an updated PCE including the quantum of currently proposed units (153 No.) has been submitted, and a response is currently awaited. It is expected that the updated COF will similarly state that the foul water connection is feasible.

3.2 Existing Foul Drainage

The Dunmurry Rd Wastewater Pump Station (WWPS) is located southeast of the subject site. The WWPS was constructed to accommodate foul flows from future development within the LAP lands north and west of the WWPS (including the subject site).

Existing foul drainage infrastructure information, location of manholes, cover levels, and invert levels, have been sourced from available Uisce Éireann QGIS data, the Uisce Éireann COF Letter, and available as-built information from the approved Phase 1 Southgreen development.

As part of the currently under construction South Green Phase 1 development, located directly south of the subject site, a 450mm diameter foul spine sewer will be installed to facilitate the foul connection for the Phase 2 subject site. Presently, an existing short segment of 450mm foul sewer is located below the road bisecting Phases 1 and 2, built to facilitate the foul connection between the phases. The short segment of foul sewer has an upstream manhole, located in Phase 2, with ref. no. F4-AS-BUILT, that has a cover level of 105.497 OD Malin and an invert level of 103.759 OD Malin, and a downstream manhole located in Phase 1 with a corresponding cover level of 107.421 OD Malin and an invert level of 103.621 OD Malin.

Refer to Figure 3-1 for an indicative illustration of the existing 450mm spine foul sewer and proposed connection point from the subject development to the existing 450mm foul segment.

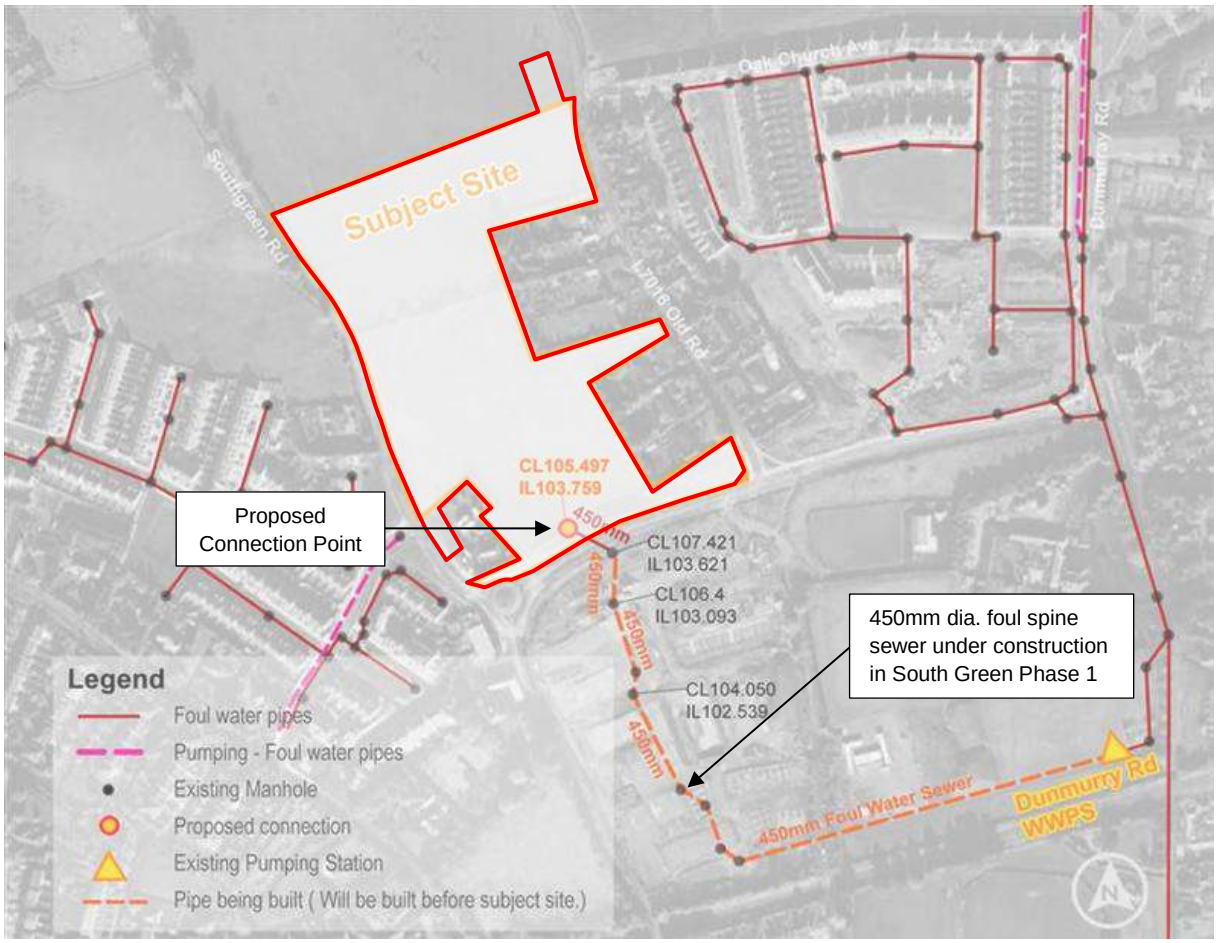


Figure 3-1 Indicative Sketch - Existing Foul Water Network

3.3 Existing Network Capacity

The ultimate outfall of the LAP lands foul sewer is the Kildare Town Wastewater Treatment Plant (WWTP) located south of the subject site. The WWTP was upgraded in 2013 to facilitate capacity expansion from 10,000 PE (population equivalent) to 28,000 PE.

Following the WWTP upgrades for the town of Kildare the following works were undertaken:

- Upgrading and integrating the existing foul / combined sewers.
- Constructing 3 no. new pumping stations, one of which incorporates storage.
- Installing approximately 3.2km of new sewers and rising mains.

According to the Central Statistics Office (CSO) Census, the town of Kildare had a population of 10,302 in the year 2022. According to the Kildare Town LAP, and based on the 2022 CSO data, the population and housing targets for the Plan (2023-20029) offers a population target of 11,682 persons estimated to the end of 2029. The WWTP offers a total capacity of 28,000 PE, which corresponds to an approximate available surplus capacity 16,318 PE (53% surplus capacity) above the estimated total population of 11,682 in 2029. There is theoretically more than adequate capacity in the public foul water network to accommodate the subject development.

Uisce Eireann publish an annual register of Wastewater Treatment Capacity on a County-by-County basis. The most recent register was published in December 2024 and reports that there is available capacity in the Kildare Town WWTP. Refer to Figure 3-2 for an extract of the register available online from water.ie. A “Green” indication of available capacity signals spare capacity in the system. However, it should be noted that according to Uisce Eireann this register provides wastewater treatment capacity information only and does not provide an indication of network capacity.

Final confirmation of capacity within the network is given in an Uisce Eireann COF Letter.



Region	County	Settlement	Wastewater Treatment Plant (WWTP)	Reg #	Indication of Available Capacity	WWTP Project Planned/Underway
EM	Kildare	Droichead Nua	ULLVSS WWTP Osberstown	D0002	- Green	
EM	Kildare	Naas	ULLVSS WWTP Osberstown	D0002	- Green	
EM	Kildare	Celbridge	LLVSS WWTP Leixlip	D0004	- Green	
EM	Kildare	Leixlip	LLVSS WWTP Leixlip	D0004	- Green	
EM	Kildare	Maynooth	LLVSS WWTP Leixlip	D0004	- Green	
EM	Kildare	Athy	Athy WWTP	D0003	- Green	
EM	Kildare	Kildare	Kildare Town WWTP	D0178	- Green	

Figure 3-2: Uisce Eireann Wastewater Treatment Capacity Register (Dec 2024)

3.4 Future Development of Lands

According to the Kildare Town Local Area Plan (LAP), the lands located to the north and northwest of the subject development are designated for future development. Currently, these lands are zoned for educational, and community uses, a neighbourhood centre, and active green space. However, it is possible that a significant portion of these lands may also be proposed for residential development.

Based on the total area available, it is estimated that up to 2,100 No. residential units could potentially be accommodated. As a preliminary estimate, these future developments could generate an additional daily wastewater load of approximately 952 m^3/day, corresponding to a projected population of 6,345 persons.

These figures are indicative only and are intended to provide an estimate of the potential additional future flows that may need to be accommodated within the public foul drainage system. Accounting for the potential future development and population of the lands to the north and northwest, the WWTP capacity of 28,000 PE remains more than sufficient to serve the overall population.

The foul water network required to serve these future developments will need to be designed as part of the Phase 2 subject development, ensuring connectivity to the system at the northern boundary of the Phase 2 subject lands. As such, a 375mm diameter spine sewer is proposed as part of the subject development.

3.5 Proposed Foul Drainage Calculation

It is proposed to connect the subject site’s foul drainage into the existing 450 mm diameter gravity foul network south of the site, currently being constructed as part of the South Green Phase 1 development.

The connection will be made at the existing foul water manhole located on the south of the subject site with ref. F4-AS-BUILT. The proposed connection point is indicated in Figure 3-1.

The spine sewer to be laid in a north-south direction through the subject site will be 375mm in diameter to cater for potential future development of the lands to the north and northwest of the subject development.

The subject site's proposed foul network will ultimately outfall at the Kildare Wastewater Treatment Plant (WWTP) located c. 1.6 km from the site. The Kildare WWTP, as mentioned, has a current capacity of 28,000 Population Equivalent (P.E).

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0200 - *Proposed Drainage Layout* for the proposed foul drainage layout.

Based on the Uisce Éireann Code of Practice, the peak foul flow from the proposed development will be as outlined in Table 3-1.

Table 3-1: Calculation of Proposed Foul Water Flow

Description	No. of Units	Flow (ℓ/h/day)	Population per Unit	Infiltration Factor	Total Discharge (ℓ/d)
Residential Development	153 No.	150	2.7	1.1	61,965

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge (from above table)	61,695	ℓ/d
Dry Weather Flow (DWF)	0.72	ℓ/s
Peak Foul Flow (= 6 x DWF)	**4.30**	**ℓ/s**

The total dry weather flow generated from the proposed development is 0.72 ℓ/s and the peak foul water flow generated from the development is calculated as 4.30 ℓ/s, with a proposed outfall from the development as 1 No. 375 mm diameter pipe laid at a minimum gradient of 1:300.

The outfall pipe has a capacity of 115 ℓ/s and is thus adequate to cater for the proposed development and future developments discharge of foul flows.

3.6 Foul Drainage Network Design

Foul water sewers will consist of uPVC or concrete socket and spigot pipes (to IS 6) and will lay strictly in accordance with the Uisce Éireann Code of Practice for Wastewater Infrastructure and requirements for taking charge.

The design of the subject site's foul water drainage network will incorporate 150 mm and 225 mm diameter pipes and a 375mm diameter spine sewer. The installation of these pipes will adhere to the requirements outlined in Uisce Éireann's Wastewater Standards and Code of Practice.

4. Surface Water Drainage

4.1 Introduction

The 5.74 ha subject site is entirely greenfield, with no civil services currently installed within its boundaries. The surface water management strategy for the proposed development has been prepared with reference to the Kildare Town Local Area Plan and related surface water addendum documents, the Greater Dublin Strategic Drainage Study (GDSDS), and the Kildare County Council (KCC) Sustainable Drainage Systems (SuDS) Guidance Document.

The surface water management strategy has been carefully developed to incorporate nature-based Sustainable Urban Drainage Systems (SuDS) features throughout the site. These elements are integrated into the overall drainage network to facilitate natural attenuation, promote infiltration, and support water quality improvements. Features such as swales, permeable paving, bio-retention tree pits, above ground detention basins and below ground infiltration attenuation areas have been strategically located across the development to manage runoff at source, reduce flow rates, and mimic the site's natural hydrological processes. This approach not only addresses surface water quantity and quality but also enhances local biodiversity and contributes positively to the site's visual and ecological character.

4.2 Hydrology and Flood Risk

According to a Surface Water Study undertaken by RPS and commissioned by KCC, the subject lands are located within the Tully Stream watercourse catchment, and, historically drained in a west-east and north-south direction to the Tully Stream located c. 2 km south, which is further south of the M7 located in Tully. The Tully Stream ultimately discharges into the River Barrow. Upgrades to the overall Kildare Town surface water networks have taken place to reroute runoff along the M7, however, and not under the M7 towards the Tully Stream.

The Kildare Town Local Area Plan 2023-2029 – Strategic Flood Risk Assessment (SFRA) indicates no areas in the town of Kildare are at risk of flooding from coastal or fluvial sources and that the town in its entirety is within Flood Zone C. The assessment does however identity specific areas in the town which are at risk of pluvial flooding (i.e. flooding caused by high intensity overland rainfall). These identified areas as outlined in Map 10.2 of the Kildare Town LAP (2023-2029) Appendix A Maps, require a site-specific flood risk assessment at development management stage.

Refer to Figure 4-1 below for an extract of this map. As can be seen from the below figure, a portion (northeast corner) of the subject lands is identified as a development at risk of pluvial flooding and as such will require a site-specific flood risk assessment. Flood risk at the subject lands is discussed in detail within the Waterman Moylan Flood Risk Assessment, submitted as part of this application under a separate cover.

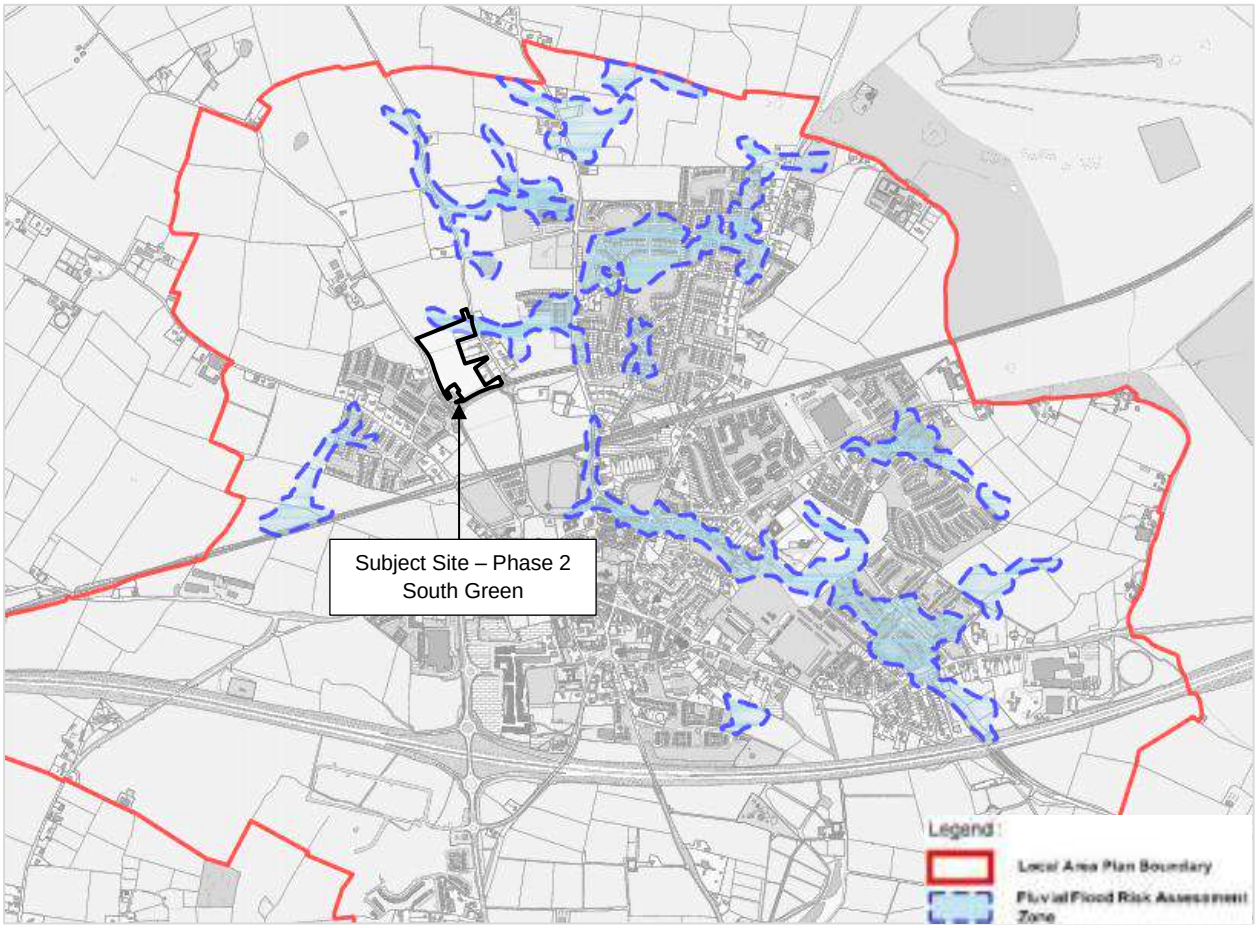


Figure 4-1: Areas requiring a Strategic Flood Risk Assessment due to Potential Pluvial Flooding

4.3 Stage 1 and 2 Surface Water Study (Kildare County Council)

A detailed Stage 1 and Stage 2 Surface Water Study was commissioned by Kildare County Council (KCC) and undertaken by RPS for the town of Kildare. The Stage 2 Surface Water Study was completed in February of 2023. The studies identify sustainable surface water management strategies for the town of Kildare with particular focus on prioritising nature-based solutions where possible, designating areas where surface water can be managed, identifying opportunities for inclusion of additional surface water attenuation facilities, identifying where existing infrastructure connections are located and where future systems can outfall to, and considering the amenity potential and value for any surface water solution within the town of Kildare.

Kildare Town was divided into 6 No. surface water subcatchment areas within the study for individual assessment. The subject lands are located within surface water subcatchment no. 5. Figure 11 from the Stage 2 Surface Water Study, extracted to Figure 4-2 below, shows the extent and assessment of subcatchment no. 5.

The study outlines its own reference system to zoned lands within the town of Kildare, different to that of the Kildare LAP Land Use Zoning Map. The reference system uses alphabetic identifiers for each zoned area called ‘Site ID’s”. According to the study the zoned sites are as follows:

- H - Southgreen (5.73 Ha) – zoned employment
- I - West of Dunmurray Road (5.73 Ha) – zoned residential
- K - West of Old Road (4.53 Ha) – zoned residential
- O - Between Old Road and South Green Road (11.59 Ha) – zoned residential

The subject lands are located within the residential Site “O”. Figure 4-2 illustrates Site O by dark hatching and the subject lands are shown in the figure by the blue dashed outline.

According to the study the subject lands have been earmarked for the surface water runoff to discharge at a Potential Nature-Based Management Area (NBMA). The location of these management areas can be seen by blue flower icons shown in Figure 4-2. The management area for which the subject lands is proposed to drain is an existing pond located northeast of the site.

The subject lands are not located directly adjacent to the designated NBMA, and third-party lands lie between the subject site and the NBMA to both the north and east. As such, it is not feasible to design a direct connection from the proposed development’s surface water network to the NBMA without either obtaining third-party consent or undertaking a detailed surface water drainage design for the intervening lands.

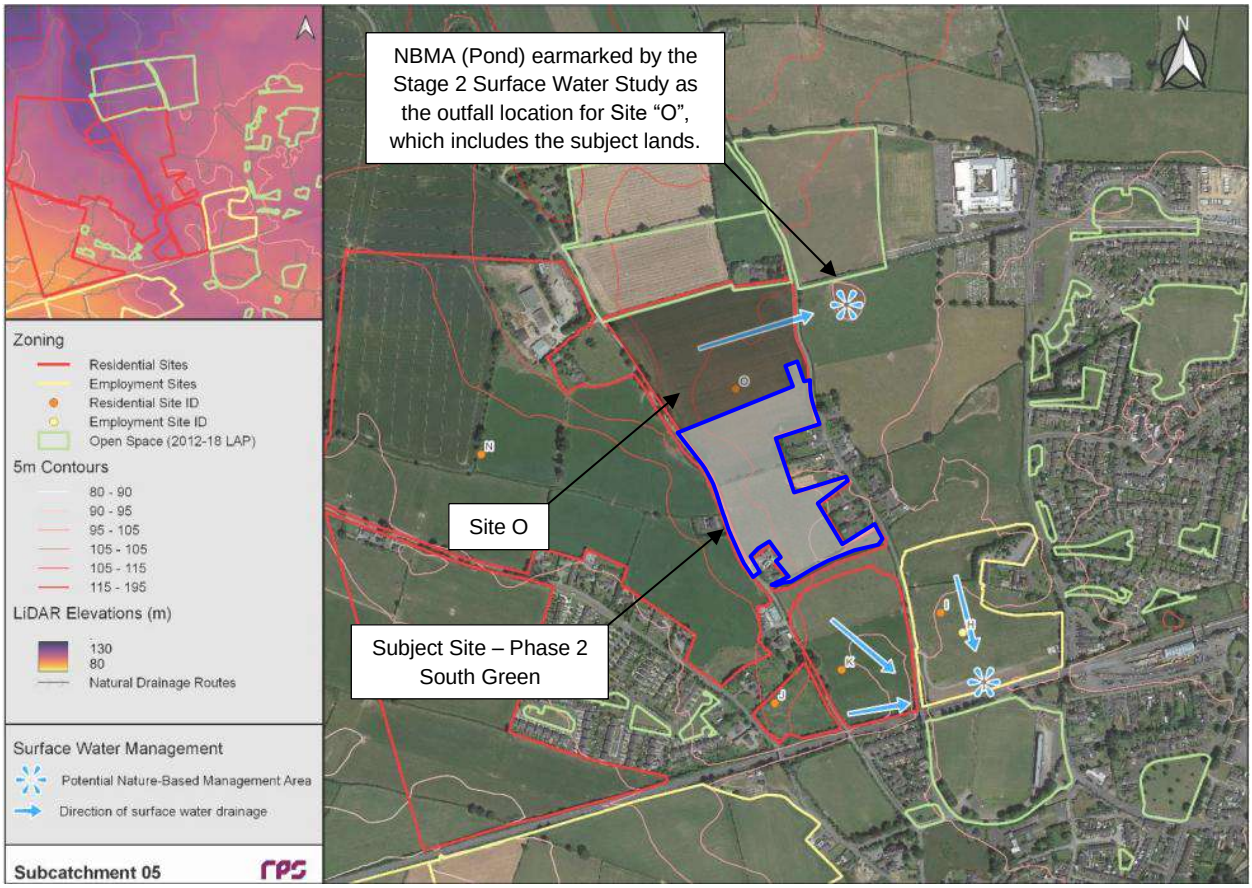


Figure 4-2: Subcatchment 05 (Stage 2 Surface Water Study, KCC)

It is noted that this zoning strategy aligns with the Kildare LAP that has zoned the subject lands as *Phase 2 - New Residential* (refer to Figure 2-4 for details).

4.4 Existing Surface Water Drainage

According to the available Uisce Éireann QGIS database, no existing surface water infrastructure is present near the subject lands. According to the Stage 1 Surface Water Study, the majority of areas in the vicinity of the subject lands north of the Kildare Railway Line discharge surface water to the ground via infiltration with lands south of the railway discharging to the ground, to a combined network discharging to the Tully stream, or via discharging to the M7 surface water network.

4.5 Subject Lands Soil Characteristics

A detailed hydrogeological investigation of the subject lands will be undertaken to provide an understanding of the groundwater system within the lands. The infiltration rate of the soil will be established from the hydrogeological assessment at 3 No. locations corresponding with the proposed attenuation systems (infiltration areas).

The preliminary design of the below ground infiltration systems is based on the assumption of a 2 m-deep gravel layer present within the underlying strata. Supporting data has been drawn from the adjacent South Green Phase 1 development, situated directly to the south of the subject site. Site investigations from Phase 1 have indicated an infiltration rate of 1×10^{-5} m/s, which has been used to inform and guide the initial design approach for the proposed infiltration systems.

As mentioned, a hydrogeological investigation will be carried out to verify the underlying soil conditions prior to the submission of the planning application for the subject development. The final design of the infiltration systems will be informed by and reflect the findings of this investigation.

4.6 Existing Flow Route Analysis

Expanding on Chater 2.2 of this report, the topography of the site includes steeply sloped lands, generally from west to east, with a small portion of the northeast corner of the lands sloping from northeast to southwest. Refer to Figure 4-3 for a map of the subject lands showing the proposed site layout, natural contours, a selection of existing spot elevations, and arrows indicating the slope direction of the existing lands. It is noted that the arrows also represent the existing flow route analysis of the lands (the natural path of rainfall runoff falling on the subject lands).

Two key aspects of designing levels for the proposed development (designed road levels and finished floor levels) include analysing the natural contours of the site to minimise cut-and-fill operations as far as practically possible, i.e. working with the natural slopes of the land, and, ensuring positive drainage, i.e. designing roads to allow for efficient surface water runoff, avoiding low points that may cause ponding, and ensuring appropriate exceedance flow routes through the development in the event of a flood.

Surface water catchments are designed based on the proposed flow paths generated within the development as a result of the designed levels and on the proposed location of the attenuation areas within green spaces. The proposed site levels have been designed to incorporate flood routing / exceedance flow overland within the internal roads network, conveying the rainfall runoff external to the site and away from proposed residential dwellings and structures in the event of an extreme rainfall event. Based on the flow paths through the development, 3 No. surface water catchments are proposed for the subject lands, as discussed in the following section.



Figure 4-3: Existing Ground Contours of the Subject Lands (Existing Flow Route Analysis)

4.7 Proposed Surface Water Catchments

Due to the site topography and the location of the strategic open green space areas, 3 No. surface water sub-catchments have been designed for the subject development. The total area of the subject lands is c. 57,500 m^2 of which 55,181 m^2 represents the total surface water catchment area of the proposed development. The details of the 3 No. sub-catchments are included below:

- Catchment A – South

The catchment has a total area of 16,439 m^2 and is proposed to discharge into an attenuation system located at the southeast green space area of the development. The total impermeable area of this catchment is 6,920 m^2 correlating to a percent hardstanding of 42%.

Catchment A drains the southern portion of the development, draining c. 29.8% of the subject lands' surface water catchment area.

- Catchment B – Central

The catchment has a total area of 20,353 m^2 and is proposed to discharge into an attenuation system located at the central green space area of the development. The total impermeable area of this catchment is 12,310 m^2 correlating to a percent hardstanding of 60.50%.

Catchment B drains the central portion of the development, draining c. 36.9% of the subject lands' surface water catchment area.

- Catchment C – North

The catchment has a total area of 18,389 m^2 and is proposed to discharge into an attenuation system located at the southeast green space area of the development. The total impermeable area of this catchment is 11,170 m^2 correlating to a % hardstanding of 60.74%.

Catchment C drains the northern portion of the development, draining c. 33.3% of the subject lands' surface water catchment area.

Refer to Figure 4-4 for an illustration of the extent of the 3 No. surface water sub-catchments.

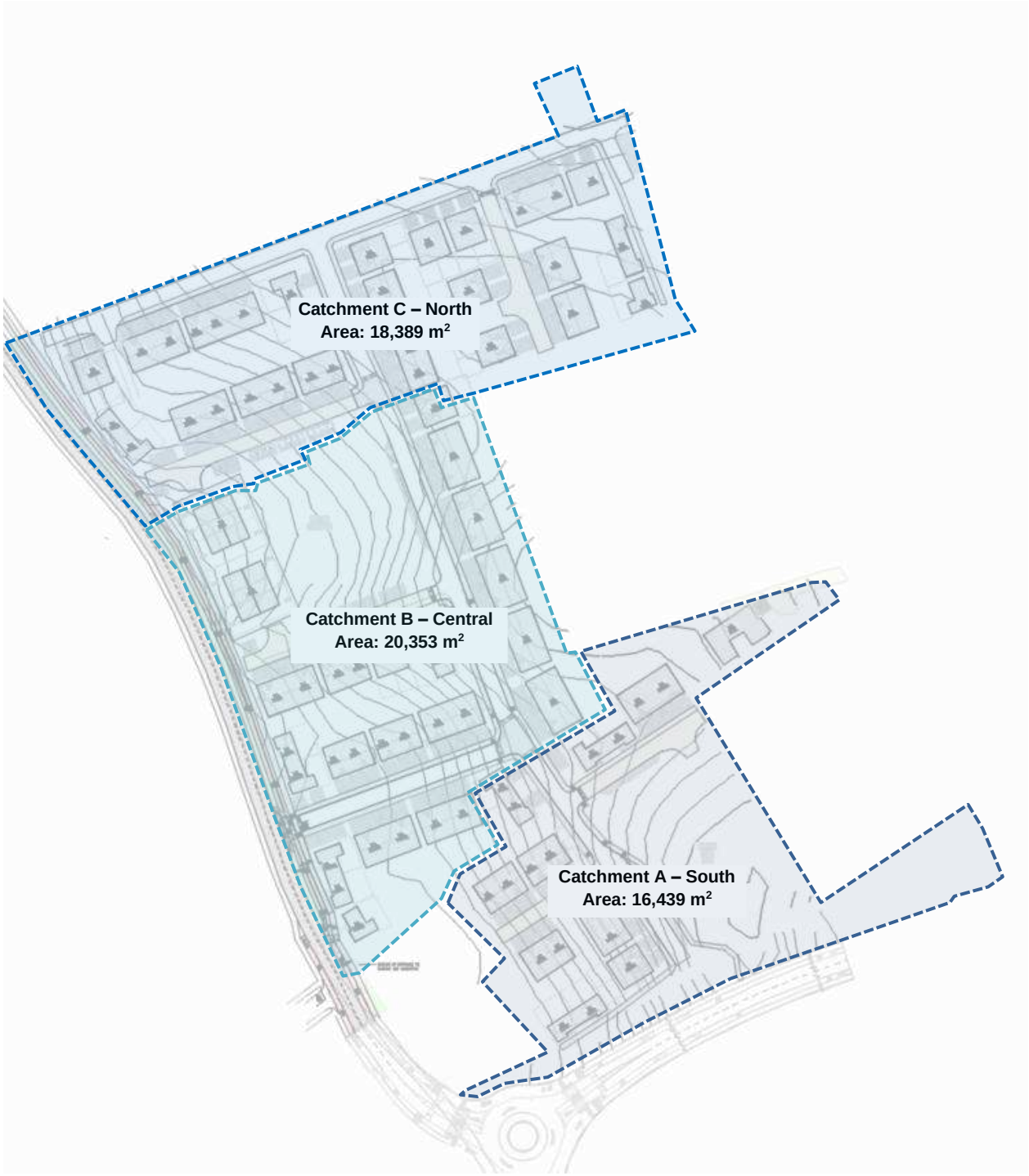


Figure 4-4: Subject Site Surface Water Sub-Catchments, Contours, & Spot Elevations

4.8 Proposed Surface Water Drainage Strategy

It is proposed, similar to Phase 1 South Green, to discharge surface water from the subject site to the ground via. Infiltration. It is proposed to incorporate 3 No. attenuation systems, 1 No. system per sub-catchment. The attenuation systems will comprise of an above ground detention basin and below ground infiltration area, located within an open green space area adjacent to or within the corresponding sub-catchment.

By allowing surface water to naturally percolate into the soil as the main surface water attenuation strategy, this strategy not only mimics the pre-development hydrological cycle but also significantly reduces runoff volumes, lowers flood risk, and supports groundwater recharge. Given Kildare Town's geology and the increasing emphasis on sustainable development, prioritising infiltration to ground as the main surface water attenuation method offers a low-impact, long-term solution that enhances local resilience to climate change while promoting biodiversity and water quality improvements. This nature-based approach aligns with national SuDS guidance and Kildare's commitment to environmental stewardship.

The attenuation systems are sized to accommodate the extreme 1-in-100-year storm event with 30% climate change and 10% urban creep allowances included, as per KCC requirements. The final design of the infiltration systems will be informed by and reflect the findings of hydrogeological investigation undertaken for the subject lands.

As mentioned, it is proposed that the surface water runoff for the development will be intercepted, collected, slowed, and attenuated through the use of nature-based rainwater management and SuDS features. The SuDS features proposed for the subject site are summarised below:

- Permeable paving at private parking / driveways.
- Bio-retention tree pits used in strategic public areas within landscaping and adjacent to hardstanding areas such as the internal roads network.
- Swales located adjacent to footpaths or the internal roads network to collect rainfall runoff from same.
- Above ground attenuation basins for each sub-catchment to facilitate above ground rainfall storage.
- Below ground infiltration systems for each sub-catchment to facilitate infiltration to ground.

These SuDS features will also add value to the biodiversity potential of the development.

The images taken from the KCC Sustainable Drainage Systems Guidance document, shown below in Figure 4-5, illustrate already constructed robust and aesthetically pleasing nature-based solutions in the form of permeable surfacing at car parking spaces / driveways and a well-established detention basin in a public open space.



Figure 4-5: Constructed Permeable Paving and Detention Basin (KCC SuDS Guidance Document)

The flow of rainfall runoff both overland and within the surface water network to the relevant discharge points (infiltration systems), which represents the modified flow analysis, is indicatively illustrated in Figure 4-6, below.

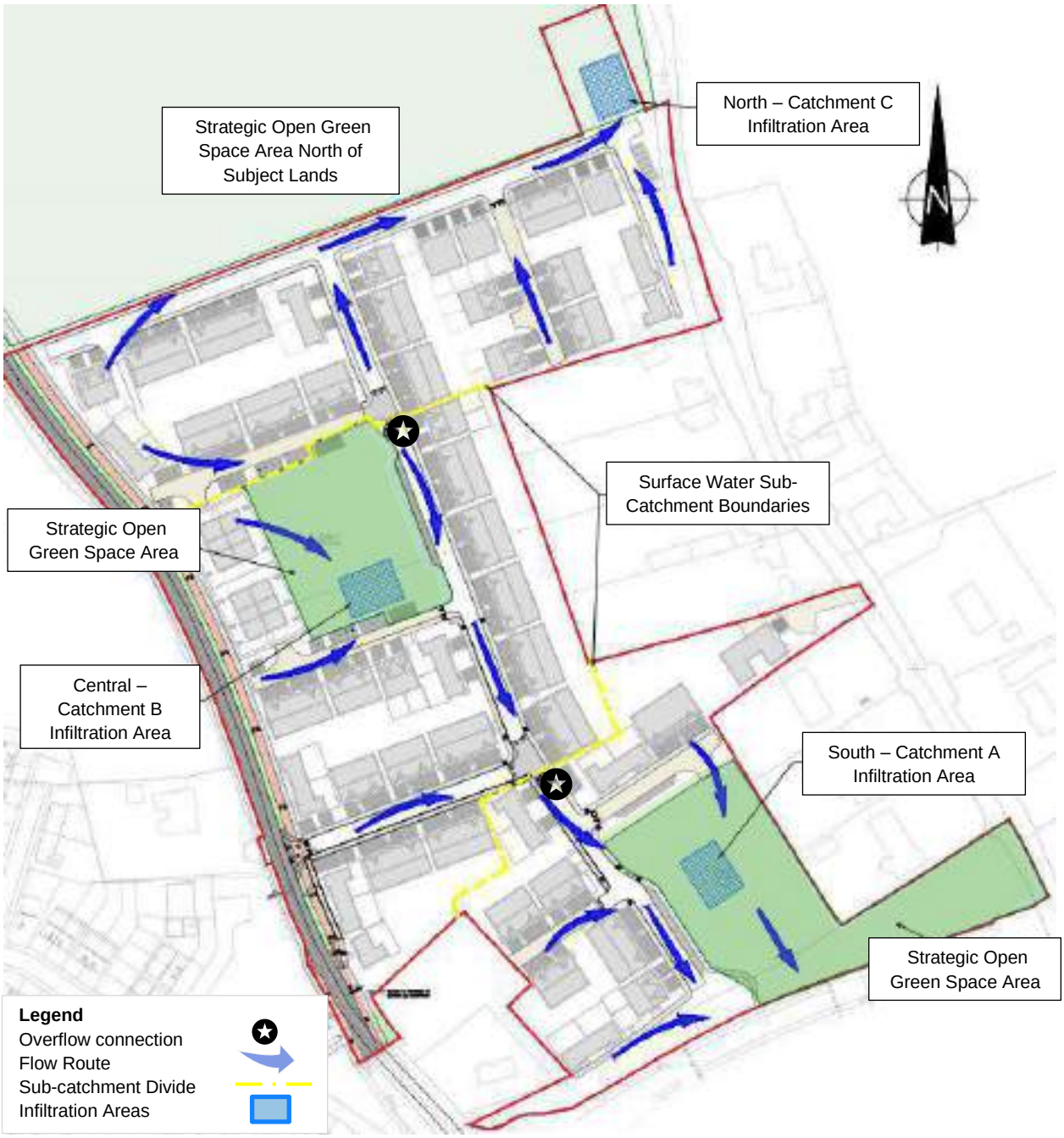


Figure 4-6: Indicative Sketch of Surface Water Flow Paths in Sub-Catchments (Modified Flow Analysis)

As discussed in Chapter 4.3 of this report, the Stage 2 Surface Water Study commissioned by KCC identifies an existing pond located northeast of the development as the nominated Nature-Based Management Area (NBMA) for Site O, within which the subject lands are located.

The primary method of rainfall runoff treatment for the proposed development is infiltration to ground. It is proposed that flood volumes up to and including the 1-in-100-year storm event, with an additional 30% allowance for climate change, will be managed entirely through infiltration. The system will provide online

storage through a combination of swales, permeable paving, bio-retention tree pits, detention basins, and infiltration systems, all designed to accommodate the full long-term storage volume required for the site.

2 No. overflow pipes will be provided between:

- The Southern Catchment A and Central Catchment B;
- The Central Catchment B and the Northern Catchment C.

The overflow pipes are proposed to provide additional resilience in the event of a storm exceeding the design capacity of the surface water network. The 2 No. connections will operate as a below-ground relief mechanism, distinct from above-ground controlled exceedance routes, connecting the entirety of the surface water network and allowing runoff to flow northwards towards the existing pond and the area of the proposed NBMA. It is noted however that the subject lands are not located adjacent to the NBMA and third party ownership lands are located between the subject lands and the NBMA. As such, it is not possible to design a direct connection into the NBMA. Refer to Figure 4-6 for the location of the overflow connections between the sub-catchment, represented by a circle/star symbol.

4.9 Surface Water Calculations

It is proposed to discharge the subject developments surface water runoff to the ground via. infiltration within 3 No. attenuation systems, 1 No. per sub-catchment. As no surface water runoff from the subject development is proposed to be discharged into a public watercourse or network, the pre-development or Greenfield Run-off Rate for the subject lands is not applicable to the surface water design. The rainfall runoff will discharge into the underlying soils at the natural infiltration rate.

4.10 Proposed Surface Water Storage

4.10.1 Introduction

Where infiltration is feasible - long-term storage is achieved by allowing water to soak into the ground, providing a sustainable and low-impact drainage solution in line with SuDS best practices.

Long-term storage through infiltration to ground represents the most sustainable and preferred approach to surface water management on this site, aligning with both Kildare County Council's SuDS policies and the GDSDS principles. By allowing runoff to mimic natural drainage pathways and infiltrate locally, infiltration systems provide a direct link to the hydrological cycle, reducing runoff volumes at source, protecting water quality, and recharging groundwater.

Unlike more engineered solutions, infiltration removes the need for long-term reliance on downstream infrastructure and supports the "source control first" philosophy central to both Kildare's and the GDSDS's SuDS hierarchy. In essence, where ground conditions allow, infiltration is not only the most sustainable option - it is the most resilient, cost-effective, and future-proofed strategy for managing surface water in a changing climate.

The subject development's surface water strategy has been designed with long-term storage as the primary attenuation method.

4.10.2 Required Storage Volume

The total area of the catchment, including roads, parking, footpaths, green areas, and storage containers, is approximately 5.74 ha, with a net hardstanding contributing area of 3.05 ha, which equates to c. 53% hardstanding area. The contributing impermeable areas are shown in Table 4-2.

It is proposed, in accordance with the recommendations of the Greater Dublin Strategic Drainage Study, that the 1-in-100-year critical design storm will be used for stormwater volumetric calculations (to establish on-site storage required) with a 30% additional allowance for climate change and 10% allowance for creep.

According to the FLOW model (Causeway software) of the full site's surface water attenuation storage, the site requires a total storage volume of c. 2,619 m^3 surface water for the critical storm event. Of the total storage volume, each sub-catchment requires the following volumes:

Table 4-1: Surface Water Attenuation Storage Required per Sub-Catchment

Sub-Catchment Identifier	Storage Volume Required (m^3)
Sub-Catchment A (Southern Catchment)	622 m^3
Sub-Catchment B (Central Catchment)	1,042 m^3
Sub-Catchment C (Northern Catchment)	955 m^3
Total Surface Water Attenuation Storage Required	**2,619 m^3**

Refer to Appendix B for the surface water model including the attenuation storage calculation, completed using FLOW (Causeway) Software, for the subject development.

4.10.3 Total Impermeable Areas

The impermeable area of the subject site is calculated by multiplying the contributing area type receiving rainfall with the respective runoff coefficient. The impermeable areas calculated for the subject development overall can be found in Table 4-2 with the impermeable areas per sub-catchment shown in Table 4-3, below.

Table 4-2: Contributing Impermeable Areas within the Subject Development

Contributing Area Type	Contributing Area (m^2)	Runoff Coefficient	Impermeable Area (m^2)
Green Spaces	26,680	0.2	5,336
Roads	6,400	0.9	5,760
Footpaths	3,130	0.9	2,817
Parking court/Permeable surfacing	3,580	0.9	3,222
Roof	13,400	1.0	13,400
Total Impermeable Area			**30,535 m^2**

Table 4-3: Contributing Impermeable Areas within each Sub-Catchment

Sub-Catchment Identifier	Contributing Area (m2)	% Hardstanding
Sub-Catchment A (Southern Catchment)	6,920 m^2	42.00 %

Sub-Catchment B (Central Catchment)	12,310 m^2	60.50 %
Sub-Catchment C (Northern Catchment)	11,170 m^2	60.74 %
Total Impermeable Area	**30,535 m^2**	

SuDS features are designed to intercept, store, slow, filter, and infiltrate runoff from these impermeable areas with the aim of:

- Reducing flood risk;
- Improving water quality;
- Encouraging groundwater recharge, and;
- Enhancing biodiversity and amenity.

The SuDS features proposed for the 3 No. sub-catchments of the subject development are discussed below.

4.10.4 Description of Proposed SuDS Features

The SuDS features proposed within the subject development are discussed below:

Permeable surfacing / paving

Permeable paving is proposed for the private parking areas / driveways to manage surface water runoff directly from these hard surfaces and from the residential dwellings roofs to reduce the risk of flooding. Downpipe collector drains can be routed from the roof gutters to connect into the below ground permeable paving driveways as an additional treatment process before discharging to the surface water mainline.

The storage layer of the permeable paving system has a depth of 350 mm and a void ratio of 0.3, meaning 30% of the storage volume consists of void spaces, allowing for effective water retention. This storage layer facilitates the management of stormwater by providing temporary detention, which helps to reduce peak runoff and promote gradual infiltration.

Bio-retention tree pits

Bio-detention tree pits are proposed adjacent to the internal roads network and footpath arrangements in the subject development. This SuDS feature will capture surface water runoff from the adjacent road and/or footpath, filtering and slowing the surface water within the pit before conveying it to the mainline network and attenuation storage area within each sub-catchment. The pits have been located within the public realm.

This SUDS feature is designed as 1m in depth, 1m in width & length, and has an associated voids ratio of 0.4.

Swales

A swale is a shallow, vegetated, linear depression designed to convey, store, and treat surface water runoff from adjacent impermeable surfaces such as roads, car parks, and footpaths. In line with KCC's SuDS principles, swales provide an effective means of managing runoff close to source while delivering water quality, quantity, and biodiversity benefits.

Swales are typically grass-lined or planted with low-maintenance, native vegetation, allowing for infiltration of surface water into the ground where soil conditions permit, or conveyance to downstream SuDS features such as the proposed detention basins and attenuation areas.

Above Ground Detention Basins

A detention basin is a normally dry vegetated depression designed to temporarily store surface water runoff during rainfall events and release it at a controlled rate to downstream systems. Unlike infiltration systems, detention basins do not typically allow water to soak into the ground, but instead attenuate flows and provide time for sedimentation and pollutant removal before discharge.

An above ground detention basin is proposed in each sub-catchment, located above the proposed infiltration areas. Where feasible, surface water runoff will be conveyed above ground directly into the detention basin. For runoff that enters the subsurface attenuation system, an open-grated manhole will be incorporated at the interface between the detention basin and infiltration area. This will allow exceedance flows during extreme storm events to discharge above ground, providing an additional overflow route from the infiltration system.

Infiltration Areas

An infiltration area is a subsurface or surface feature designed to temporarily store surface water runoff and allow it to infiltrate directly into the underlying ground, thereby reducing runoff volumes, attenuating peak flows, and supporting groundwater recharge.

In accordance with Ireland's SuDS guidance, infiltration systems are most effective when located close to the runoff source and are particularly suited to developments with permeable or moderately permeable soils, and where groundwater levels and contamination risks are suitably low.

The final design of the infiltration systems will be informed by and reflect the findings of this investigation.

4.10.5 SuDS Features Proposed per Sub-Catchment

The SuDS features proposed for sub-catchments A, B, C, are summarised in the tables to follow.

Table 4-4: Southern Catchment A - Details of Proposed SuDS Features

Southern Catchment A					
SUDS feature	Types of Contributing Areas	SUDS Feature Area (m^2)	Voids ratio	Depth (m)	Storage provided (m^3)
Permeable paving	Private driveways and residential roofs	510 m^2	0.3	0.35	37.8 m^3 (c.28.35 m^3)**
Bio-Retention Tree Pits	Roads, footpaths, green space areas	4 m^2	0.4	1.00	1.6 m^3
Swales	Footpaths, roads, green space areas	175 m^2	0.4	1.00	70.0 m^3
Detention Basin	Road, footpaths, roofs, green space areas	-	1.0	1.00	250.0 m^3

Infiltration Area	Road, footpaths, roofs, green space areas	-	0.95	2.00	315.0 m^3
Total Storage Provided in Catchment A					665 m^3

Note ** In reality, the storage offered by the permeable paving will be c. 0.75 x (total potential) due to the 1:40 slope of this SuDS feature.

A total of 4 No. of swales, 4 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed within Southern Catchment A.

Southern Catchment A requires a total attenuation storage volume of 622 m^3; this volume is achieved through the use of the above SuDS features which offer a total of 665 m^3 of storage.

The details of the proposed SuDS features within sub-catchment B are discussed below.

Table 4-5: Central Catchment B - Details of Proposed SuDS Features

Central Catchment B					
SUDS feature	Types of Contributing Areas	SUDS Feature Area (m^2)	Voids ratio	Depth (m)	Storage provided (m^3)
Permeable paving	Private driveways and residential roofs	830 m^2	0.3	0.35	124.3 m^3 (c. 93.23 m^3)**
Bio-Retention Tree Pits	Roads, footpaths, green space areas	11 m^2	0.4	1.00	4.4 m^3
Swale	Footpaths, roads, green space areas	105 m^2	0.4	1.00	42.0 m^3
Detention Basin	Road, footpaths, roofs, green space areas	-	1.0	0.50	350.0 m^3
Infiltration Area	Road, footpaths, roofs, green space areas	-	0.95	2.00	665.0 m^3
Total Storage Provided in Catchment B					1,155 m^3

A total of 2 No. of swales, 11 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed within Central Catchment B.

Central Catchment B requires a total attenuation storage volume of 1,042 m^3; this volume is achieved through the use of the above SuDS features which offer a total of 1,155 m^3 of storage.

The details of the proposed SuDS features within sub-catchment C are discussed below.

Table 4-6: Northern Catchment C - Details of Proposed SuDS Features

Northern Catchment C					
Permeable paving	Private driveways and residential roofs	1,438 m^2	0.3	0.35	201.3 m^3 (c. 151 m^3)**

Bio-Retention Tree Pit	Private driveways, green spaces areas, roofs	14 m^2	0.4	1.00	5.6 m^3
Swales	Footpaths, roads, green space areas	214 m^2	0.4	1.00	85.6 m^3
Detention Basin	Road, footpaths, roofs, green space areas	-	1.00	1.00	460.0 m^3
Infiltration Area	Road, footpaths, roofs, green space areas	-	0.95	2.20	420.0 m^3
Total Storage Provided in Catchment C					1,122 m^3

A total of 2 No. of swales, 14 No. tree pits, 1 No. detention basin, and 1 No. infiltration system are proposed within Northern Catchment C.

Northern Catchment C requires a total attenuation storage volume of 955 m^3; this volume is achieved through the use of the above SuDS features which offer a total of 1,122 m^3 of storage

Further details pertaining to the attenuation areas proposed in each sub-catchment is discussed below.

4.10.6 Attenuation Areas per Sub-Catchment

Southern Catchment A

- Above Ground Detention Basin Details

  An above ground detention basin is proposed within the open green space area located at the southeast corner of the proposed development. The basin has a bottom of bank level of 105.5 m OD Malin and a top of bank level of 106.5 m OD Malin; the basin is 1.0 m in depth.

  The total above ground storage volume provided by the basin is c. 250 m^3. The basin has side slopes of 1:4 and has been designed to ensure the top of water level (T.W.L) is at least 500 mm below the adjacent finished floor levels of the residential units. During the 1-in-100-year flood event, the T.W.L reaches 106.47 m OD Malin.

  The lowest adjacent FFL in the catchment is 107.40 m, resulting in the highest flood water level being 930 mm below the lowest FFL.

  The basin is located within an open green space amenity area and floods with up to 237 m^3 of rainfall runoff during the extreme 1-in-100-year storm event with 30% climate change.

- Below Ground Infiltration Area

  An infiltration trench system is proposed below the Southern Catchment A detention basin. The mainline surface water network will connect into the infiltration system before discharging into the above ground detention basin via. an open grate manhole, during extreme storm events. Where possible, runoff will be brought overland and into the above ground detention basin directly.

  The infiltration system is designed with 3 No. trenches, 2m deep, 2.5m wide, and 30m in length each. The porosity of this system is taken as 95%.

  The infiltration system holds 315 m^3 of runoff during the extreme 1-in-100-year flood event including 30% for climate change.

Central Catchment B

- Above Ground Detention Basin Details

  An above ground detention basin is proposed within the open green space area located at the central green space of the proposed development. The basin has a bottom of bank level of 107.35 m OD Malin and a top of bank level of 107.85 m OD Malin; the basin is 0.5 m in depth.

  The total above ground storage volume provided by the basin is c. 350 m^3. The basin has side slopes of 1:4 and has been designed to ensure the top of water level (T.W.L) is at least 500 mm below the adjacent finished floor levels of the residential units. During the 1-in-100-year flood event, the T.W.L reaches 107.73 m OD Malin.

  The lowest adjacent FFL in the catchment is 108.30 m, resulting in the highest flood water level being 570 mm below the lowest FFL.

  The basin is located is located within an open green space amenity area and floods with up to 329 m^3 of rainfall runoff during the extreme 1-in-100-year storm event with 30% climate change.

- Below Ground Infiltration Area

  An infiltration trench system is proposed below the Central Catchment B detention basin.

  The mainline surface water network will connect into the infiltration system before discharging into the above ground detention basin via. an open grate manhole, during extreme storm events. Where possible, runoff will be brought overland and into the above ground detention basin directly.

  The infiltration system is designed with 5 No. trenches, 2m deep, 2.5m wide, and 28m in length each. The porosity of this system is taken as 95%.

  The infiltration system holds 665 m^3 of runoff during the extreme 1-in-100-year flood event including 30% for climate change.

Northern Catchment C

- Above Ground Detention Basin Details

  An above ground detention basin is proposed within the future strategic green open space area north of the development, at the northeast corner to the site. The basin has a bottom of bank level of 105.0 m OD Malin and a top of bank level of 106.0 m OD Malin, the basin is 1.0 m in depth.

  The total above ground storage volume provided by the basin is c. 460 m^3. The basin has side slopes of 1:4 and has been designed to ensure the top of water level (T.W.L) is at least 500 mm below the adjacent finished floor levels of the residential units. During the 1-in-100-year flood event, the T.W.L reaches 105.80 m OD Malin.

  The lowest adjacent FFL in the catchment is 107.35 m, resulting in the highest flood water level being 1.55 m below the lowest FFL.

  The basin is located is located within an area earmarked for future open green space amenity and floods with up to 444 m^3 of rainfall runoff during the extreme 1-in-100-year storm event with 30% climate change.

- Below Ground Infiltration Area

  An infiltration trench system is proposed below the Northern Catchment C detention basin.

The mainline surface water network will connect into the infiltration system before discharging into the above ground detention basin via. an open grate manhole, during extreme storm events. Where possible, runoff will be brought overland and into the above ground detention basin directly.

The infiltration system is designed with 4 No. trenches, 2.2m deep, 2.5m wide, and 30m in length each. The porosity of this system is taken as 95%.

The infiltration system holds 420 m^3 of runoff during the extreme 1-in-100-year flood event including 30% for climate change.

4.10.7 Summary of Surface Water Storage Provided in Attenuation Areas

A summary of the surface water storage provided in each of the attenuation areas during the extreme 1-in-100-year storm event (including 30% climate change) is included below:

Table 4-7: Storage Volume Provided during the 1-in-100-year extreme storm event

Sub-Catchment	Detention Basin	Infiltration System	Total
Southern Catchment A	250 m^3	315 m^3	565 m^3
Central Catchment B	350 m^3	665 m^3	1,015 m^3
Northern Catchment C	460 m^3	420 m^3	880 m^3
Total Storage Provided			**2,435 m^3**

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0100 for the proposed layout.

Refer to Appendix B for the surface water model including the attenuation storage calculation, completed using FLOW (Causeway) Software, for Catchments A, B & C within the subject development.

4.11 Surface Water Network Design

Calculations for pipe sizes and gradients are based on surface water runoff from hardstanding areas such as the cycle tracks, storage containers, access road, the parking areas, and footpaths, using the Rational Method for surface water design (Bilhams Formula), with a storm return period (N) of 5 years.

Strict separation of surface water and wastewater will be implemented within the development. Drains will be laid in such a manner as to minimise the risk of inadvertent connection of waste pipes to the surface water system.

Surface water local drains will be a minimum of 150mm dia. and generally will consist of PVC (to IS 153) or concrete socket and spigot pipes (to IS 6). These drains will be laid to comply with the requirements of Kildare County Council.

Pipe capacities and velocities have been calculated using the Colebrook-White formula with a roughness coefficient (Ks) of 0.6 mm.

5. SUDS Design

5.1 SUDS Assessment

As per Kildare County Council guidelines surface water and SUDS will be managed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Volume 2, for New Developments and CIRIA documents. These documents specify that surface water run-off is to be managed as close to its source as possible. The following section outlines the SUDS strategy and maintenance for the subject site.

Sustainable Urban Drainage Systems (SUDS) have been developed and are in use to alleviate the detrimental effects of traditional urban stormwater drainage practices that typically consisted of piping run-off of rainfall from developments to the nearest receiving watercourse. Surface water drainage methods that take account of quantity, quality, and amenity issues are collectively referred to as SUDS. They are typically made up of one or more structures, built to manage surface water run-off by using nature-based solutions.

The use of SUDS to control run-off also provides the additional benefit of reducing pollutants in the surface water by settling out suspended solids, and in some cases providing biological treatment.

The proposed surface water drainage system for this development has been designed as a sustainable urban drainage system and uses permeable surfacing for private parking areas / driveways, swales adjacent to roads/footpaths, bio-retention tree pits, above ground detention basins, and below ground infiltration systems to achieve:

- Treatment of runoff and removal of pollutants to improve quality;
- Restriction of outflow and controlling quantity of flow; and
- Increased amenity value for the development.

A stormwater management or treatment train approach assures that run-off quantity and quality are improved. The following objectives of the treatment train provide an integrated and balanced approach to help mitigate the changes in stormwater run-off flows that occur as land is urbanised and to help mitigate the impacts of stormwater quality on receiving systems:

1) **Source control:** conveyance and infiltration of run-off; and

2) **Site Control:** reduction in volume and rate of surface run-off, with some additional treatment provided.

The applicant has considered the use of all appropriate SUDS measures as part of the site SUDS strategy; details are outlined in Table 5-1.

Table 5-1: SUDS Measures

SUDS Stage	SUDS Measure	Measure Outline	Use on site
Source Control	Permeable Surfacing / Paving	Permeable surfacing materials are made of porous material that enable surface water runoff to flow through or between the blocks into a layer of imported, easily	The permeable paving driveways will collect overland surface water runoff at source from the parking, from adjacent footpath

SUDS Stage	SUDS Measure	Measure Outline	Use on site
		draining, material. Generally permeable surfacing areas will be constructed with permeable pipe systems below ground that connect into the surface water mainline with an inspection chamber.	arrangements, and from the residential dwelling roofs.
	Bio-retention Tree Pits	Bio-retention systems) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution through the use of engineered soils and vegetation. The are particularly effective in delivering interception of rainfall. The pits will intercept and treat rainfall directly before discharging into the surface water network.	A total of 29 No. bio-detention tree pits will be constructed next to parking bays, adjacent to the internal roads network.
	Swales	Swales are shallow, landscaped depressions designed to store and/or convey run-off and remove pollutants. They may be used as conveyance structures to pass the run-off to the next stage of the treatment train and can be designed to promote infiltration where soil and groundwater conditions allow.	Swales are proposed throughout the subject development, in ach sub-catchment, adjacent to hardstanding areas such as roads and footpaths.
Site Control	Detention Basins	Detention basins are proposed to be utilised for attenuation of surface water. These basins can be utilised during regular weather conditions and generally remain dry with water levels increasing during heavier rainfall events. Detention basins are engineered depressions in the ground and are typical seeded with grass and may also be suitable for planting.	1 no. above-ground detention basin with a below ground Infiltration system is proposed for each catchment (3 No. basins in total). This facility is proposed to capture surface water runoff during an extreme storm event working in tandem with the below ground infiltration system.
	Infiltration Trenches / System	An infiltration trench is an excavated linear feature filled with clean granular material (typically crushed stone) that provides temporary storage of surface water runoff before allowing it to infiltrate into the surrounding subsoil. Surface water enters the trench via perforated pipe inlets, filter strips, or proprietary catchpit chambers. Once inside, water temporarily fills the voids between the	1 no. below ground infiltration trench system with multiple trenches is proposed for each catchment (3 No. infiltration systems in total). This SuDS feature is proposed to capture up to the 1-in-100-year extreme storm event including 30% climate change. Each infiltration system is

SUDS Stage	SUDS Measure	Measure Outline	Use on site
		aggregate, then gradually soaks into the ground.	proposed to be located with an open green space area.

In accordance with The SuDS Manual (CIRIA C753) the pollution prevention guidelines have been followed to ensure appropriate levels of treatment are provided before attenuated run-off from the site is discharged into the ordinary watercourse, the Irish sea.

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0200 for the proposed drainage and SUDS details.

5.2 SUDS Maintenance

For the SUDS strategy to work as designed the entire drainage system must be well maintained. It will be the responsibility of the landowners and site management team to ensure the drainage system is maintained. Maintenance and cleaning of gullies, and manholes will ensure adequate performance.

Maintenance schedules for the various SUDS features have been sourced from The SuDS Manual (CIRIA C753) and summarised in the tables to follow.

Table 5-2: Permeable Surfacing / Pavement Maintenance Schedule

	Maintenance Period	Maintenance Task	Frequency
Permeable Surfacing	Regular	Brushing and vacuuming (standard cosmetic sweep over the whole surface)	Once a year, after autumn leaf fall, or as required, based on site specific observations of clogging or manufacturer's recommendations.
	Occasional	Removal of weeds	As required
	Remedial actions	Remediation work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required
	Monitoring	Inspect silt accumulation rates and establish appropriate brushing frequencies. Monitor inspection chambers.	Annually

Table 5-3: Bio-Retention Tree Pit Maintenance Schedule

	Maintenance Period	Maintenance Task	Frequency
Bio-Retention Tree Pits	Regular	Remove the litter and debris	Monthly, or as required
		Cut grass (if applicable) – to retain height within specified design range.	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants.	Monthly at start, then as required
		Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
		Inspect infiltration coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
	Occasional	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment area
	Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
		Re-level uneven surfaces and reinstate design levels	As required
		Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
		Remove and dispose of oils or petrol residues using safe standards practices	As required

Table 5-4: Swale Maintenance Schedule

	Maintenance Period	Maintenance Task	Frequency
Swales	Regular	Remove the litter and debris	Monthly, or as required
		Cut grass – to retain height within specified design range.	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants.	Monthly at start, then as required
		Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
		Inspect infiltration coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
	Occasional	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment area
	Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
		Re-level uneven surfaces and reinstate design levels	As required
		Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
		Remove and dispose of oils or petrol residues using safe standards practices	As required

Table 5-5: Detention Basin Maintenance Schedule

	Maintenance Period	Maintenance Task	Frequency
Detention Basin	Regular	Remove the litter and debris	Monthly
		Cut grass – for spillways and access routes	Monthly (during growing season), or as required
		Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
		Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
		Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
		Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
		Check any penstocks and other mechanical devices	Annually
		Tidy all dead growth before start of growing season	Annually
		Remove sediment from inlets, outlet and forebay	Annually (or as required)
		Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
	Occasional	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment area
		Prune and trim any trees and remove cuttings	Every 2 years, or as required
		Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required
	Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
		Realignment of rip-rap	As required
		Repair/rehabilitation of inlets, outlets and overflows	As required
		Relevel uneven surfaces and reinstate design levels	As required

Table 5-6: Infiltration Systems (Soakaways)

	Maintenance Period	Maintenance Task	Frequency
Infiltration Systems (Soakaways)	Regular	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
		Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
		Trimming any roots that may be causing blockages	Annually (or as required)
	Occasional	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
	Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
		Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
	Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
		Check soakaway to ensure emptying is occurring	Annually

6. Water Supply

6.1 Introduction

The surrounding area in Southgreen is serviced by Uisce Éireann with water supply infrastructure, the water supply network for which the site will connect into (located within Southgreen, west of the site).

A Pre-Connection Enquiry (PCE) form was submitted Waterman Moylan to Uisce Éireann in December of 2024 to establish the available capacity in the network to facilitate the proposed development's water demands. The relevant Uisce Éireann reference number for the submission is CDS24010462. A response in the form of a Confirmation of Feasibility (COF) Letter was received on the 7th of February 2025 stating the development's water supply connection is feasible without infrastructure upgrades required to the public network.

Given the requirement for planning submissions to include up-to-date COF's (within the past six months) from Uisce Éireann and that the schedule of accommodation at the time of submitting the original PCE was c. 150 No. units, an updated PCE including the quantum of currently proposed units (153 No.) has been submitted, and a response is currently awaited. It is expected that the updated COF will similarly state that the water supply connection is feasible.

6.2 Existing Infrastructure

Information pertaining to the existing water supply infrastructure in the vicinity of the subject development is retrieved from the as-built drawing information and ground penetrating radar survey (GPR) for the Southgreen Phase 1 development, the Uisce Éireann COF Letter and the Uisce Éireann QGIS database.

According to the Uisce Éireann COF and the GPR survey/as-built info, an existing 315mm HDPE watermain is located within Southgreen Road, west of the development, and an existing 250mm uPVC watermain is located within Old Road, east of the development. Furthermore, according to the GPR survey/as-built info, the existing 315mm HDPE watermain runs along the southern road (between Phase 1 and the subject development), along Southgreen Road to the west, and loops around the northern boundary of the subject lands to connect into the existing 250mm uPVC watermain in Old Road on the east.

Refer to Figure 6-1 for an indicative sketch of the existing water supply is in the vicinity of the subject development.

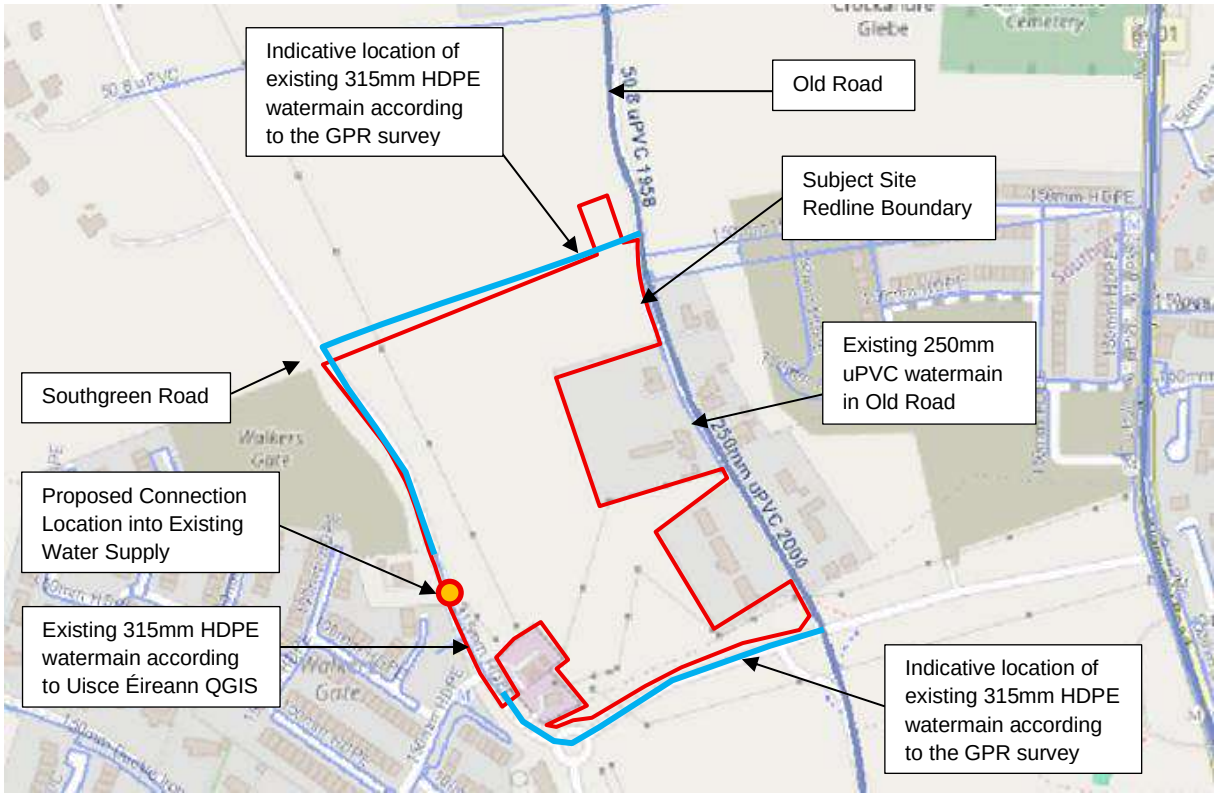


Figure 6-1 Indicative Sketch – Existing Uisce Éireann Water Supply Infrastructure near Subject Lands

6.3 Proposed Water Supply Network and Demand Calculation

It is proposed to connect the subject site's water supply into the existing 315 mm diameter HDPE water supply network west of the site, within Southgreen Road. The proposed development's water supply network will consist of 100 mm & 150 mm diameter networks looped within the internal roads network of the proposed development.

A water meter in accordance with the Uisce Éireann's Water Code of Practice will be installed on the proposed network before connecting into the existing 315 mm diameter watermain.

The proposed connection location of the subject developments water supply network is proposed at the subject development's access onto Southgreen Road. Refer to Figure 6-1 for which shows the proposed location with an indicative red and orange dot.

Refer to Waterman Moylan Drawing No. SOU-WMC-ZZ-XX-DR-C-P0300 for the proposed water supply layout.

The proposed development will consist of 153 No. residential units. Based on the Uisce Éireann Code of Practice, the peak water supply demand from the proposed development will be as outlined in Table 3-1.

Table 6-1: Total Water Demand Calculation

Description	No. of Units	Flow (ℓ/h/day)	Population per Unit	Average Daily Domestic Demand (ℓ/d)
Residential Development	153 No.	150	2.7	63,180
Average Daily Domestic Demand (from above)				0.73 ℓ/s
Average Day/Peak Week Demand (x1.25)				0.91 ℓ/s
Daily Peak Demand (x5)				**4.57** ℓ/s

As can be seen from the above table, the total daily peak water supply demand for the development is 4.57 ℓ/s. The total water requirement, from the public supply, for the development, is estimated at 68.18 m^3/day.

6.4 Watermain Network Design

Water Mains suitable for works and approved by Uisce Éireann shall be polyethylene (PE), with PE80 or PE100 rating (MDPE, HDPE or HPPE).

Refer to Figure 6-1 for an indicative sketch of the existing water supply network for the subject site. All water infrastructure will be designed in strict accordance with Uisce Éireann's Standards and Code of Practice.

Refer to Waterman Moylan Drawing No. SOU-WMC-ZZ-XX-DR-C-P0300 for details of the existing and proposed watermain to serve the subject lands.

6.5 Water Conservation

The water demand for the development can be subdivided as follows:

- Potable / Non-potable Breakdown

Detailed studies have quantified the breakdown between potable and non-potable uses for residential uses. According to the guideline: Promoting Sustainable Household Water Consumption, issued by Irish Water in September 2019, Figure 2.3 of the document (shown in Figure 6-2 below) illustrates the water use patterns that have been documented for a three-person household in the UK (insufficient data is available from Ireland households).

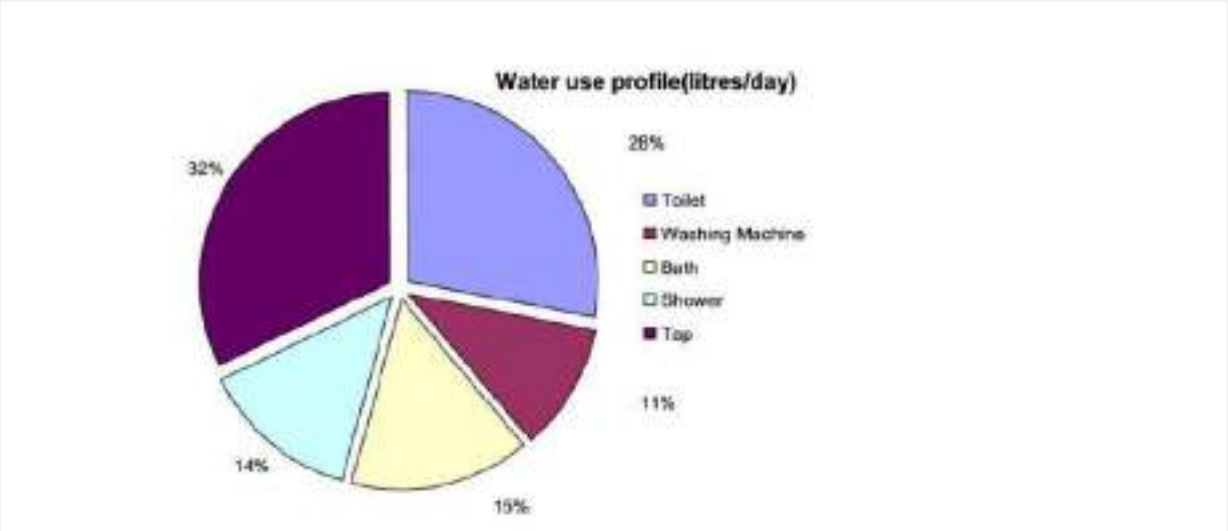


Figure 6-2: Water use patterns for 3-person households

The following water conservation measures will be used, to reduce overall water demand – water saving device installations including:

- Kitchen tap swivel aerator
- Water saving shower heads
- Spray taps
- Low volume flush / dual flush WC's
- Draw off tap controls
- Leak detection measures – through the metering of supply

7. Transportation

7.1 Proposed Site Access

The subject site is located north of Kildare Town, Co. Kildare. The site will have 1 No. proposed vehicular access point, off the Southgreen Road, to the west of the development. It is proposed to construct a 6m wide access road connecting Southgreen Road to the entrance of the proposed development.

Southgreen Road is a rural roadway that begins at its intersection with Green Road, Friary Road, and Pigeon Lane, situated to the south of the southwestern railway line. It runs in a northerly direction, crossing the railway via an overpass, and terminates at its junction with the R401. Southgreen Road is proposed to be upgraded to a 6m wide two-way carriageway.

No footpaths exist on either side of Southgreen Road along the western boundary of the subject development. There are also currently no cycle facilities along this boundary. The posted speed limit on the Southgreen Road in the area of the subject site is 50 km/hr. It is proposed as part of the upgrade works to construct a dual cycle-track and 2m wide pedestrian footpath on the eastern side of Southgreen Road as part of this subject development.

7.2 Roads Design

The proposed development has been designed with internal road gradients of 1:150 (minimum) and 1:20 (maximum).

According to the Design Manual for Urban Roads and Streets (DMURS), a corresponding visibility splay of 2.4 m 65 m is applicable for a bus route road with a design speed of 50 km/hr. Forward visibility splays of 2.4 m x 65 m have been achieved at the proposed access junction on Southgreen Road.

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0115 for the proposed visibility splays at the Southgreen Road entrance.

The road is designed as 6.0 m and 5.5 m wide throughout. Public concrete footpaths to the north and south of the proposed junction access will be provided within the proposed access road to facilitate future pedestrian linkage with the Southgreen Road. It is also proposed to provide a dual lane cycle track along Southgreen Road within the development's redline boundary to facilitate further cycle infrastructure as part of the Southgreen Masterplan objectives.

A total of 5 No. homezone/woonerf streets are proposed within the development, incorporating 2 No. raised tables as part of the internal layout. This design approach reflects the core principles of DMURS by prioritising pedestrian movement and safety over private vehicle access.

7.3 Car Parking

The required and proposed car parking quantum for the development is discussed in detail under Chapter 9 of the Traffic and Transportation (TTA) report undertaken by Waterman Moylan and submitted as part of this application.

7.3.1 Car Parking Standards

The following guidelines and documents were assessed for the car parking standards of the subject development:

- Sustainable Residential Development and Compact Settlements Guidelines for Planning Authorities (2024)
- Sustainable Urban Housing: Design Standard for New Apartments (July 2023)
- Kildare County Development Plan 2023 – 2029

Each of the above standards is discussed in detail under Chapter 9.1 of the TTA. The Kildare County Development Plan standards are included here within for ease of reference.

Kildare County Development Plan sets out that *New residential development should take account of the different criteria regarding car parking including*:

Parking spaces for visitors should be a minimum of 10% of the overall number of parking spaces provided in new residential developments.

The maximum car parking spaces based on the Kildare County Development Plan is detailed in Table below.

Table 7-1: Kildare County Development Plan 2023 – 2029 – Maximum Car Parking Spaces

Unit Type	No. Units	Maximum Car Parking Spaces			
		Ratio		Maximum	
		Resident	Visitor	Resident	Visitor
2-bed Houses	4	1	-	4	-
3-bed Houses	107	1	-	107	-
4-bed Houses	30	1.5	0.5 per unit	45	15
1-bed Apartments	4	1	1 per 4 units	4	3
2-bed Apartments	8	1		8	
Total	**153**			**168**	**18**

7.3.2 Car Parking Provided

Based on the County Development Plan and the national policies indicated above, it is proposed an appropriate level of car parking for the proposed site.

Table below shows the car parking spaces breakdown.

Table 7-2: Proposed Car Parking Spaces

Unit Type	No. Units	Car Parking Spaces			
		Ratio		Proposed	
		Resident	Visitor	Resident	Visitor
2-bed Houses	4	1	1 per 5 units	4	29
3-bed Houses	107	1		107	

4-bed Houses	30	1		30	
1-bed Apartments	4	1	1 per 3 units	4	4
2-bed Apartments	8	1		8	
Total	**153**	1	1 per 5 units	**153**	**33**
				186	

Therefore, for the Subject Development is proposed a total of 190 No. car parking spaces. Of the total number of spaces, 153 No. for residents and 33 No. for visitors.

The proposed car parking strategy considers the well-connected pedestrian infrastructure, the existing and potential future cycle network. Consequently, the proposed car parking provision is considered to offer an appropriate balance between the relevant standards, considering the site's location, current and future accessibility for residents, and the range of housing typologies proposed.

7.4 Cycle Parking

Based on the County Development Plan and the national policies indicated above, it is proposed an appropriate number of cycle parking for the proposed site.

Cycle parking spaces proposed for the subject development are shown in the below.

Table 7-3: Kildare County Development Plan 2023 – 2029 – Maximum Car Parking Spaces

Unit Type	No. Units	Ratio		Required	
		Resident	Visitor	Resident	Visitor
2-bed Houses	2 No. Mid-terrace (4 total)	2	1	4	2
3-bed Houses	45 No. Mid-terraces (107 total)	3	1	135	45
4-bed Houses	0 No. Mid-terrace (30 total)	-	-	-	-
1-bed Apartments	4	1	1	4	4
2-bed Apartments	8	2	1	16	8
Total	**59 (153 total)**			**159**	**57**
				216	

The subject development included a total of 216 no. cycle parking spaces for apartments. Of these, 459 no. are for residents and 57 no. for visitors.

7.5 Traffic Analysis

Please refer to the Waterman Moylan TTA submitted as part of this planning application, and for which includes details on the following traffic analysis' for the subject development:

- Trip Generation and Distribution

- Junction Assessments
- Traffic Models

The summary of the Junction Assessment and Traffic Model, extracted from the TTA is included below:

The results of the analysis demonstrated that all junctions assessed and the shuttle link on Southgreen Road would operate within their respective capacities for all years and scenarios analysed.

7.6 Public Transport

This subject site is located in a town setting and is serviced by public transport. The details of the subject site and available public transport options are included below.

7.6.1 Bus Services

The nearest bus stops to the site are situated near Kildare Rail Station which is c. 1.0 km (14-min walk) as shown in Figure 7-1 below. The bus stops are served by bus route 883. Additional bus routes are available in Kildare Town Centre, around 1.2 km from the site (a 16-minute walk), including the bus routes 126, 126A, 126B, 126D, 26T, 126U, 726, IW02 & UM14.

The distance and walking times shown in the below figure are obtained from the southern pedestrian access to the subject site.

The bus routes and their frequencies are provided in Table 3 of the TTA. The times indicated in the table are based on the timetable for each bus stop. The full bus timetables are provided in Appendix A of the TTA.

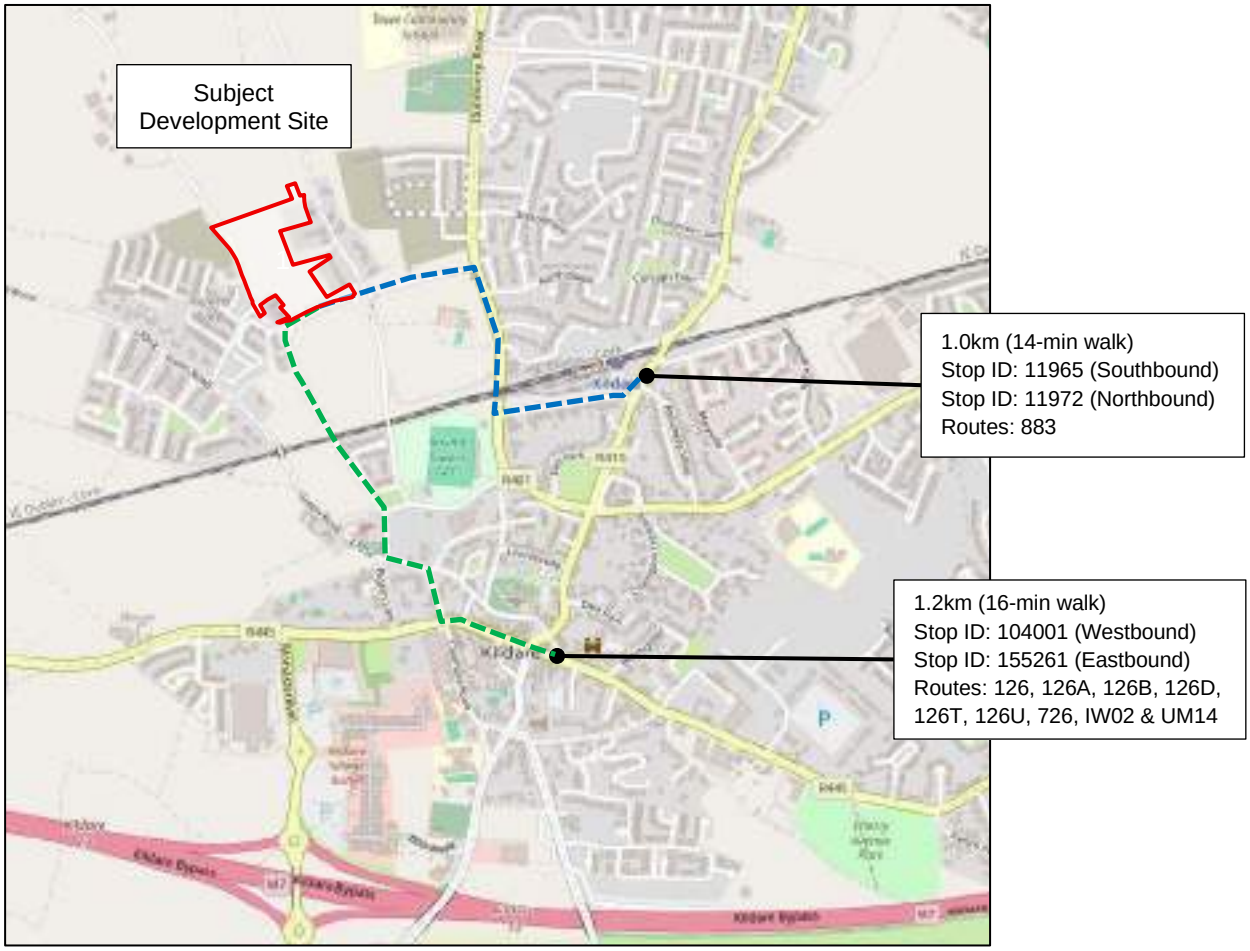


Figure 7-1: Bus Network – Walking distance from development to Bus Stops

7.6.2 Railway Network

The nearest rail station to the subject site is the Kildare Rail Station, located approximately 900m to the southeast of the site. This distance can be reached in 12-minute walking or c. 3-minute cycling. The location of the Kildare Rail Station in relation to the subject development can be seen in Figure 7-2, below.

For details of the rail rout serving the station, refer to Table 4 and Appendix A of the TTA.

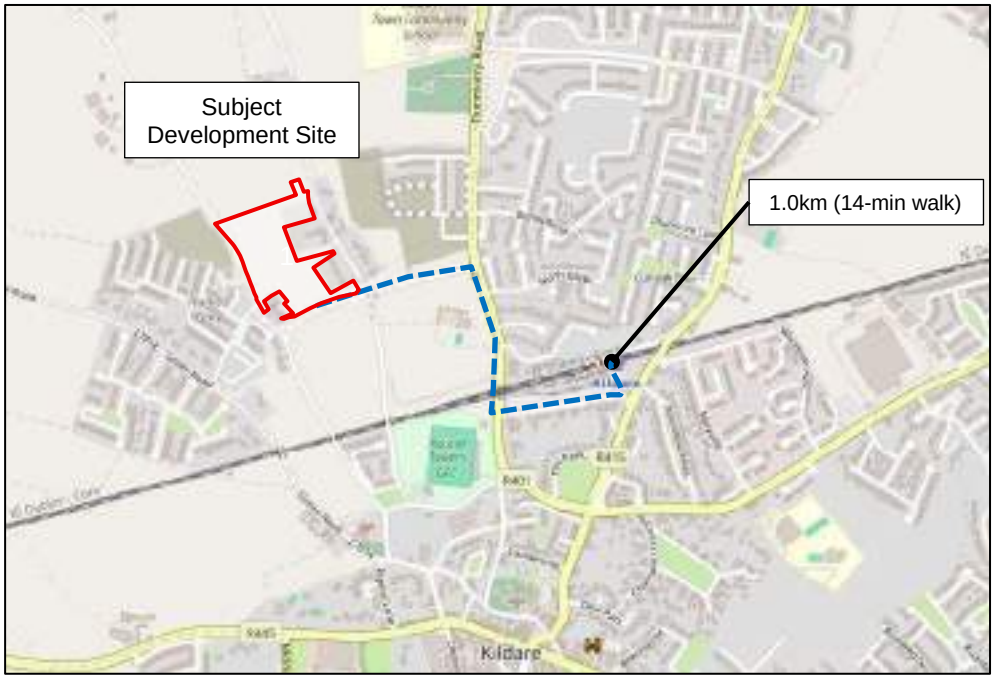


Figure 7-2: Location of Kildare Rail Station

7.6.3 Existing Cycle Facilities

Existing cycle facilities are present along the southern road, adjacent to the subject development. The future cycle network development plans in the vicinity of the subject development significant. Refer to Chapter 4.2 of the TTA for details of the cycling measures proposed in the Southgreen area and near the subject development under the Kildare Town LAP (2023-2029) and the GDA Cycle Network Plan (2002).

7.6.4 Existing Pedestrian Facilities

The existing pedestrian infrastructure in the surrounding urban area comprises a well-connected network of footpaths that link the various neighbourhoods to one another, to the existing educational institutions and to the surrounding public transport network. The surrounding area is characterised by the presence of footpaths on both sides of the road and pedestrian crossings at all intersections. The extensive interconnection of the network allows for greater flexibility in the transportation of pedestrians.

Figure 7-3 below details the 10-minute, 15-minute and 24-minute walking catchments areas to summarise the accessibility of the subject site on foot (Preferred Maximum) to “Town Centres, Commuting / School / Sight-seeing, and Elsewhere” respectively. The figure below illustrates the presence of grocery stores, schools and first medical care within each walking isochrone.

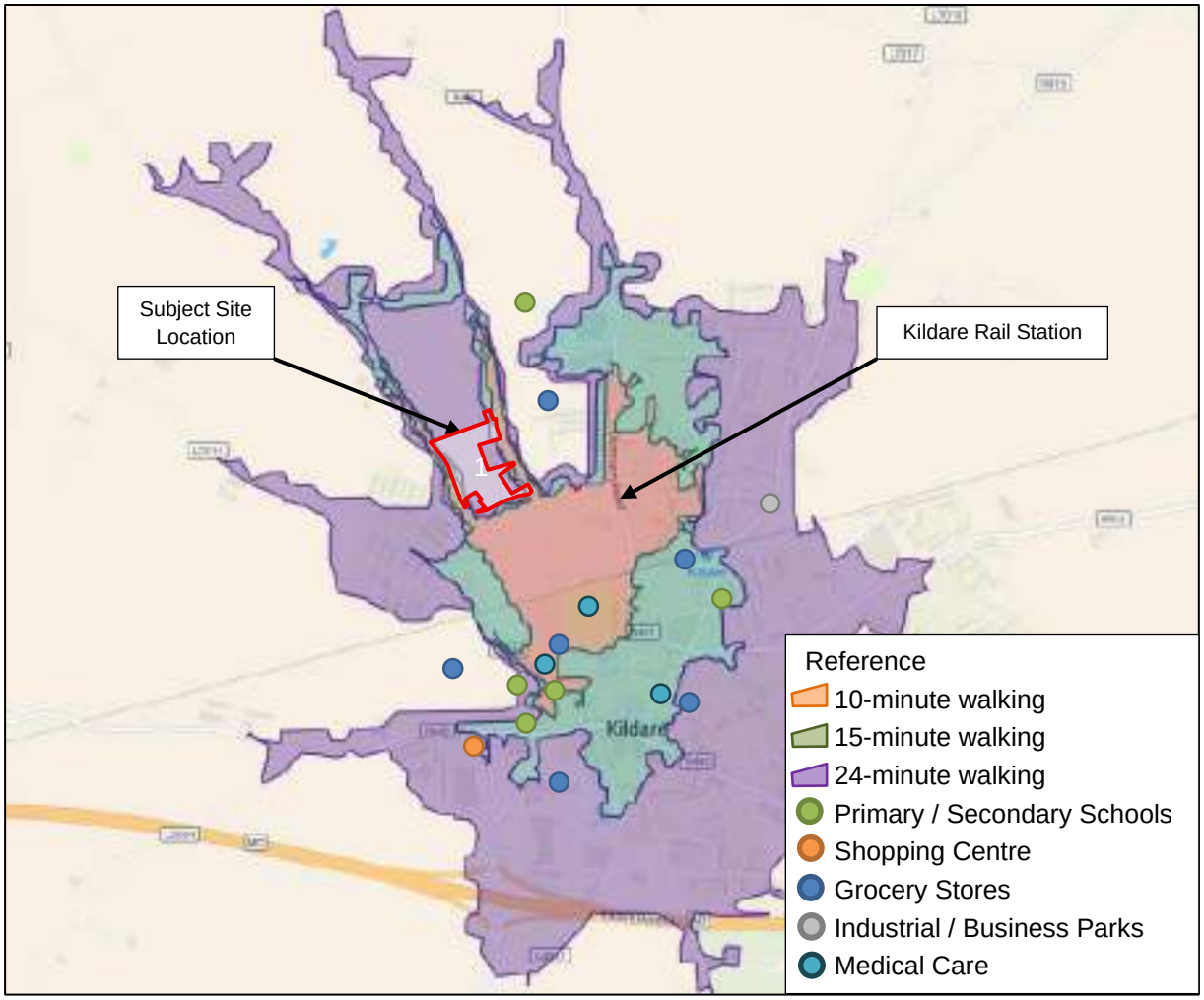


Figure 7-3: Isochrone map indicating Walking Accessibility (Source: Smappen)

APPENDICES

A. Uisce Éireann Confirmation of Feasibility Letter

CONFIRMATION OF FEASIBILITY

Cormac Maher

Waterman Moylan
Block S
Eastpoint Business Park
Alife Byrne Road
Eastwall
Dublin
D03H3F4

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

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

7 February 2025

Our Ref: CDS24010462 Pre-Connection Enquiry
South Green, Kildare, Co. Kildare

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 150 unit(s) at South Green, Kildare, Co. Kildare, (the **Development)**.

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

- **Water Connection** - Feasible without infrastructure upgrade by Uisce Éireann

- **Wastewater Connection** - Feasible without infrastructure upgrade by Uisce Éireann

- Proposed connection to Uisce Éireann network is via Phase 1 of Southgreen Development Zone, south of the site. All the relevant Phase 1 wastewater infrastructure must be completed, of adequate capacity and connected to Dunmurray Road Pumping station, prior the connection.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann infrastructure. Before the Development can be connected

Stiúrthóirí / Directors: Niall Gleeson (POF / CEO), Jerry Grant (Cathaoirleach / Chairperson), Gerard Britchfield, Liz Joyce, Michael Nolan, Patricia King, Eileen Maher, Cathy Mannion, Paul Reid, Michael Walsh.
Oifig Chláraithe / Registered Office: Teach Colvill, 24-26 Sráid Thalbóid, Baile Átha Cliath 1, D01 NP86 / Colvill House, 24-26 Talbot Street, Dublin, Ireland D01NP86
Is cuideachta ghníomhaíochta ainmnithe atá faoi theorainn scaireanna é Uisce Éireann / Uisce Éireann is a designated activity company, limited by shares.
Cláraithe in Éirinn Uimh.: 530363 / Registered in Ireland No.: 530363.

to our network(s) you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.

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/

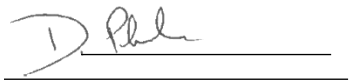
Where can you find more information?

- **Section A -** What is important to know?
- **Section B -** Details of Uisce Éireann's Network(s)

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

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

Yours sincerely,



Dermot Phelan
Connections Delivery Manager

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 Uisce Éireann's network(s). • Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application and be granted and sign a connection agreement with Uisce Éireann.
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?	• Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	• All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *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 Uisce Éireann's network(s)?	• Requests for maps showing Uisce Éireann'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 Uisce Éireann 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)

Section B – Details of Uisce Éireann's Network(s)

The map included below outlines the current Uisce Éireann infrastructure adjacent the Development: To access Uisce Éireann Maps email datarequests@water.ie



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Note: The information provided on the included maps as to the position of Uisce Éireann's underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Uisce Éireann.

Whilst every care has been taken in respect of the information on Uisce Éireann's network(s), Uisce Éireann assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Uisce Éireann's underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Uisce Éireann's underground network(s) is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

B. Surface Water Model For Catchments A, B and C (Flow Causeway)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	15.400	Minimum Backdrop Height (m)	0.200
Ratio-R	0.320	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.095	4.00	107.300	1200	672309.062	713165.296	1.375
2	0.017	4.00	108.150	1200	672286.056	713200.985	2.437
3	0.103	4.00	110.100	1200	672244.830	713181.990	1.425
4	0.053	4.00	108.150	1200	672278.925	713203.988	2.551
5	0.022	4.00	108.086	1200	672249.983	713244.943	1.511
6	0.048	4.00	107.940	1350	672262.508	713227.286	2.559
7	0.096	4.00	106.900	1200	672312.658	713258.881	1.425
8	0.040	4.00	107.270	1350	672286.320	713242.525	2.100
South Basin			107.000		672291.458	713235.427	1.918
Southern Soakaway	0.034		107.000		672296.505	713228.325	2.005
PP S2	0.025	4.00	108.000		672277.947	713195.530	1.350
PP S1	0.036	4.00	108.500		672266.881	713238.477	1.350
S1 Swale - 40 m	0.052	4.00	107.500		672279.733	713230.323	1.350
Sw Swale - 45 m	0.065	4.00	110.000		672299.935	713156.078	1.350
13		4.00	110.000	1200	672276.480	713142.437	1.425

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	1	2	42.462	0.600	105.925	105.713	0.212	200.0	225	4.98	50.0
2	2	4	7.738	0.600	105.713	105.674	0.039	200.0	225	5.12	50.0
3	3	4	40.576	0.600	108.675	106.646	2.029	20.0	225	4.23	50.0
4	4	6	28.501	0.600	105.599	105.456	0.143	200.0	300	5.55	50.0
5	5	6	21.648	0.600	106.575	106.467	0.108	200.0	225	4.39	50.0
6	6	8	28.271	0.600	105.381	105.240	0.141	200.0	375	5.91	50.0
7	7	8	31.003	0.600	105.475	105.320	0.155	200.0	225	4.56	50.0
8	8	South Basin	8.762	0.600	105.170	105.082	0.088	100.0	375	6.00	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	0.921	36.6	28.9	1.150	2.212	0.160	0.0	152	1.018
2	0.921	36.6	36.4	2.212	2.251	0.201	0.0	184	1.045
3	2.939	116.8	18.5	1.200	1.279	0.103	0.0	60	2.161
4	1.108	78.3	64.4	2.251	2.184	0.357	0.0	208	1.232
5	0.921	36.6	3.9	1.286	1.248	0.022	0.0	50	0.605
6	1.277	141.1	92.9	2.184	1.655	0.514	0.0	222	1.360
7	0.921	36.6	17.3	1.200	1.725	0.096	0.0	109	0.907
8	1.812	200.1	117.5	1.725	1.543	0.650	0.0	207	1.881

Flow+ v12.0 Copyright © 1988-2025 Causeway Technologies Ltd

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
9	South Basin	Southern Soakaway	8.713	0.600	105.082	104.995	0.087	100.0	375	6.08	50.0
3.000	PP S2	2	9.773	0.600	106.650	106.287	0.363	26.9	150	4.08	50.0
7.000	PP S1	6	12.015	0.600	107.150	106.948	0.202	59.5	150	4.15	50.0
6.000	S1 Swale - 40 m	6	17.491	0.600	106.150	105.874	0.276	63.4	150	4.23	50.0
2.000	Sw Swale - 45 m	1	12.972	0.600	108.650	106.000	2.650	4.9	150	4.05	50.0
1.000	13	1	39.801	0.600	108.575	106.234	2.341	17.0	225	4.21	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
9	1.812	200.1	117.5	1.543	1.630	0.650	0.0	207	1.881
3.000	1.948	34.4	4.5	1.200	1.713	0.025	0.0	37	1.353
7.000	1.306	23.1	6.5	1.200	0.842	0.036	0.0	54	1.122
6.000	1.265	22.4	9.5	1.200	1.916	0.052	0.0	68	1.215
2.000	4.586	81.0	11.7	1.200	1.150	0.065	0.0	38	3.276
1.000	3.189	126.8	0.0	1.200	0.841	0.000	0.0	0	0.000

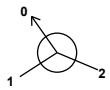
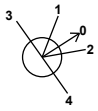
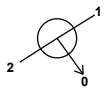
Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	42.462	200.0	225	Circular	107.300	105.925	1.150	108.150	105.713	2.212
2	7.738	200.0	225	Circular	108.150	105.713	2.212	108.150	105.674	2.251
3	40.576	20.0	225	Circular	110.100	108.675	1.200	108.150	106.646	1.279
4	28.501	200.0	300	Circular	108.150	105.599	2.251	107.940	105.456	2.184
5	21.648	200.0	225	Circular	108.086	106.575	1.286	107.940	106.467	1.248
6	28.271	200.0	375	Circular	107.940	105.381	2.184	107.270	105.240	1.655
7	31.003	200.0	225	Circular	106.900	105.475	1.200	107.270	105.320	1.725
8	8.762	100.0	375	Circular	107.270	105.170	1.725	107.000	105.082	1.543
9	8.713	100.0	375	Circular	107.000	105.082	1.543	107.000	104.995	1.630
3.000	9.773	26.9	150	Circular	108.000	106.650	1.200	108.150	106.287	1.713
7.000	12.015	59.5	150	Circular	108.500	107.150	1.200	107.940	106.948	0.842
6.000	17.491	63.4	150	Circular	107.500	106.150	1.200	107.940	105.874	1.916
2.000	12.972	4.9	150	Circular	110.000	108.650	1.200	107.300	106.000	1.150
1.000	39.801	17.0	225	Circular	110.000	108.575	1.200	107.300	106.234	0.841

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
2	2	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
3	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
4	4	1200	Manhole	Adoptable	6	1350	Manhole	Adoptable
5	5	1200	Manhole	Adoptable	6	1350	Manhole	Adoptable
6	6	1350	Manhole	Adoptable	8	1350	Manhole	Adoptable
7	7	1200	Manhole	Adoptable	8	1350	Manhole	Adoptable
8	8	1350	Manhole	Adoptable	South Basin		Junction	
9	South Basin		Junction		Southern Soakaway		Junction	
3.000	PP S2		Junction		2	1200	Manhole	Adoptable
7.000	PP S1		Junction		6	1350	Manhole	Adoptable
6.000	S1 Swale - 40 m		Junction		6	1350	Manhole	Adoptable
2.000	Sw Swale - 45 m		Junction		1	1200	Manhole	Adoptable
1.000	13	1200	Manhole	Adoptable	1	1200	Manhole	Adoptable

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	672309.062	713165.296	107.300	1.375	1200		1	2.000	106.000	150
							2	1.000	106.234	225
							0	1	105.925	225
2	672286.056	713200.985	108.150	2.437	1200		1	3.000	106.287	150
							2	1	105.713	225
							0	2	105.713	225
3	672244.830	713181.990	110.100	1.425	1200		0	3	108.675	225
4	672278.925	713203.988	108.150	2.551	1200		1	3	106.646	225
							2	2	105.674	225
							0	4	105.599	300
5	672249.983	713244.943	108.086	1.511	1200		0	5	106.575	225
6	672262.508	713227.286	107.940	2.559	1350		1	7.000	106.948	150
							2	6.000	105.874	150
							3	5	106.467	225
							4	4	105.456	300
							0	6	105.381	375
7	672312.658	713258.881	106.900	1.425	1200		0	7	105.475	225
8	672286.320	713242.525	107.270	2.100	1350		1	7	105.320	225
							2	6	105.240	375
							0	8	105.170	375
South Basin	672291.458	713235.427	107.000	1.918			1	8	105.082	375
							0	9	105.082	375
Southern Soakaway	672296.505	713228.325	107.000	2.005			1	9	104.995	375
PP S2	672277.947	713195.530	108.000	1.350			0	3.000	106.650	150
PP S1	672266.881	713238.477	108.500	1.350			0	7.000	107.150	150
S1 Swale - 40 m	672279.733	713230.323	107.500	1.350			0	6.000	106.150	150

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Sw Swale - 45 m	672299.935	713156.078	110.000	1.350					
						0	2.000	108.650	150
13	672276.480	713142.437	110.000	1.425	1200				
						0	1.000	108.575	225

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.400	Starting Level (m)	
Ratio-R	0.320	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	30	0	0

Node South Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	106.000
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	1320

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	441.0	441.0	1.000	841.0	850.7	1.001	0.0	850.7

Node Southern Soakaway Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	104.995	Depth (m)	2.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	3654	Inf Depth (m)	2.000
Safety Factor	2.0	Pit Width (m)	2.500	Number Required	3
Porosity	0.95	Pit Length (m)	30.000		

Node PP S2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.650	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	72.000	Inf Depth (m)	0.350
Porosity	0.95	Length (m)	5.000		

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Node PP S1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.150	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	38.400	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node S1 Swale - 40 m Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.150	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Inf Depth (m)	1.000
Safety Factor	2.0	Pit Width (m)	1.000	Number Required	1
Porosity	0.40	Pit Length (m)	40.000		

Node Sw Swale - 45 m Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	108.650	Depth (m)	4.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Inf Depth (m)	4.000
Safety Factor	2.0	Pit Width (m)	1.000	Number Required	4
Porosity	1.00	Pit Length (m)	45.000		

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m^3)	
Full Bore Velocity	✓		

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Results for 1 year Critical Storm Duration. Lowest mass balance: 94.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	106.028	0.102	16.0	0.2582	0.0000	OK
15 minute summer	2	11	105.839	0.126	19.9	0.1602	0.0000	OK
15 minute summer	3	10	108.732	0.057	16.1	0.1469	0.0000	OK
5760 minute summer	4	3840	105.836	0.237	1.9	0.3662	0.0000	OK
15 minute summer	5	10	106.622	0.047	3.4	0.0660	0.0000	OK
5760 minute summer	6	3840	105.834	0.453	3.8	0.8173	0.0000	SURCHARGED
5760 minute summer	7	3840	105.835	0.360	0.8	0.8909	0.0000	SURCHARGED
5760 minute summer	8	3720	105.834	0.664	3.9	1.2051	0.0000	SURCHARGED
5760 minute summer	South Basin	3720	105.834	0.752	4.2	0.0000	0.0000	SURCHARGED
5760 minute summer	Southern Soakaway	3780	105.833	0.838	5.5	179.3390	0.0000	OK
30 minute summer	PP S2	20	106.675	0.024	3.5	0.8321	0.0000	OK
15 minute summer	PP S1	11	107.195	0.045	5.7	0.6464	0.0000	OK
15 minute summer	S1 Swale - 40 m	11	106.208	0.058	8.2	0.9800	0.0000	OK
60 minute summer	Sw Swale - 45 m	38	108.671	0.021	6.7	3.7219	0.0000	OK
15 minute summer	13	1	108.575	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	2	15.8	0.785	0.433	0.8565
15 minute summer	2	2	4	19.3	0.892	0.527	0.1674
15 minute summer	3	3	4	16.1	2.056	0.138	0.3174
5760 minute summer	4	4	6	3.5	0.463	0.045	1.8550
15 minute summer	5	5	6	3.3	0.572	0.091	0.1262
5760 minute summer	6	6	8	3.8	0.424	0.027	3.1182
5760 minute summer	7	7	8	-0.5	0.296	-0.015	1.2330
5760 minute summer	8	8	South Basin	3.7	0.414	0.018	0.9664
5760 minute summer	South Basin	9	Southern Soakaway	5.4	0.411	0.027	0.9610
5760 minute summer	South Basin	Infiltration		0.0			
5760 minute summer	Southern Soakaway	Infiltration		0.8			
30 minute summer	PP S2	3.000	2	1.9	1.046	0.056	0.0181
30 minute summer	PP S2	Infiltration		0.0			
15 minute summer	PP S1	7.000	6	4.3	0.993	0.188	0.0524
15 minute summer	PP S1	Infiltration		0.0			
15 minute summer	S1 Swale - 40 m	6.000	6	7.0	1.110	0.311	0.1096
15 minute summer	S1 Swale - 40 m	Infiltration		0.0			
60 minute summer	Sw Swale - 45 m	2.000	1	3.2	2.220	0.039	0.0186
60 minute summer	Sw Swale - 45 m	Infiltration		0.0			
15 minute summer	13	1.000	1	0.0	0.000	0.000	0.0000

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Results for 30 year Critical Storm Duration. Lowest mass balance: 94.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	11	106.237	0.312	38.3	0.7873	0.0000	SURCHARGED
4320 minute summer	2	3000	106.193	0.480	2.3	0.6075	0.0000	SURCHARGED
15 minute summer	3	10	108.762	0.087	35.8	0.2247	0.0000	OK
4320 minute summer	4	3000	106.193	0.593	4.0	0.9164	0.0000	SURCHARGED
15 minute summer	5	10	106.646	0.071	7.5	0.1001	0.0000	OK
4320 minute summer	6	3000	106.193	0.811	5.9	1.4655	0.0000	SURCHARGED
4320 minute summer	7	3000	106.193	0.717	1.1	1.7750	0.0000	SURCHARGED
4320 minute summer	8	3000	106.193	1.022	7.5	1.8568	0.0000	SURCHARGED
4320 minute summer	South Basin	3000	106.193	1.110	7.5	87.8793	0.0000	SURCHARGED
4320 minute summer	Southern Soakaway	3000	106.193	1.197	7.4	256.3593	0.0000	OK
30 minute summer	PP S2	20	106.686	0.036	7.7	1.8322	0.0000	OK
15 minute summer	PP S1	11	107.218	0.068	12.6	1.4745	0.0000	OK
15 minute summer	S1 Swale - 40 m	11	106.248	0.098	18.3	1.6390	0.0000	OK
30 minute summer	Sw Swale - 45 m	20	108.686	0.036	20.2	6.4577	0.0000	OK
15 minute summer	13	1	108.575	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	2	34.4	0.911	0.940	1.6888
4320 minute summer	2	2	4	2.2	0.456	0.061	0.3077
15 minute summer	3	3	4	35.8	2.559	0.306	0.5675
4320 minute summer	4	4	6	4.0	0.474	0.051	2.0070
15 minute summer	5	5	6	7.5	0.716	0.204	0.2255
4320 minute summer	6	6	8	5.9	0.373	0.042	3.1182
4320 minute summer	7	7	8	1.1	0.295	0.029	1.2330
4320 minute summer	8	8	South Basin	7.5	0.428	0.037	0.9664
4320 minute summer	South Basin	9	Southern Soakaway	7.0	0.575	0.035	0.9610
4320 minute summer	South Basin	Infiltration		0.3			
4320 minute summer	Southern Soakaway	Infiltration		1.2			
30 minute summer	PP S2	3.000	2	4.3	1.314	0.124	0.0318
30 minute summer	PP S2	Infiltration		0.0			
15 minute summer	PP S1	7.000	6	9.3	1.217	0.403	0.0918
15 minute summer	PP S1	Infiltration		0.0			
15 minute summer	S1 Swale - 40 m	6.000	6	16.3	1.364	0.728	0.2088
15 minute summer	S1 Swale - 40 m	Infiltration		0.0			
30 minute summer	Sw Swale - 45 m	2.000	1	10.1	2.959	0.124	0.1340
30 minute summer	Sw Swale - 45 m	Infiltration		0.1			
15 minute summer	13	1.000	1	0.0	0.000	0.000	0.0023

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Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 94.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	1	20	107.211	1.286	66.0	3.2410	0.0000	FLOOD RISK
15 minute summer	2	11	106.718	1.004	67.1	1.2726	0.0000	SURCHARGED
15 minute summer	3	10	108.794	0.119	60.3	0.3048	0.0000	OK
15 minute summer	4	11	106.587	0.987	133.2	1.5246	0.0000	SURCHARGED
15 minute summer	5	10	106.670	0.095	12.7	0.1339	0.0000	OK
4320 minute summer	6	3000	106.467	1.086	9.3	1.9607	0.0000	SURCHARGED
4320 minute summer	7	3000	106.467	0.992	1.8	2.4534	0.0000	SURCHARGED
4320 minute summer	8	3000	106.467	1.297	11.8	2.3547	0.0000	SURCHARGED
4320 minute summer	South Basin	3000	106.467	1.385	11.8	237.0779	0.0000	SURCHARGED
4320 minute summer	Southern Soakaway	3000	106.467	1.472	6.9	315.0555	0.0000	OK
30 minute summer	PP S2	20	106.703	0.053	13.1	3.8256	0.0000	OK
15 minute summer	PP S1	11	107.241	0.091	21.2	2.6070	0.0000	OK
4320 minute summer	S1 Swale - 40 m	3000	106.467	0.317	1.0	5.3126	0.0000	SURCHARGED
30 minute summer	Sw Swale - 45 m	20	108.702	0.052	34.2	9.4098	0.0000	OK
15 minute summer	13	1	108.575	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
30 minute summer	1	1	2	54.3	1.364	1.482	1.6888
15 minute summer	2	2	4	73.6	1.852	2.011	0.3077
15 minute summer	3	3	4	60.3	2.916	0.516	0.8393
15 minute summer	4	4	6	132.3	1.878	1.689	2.0070
15 minute summer	5	5	6	12.7	0.825	0.347	0.3329
4320 minute summer	6	6	8	9.2	0.386	0.065	3.1182
4320 minute summer	7	7	8	1.8	0.260	0.048	1.2330
4320 minute summer	8	8	South Basin	11.8	0.500	0.059	0.9664
4320 minute summer	South Basin	9	Southern Soakaway	6.6	0.540	0.033	0.9610
4320 minute summer	South Basin	Infiltration		0.9			
4320 minute summer	Southern Soakaway	Infiltration		1.4			
30 minute summer	PP S2	3.000	2	8.8	1.524	0.255	0.1130
30 minute summer	PP S2	Infiltration		0.0			
15 minute summer	PP S1	7.000	6	14.8	1.361	0.642	0.1311
15 minute summer	PP S1	Infiltration		0.0			
4320 minute summer	S1 Swale - 40 m	6.000	6	0.9	0.516	0.040	0.3079
4320 minute summer	S1 Swale - 40 m	Infiltration		0.1			
30 minute summer	Sw Swale - 45 m	2.000	1	21.1	3.006	0.260	0.1493
30 minute summer	Sw Swale - 45 m	Infiltration		0.1			
15 minute summer	13	1.000	1	0.0	0.000	0.000	0.7915

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	15.400	Minimum Backdrop Height (m)	0.200
Ratio-R	0.320	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.059	4.00	112.300	1200	672153.555	713239.525	1.425
2	0.082	4.00	112.000	1200	672166.829	713199.722	1.425
3	0.050	4.00	112.000	1200	672160.673	713218.869	2.417
4	0.104	4.00	108.160	1200	672244.129	713249.724	1.618
5	0.083	4.00	112.400	1200	672159.807	713350.680	1.425
6	0.127	4.00	112.189	1200	672146.744	713280.544	1.425
7	0.106	4.00	110.570	1200	672180.423	713292.649	1.433
8	0.224	4.00	108.160	1350	672222.125	713307.615	2.078
9	0.080	4.00	108.938	1200	672199.965	713363.874	1.425
10	0.090	4.00	108.679	1350	672210.235	713337.942	2.760
Central Basin	0.036	4.00	107.850		672201.272	713333.780	2.030
Central Soakaway			107.850		672188.657	713327.907	2.169
C1 Swale - 30m	0.035	4.00	108.800		672184.266	713365.841	1.000
C2 Swale - 35m		4.00	111.750		672185.331	713303.926	0.950
PP C2	0.033	4.00	108.500		672217.883	713343.341	1.100
PP C1	0.100	4.00	112.000		672173.124	713239.171	1.350

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	1	3	21.848	0.600	110.875	110.511	0.364	60.0	225	4.22	50.0
2	2	3	20.112	0.600	110.575	110.474	0.101	200.0	225	4.36	50.0
3	3	4	88.977	0.600	109.583	106.617	2.966	30.0	225	4.98	50.0
4	4	8	61.932	0.600	106.542	106.232	0.310	200.0	300	5.91	50.0
5	5	7	61.584	0.600	110.975	109.215	1.760	35.0	225	4.46	50.0
6	6	7	35.788	0.600	110.764	109.137	1.627	22.0	225	4.21	50.0
7	7	8	44.306	0.600	109.137	106.676	2.461	18.0	225	4.70	50.0
8	8	10	32.575	0.600	106.082	105.919	0.163	200.0	450	6.29	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	1.691	67.2	10.7	1.200	1.264	0.059	0.0	60	1.242
2	0.921	36.6	14.7	1.200	1.301	0.082	0.0	99	0.870
3	2.397	95.3	52.6	2.192	1.318	0.291	0.0	119	2.452
4	1.108	78.3	71.4	1.318	1.628	0.395	0.0	226	1.250
5	2.218	88.2	14.9	1.200	1.130	0.083	0.0	62	1.656
6	2.801	111.4	23.0	1.200	1.208	0.127	0.0	69	2.218
7	3.098	123.2	57.0	1.208	1.259	0.316	0.0	108	3.042
8	1.434	228.0	169.0	1.628	2.310	0.935	0.0	290	1.564

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
9	9	10	27.892	0.600	107.513	107.164	0.349	80.0	225	4.58	50.0
10	10	Central Basin	9.882	0.600	105.919	105.820	0.099	100.0	450	6.37	50.0
11	Central Basin	Central Soakaway	13.915	0.600	105.820	105.681	0.139	100.0	450	6.49	50.0
7.000	C1 Swale - 30m	9	15.822	0.600	107.800	107.642	0.158	100.0	150	4.26	50.0
6.000	C2 Swale - 35m	7	12.299	0.600	110.800	109.570	1.230	10.0	150	4.06	50.0
8.000	PP C2	10	9.362	0.600	107.400	107.338	0.062	150.0	150	4.19	50.0
1.000	PP C1	3	23.816	0.600	110.650	109.658	0.992	24.0	150	4.19	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
9	1.463	58.2	20.8	1.200	1.290	0.115	0.0	93	1.343
10	2.033	323.3	211.8	2.310	1.580	1.172	0.0	266	2.161
11	2.033	323.3	218.3	1.580	1.719	1.208	0.0	272	2.176
7.000	1.005	17.8	6.3	0.850	1.146	0.035	0.0	62	0.921
6.000	3.204	56.6	0.0	0.800	0.850	0.000	0.0	0	0.000
8.000	0.818	14.5	5.9	0.950	1.191	0.033	0.0	67	0.776
1.000	2.064	36.5	18.1	1.200	2.192	0.100	0.0	75	2.060

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	21.848	60.0	225	Circular	112.300	110.875	1.200	112.000	110.511	1.264
2	20.112	200.0	225	Circular	112.000	110.575	1.200	112.000	110.474	1.301
3	88.977	30.0	225	Circular	112.000	109.583	2.192	108.160	106.617	1.318
4	61.932	200.0	300	Circular	108.160	106.542	1.318	108.160	106.232	1.628
5	61.584	35.0	225	Circular	112.400	110.975	1.200	110.570	109.215	1.130
6	35.788	22.0	225	Circular	112.189	110.764	1.200	110.570	109.137	1.208
7	44.306	18.0	225	Circular	110.570	109.137	1.208	108.160	106.676	1.259
8	32.575	200.0	450	Circular	108.160	106.082	1.628	108.679	105.919	2.310
9	27.892	80.0	225	Circular	108.938	107.513	1.200	108.679	107.164	1.290
10	9.882	100.0	450	Circular	108.679	105.919	2.310	107.850	105.820	1.580
11	13.915	100.0	450	Circular	107.850	105.820	1.580	107.850	105.681	1.719
7.000	15.822	100.0	150	Circular	108.800	107.800	0.850	108.938	107.642	1.146
6.000	12.299	10.0	150	Circular	111.750	110.800	0.800	110.570	109.570	0.850

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	1	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
2	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
3	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
4	4	1200	Manhole	Adoptable	8	1350	Manhole	Adoptable
5	5	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
6	6	1200	Manhole	Adoptable	7	1200	Manhole	Adoptable
7	7	1200	Manhole	Adoptable	8	1350	Manhole	Adoptable
8	8	1350	Manhole	Adoptable	10	1350	Manhole	Adoptable
9	9	1200	Manhole	Adoptable	10	1350	Manhole	Adoptable
10	10	1350	Manhole	Adoptable	Central Basin		Junction	
11	Central Basin		Junction		Central Soakaway		Junction	
7.000	C1 Swale - 30m		Junction		9	1200	Manhole	Adoptable
6.000	C2 Swale - 35m		Junction		7	1200	Manhole	Adoptable

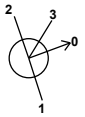
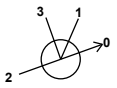
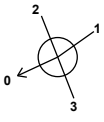
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Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8.000	9.362	150.0	150	Circular	108.500	107.400	0.950	108.679	107.338	1.191
1.000	23.816	24.0	150	Circular	112.000	110.650	1.200	112.000	109.658	2.192

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8.000	PP C2		Junction		10	1350	Manhole	Adoptable
1.000	PP C1		Junction		3	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	672153.555	713239.525	112.300	1.425	1200		0 1	110.875	225
2	672166.829	713199.722	112.000	1.425	1200		0 2	110.575	225
3	672160.673	713218.869	112.000	2.417	1200		1 2 2 1 3 1.000 0 3	110.474 110.511 109.658 109.583	225 225 150 225
4	672244.129	713249.724	108.160	1.618	1200		1 3 0 4	106.617 106.542	225 300
5	672159.807	713350.680	112.400	1.425	1200		0 5	110.975	225
6	672146.744	713280.544	112.189	1.425	1200		0 6	110.764	225
7	672180.423	713292.649	110.570	1.433	1200		1 6.000 2 6 3 5 0 7	109.570 109.137 109.215 109.137	150 225 225 225
8	672222.125	713307.615	108.160	2.078	1350		1 7 2 4 0 8	106.676 106.232 106.082	225 300 450
9	672199.965	713363.874	108.938	1.425	1200		1 7.000 0 9	107.642 107.513	150 225
10	672210.235	713337.942	108.679	2.760	1350		1 8.000 2 9 3 8 0 10	107.338 107.164 105.919 105.919	150 225 450 450

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Central Basin	672201.272	713333.780	107.850	2.030		1	10	105.820	450
						0	11	105.820	450
Central Soakaway	672188.657	713327.907	107.850	2.169		1	11	105.681	450
C1 Swale - 30m	672184.266	713365.841	108.800	1.000		0	7.000	107.800	150
C2 Swale - 35m	672185.331	713303.926	111.750	0.950		0	6.000	110.800	150
PP C2	672217.883	713343.341	108.500	1.100		0	8.000	107.400	150
PP C1	672173.124	713239.171	112.000	1.350		0	1.000	110.650	150

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.400	Starting Level (m)	
Ratio-R	0.320	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	30	0	0

Node C1 Swale - 30m Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.800	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Inf Depth (m)	1.000
Safety Factor	2.0	Pit Width (m)	1.000	Number Required	1
Porosity	0.40	Pit Length (m)	30.000		

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Node C2 Swale - 35m Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	110.800	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Inf Depth (m)	1.000
Safety Factor	2.0	Pit Width (m)	1.000	Number Required	1
Porosity	0.40	Pit Length (m)	30.000		

Node Central Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	107.350
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	600.0	320.0	0.500	805.0	350.7	0.501	0.0	650.7

Node Central Soakaway Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	105.681	Depth (m)	2.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	3634	Inf Depth (m)	2.000
Safety Factor	2.0	Pit Width (m)	2.500	Number Required	5
Porosity	0.95	Pit Length (m)	28.000		

Node PP C2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.400	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)		Depth (m)	0.350
Safety Factor	2.0	Width (m)	67.200	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node PP C1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	110.650	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	110.400	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m³)	
Full Bore Velocity	✓		

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Results for 1 year Critical Storm Duration. Lowest mass balance: 82.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	110.933	0.058	9.3	0.1138	0.0000	OK
15 minute summer	2	10	110.670	0.095	12.8	0.2163	0.0000	OK
15 minute summer	3	10	109.681	0.098	37.9	0.1515	0.0000	OK
15 minute summer	4	11	106.722	0.179	52.7	0.4334	0.0000	OK
15 minute summer	5	10	111.033	0.058	13.0	0.1337	0.0000	OK
15 minute summer	6	10	110.828	0.064	20.0	0.1873	0.0000	OK
15 minute summer	7	10	109.238	0.101	49.5	0.2649	0.0000	OK
5760 minute summer	8	3840	106.684	0.602	5.0	2.1626	0.0000	SURCHARGED
15 minute summer	9	10	107.597	0.084	16.8	0.1902	0.0000	OK
5760 minute summer	10	3840	106.684	0.765	6.3	1.5913	0.0000	SURCHARGED
5760 minute summer	Central Basin	3840	106.685	0.865	13.0	0.3037	0.0000	SURCHARGED
5760 minute summer	Central Soakaway	3720	106.683	1.002	11.8	333.2807	0.0000	OK
15 minute summer	C1 Swale - 30m	11	107.853	0.053	5.5	0.6702	0.0000	OK
15 minute summer	C2 Swale - 35m	1	110.800	0.000	0.0	0.0000	0.0000	OK
30 minute summer	PP C2	20	107.444	0.044	4.6	1.0508	0.0000	OK
15 minute summer	PP C1	12	110.703	0.053	15.7	2.5331	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	3	9.3	1.176	0.138	0.1726
15 minute summer	2	2	3	12.8	0.827	0.349	0.3106
15 minute summer	3	3	4	36.6	2.216	0.384	1.5214
15 minute summer	4	4	8	50.3	1.174	0.642	2.6566
15 minute summer	5	5	7	12.8	1.582	0.145	0.4981
15 minute summer	6	6	7	20.0	1.540	0.180	0.4777
15 minute summer	7	7	8	49.1	2.890	0.399	0.7533
5760 minute summer	8	8	10	5.0	0.435	0.022	5.1613
15 minute summer	9	9	10	16.3	1.238	0.281	0.3683
5760 minute summer	10	10	Central Basin	8.0	0.478	0.025	1.5657
5760 minute summer	Central Basin	11	Central Soakaway	11.8	0.492	0.036	2.2047
5760 minute summer	Central Soakaway	Infiltration		1.5			
15 minute summer	C1 Swale - 30m	7.000	9	4.6	0.839	0.258	0.0865
15 minute summer	C1 Swale - 30m	Infiltration		0.0			
15 minute summer	C2 Swale - 35m	6.000	7	0.0	0.000	0.000	0.0000
15 minute summer	C2 Swale - 35m	Infiltration		0.0			
30 minute summer	PP C2	8.000	10	2.6	0.613	0.177	0.0392
30 minute summer	PP C2	Infiltration		0.0			
15 minute summer	PP C1	1.000	3	9.4	1.723	0.259	0.1303
15 minute summer	PP C1	Infiltration		0.0			

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Results for 30 year Critical Storm Duration. Lowest mass balance: 82.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	110.964	0.089	20.7	0.1754	0.0000	OK
15 minute summer	2	10	110.733	0.158	28.5	0.3594	0.0000	OK
15 minute summer	3	10	109.744	0.161	84.1	0.2487	0.0000	OK
5760 minute summer	4	3900	107.405	0.863	3.9	2.0844	0.0000	SURCHARGED
15 minute summer	5	10	111.063	0.088	28.8	0.2023	0.0000	OK
15 minute summer	6	10	110.862	0.098	44.3	0.2859	0.0000	OK
15 minute summer	7	10	109.311	0.174	110.3	0.4554	0.0000	OK
5760 minute summer	8	3900	107.405	1.323	8.9	4.7525	0.0000	SURCHARGED
15 minute summer	9	10	107.653	0.140	38.4	0.3154	0.0000	OK
5760 minute summer	10	3900	107.405	1.486	10.9	3.0910	0.0000	SURCHARGED
5760 minute summer	Central Basin	3900	107.405	1.585	11.2	34.5068	0.0000	SURCHARGED
5760 minute summer	Central Soakaway	3900	107.405	1.724	13.1	573.2431	0.0000	OK
15 minute summer	C1 Swale - 30m	11	107.886	0.086	12.1	1.0971	0.0000	OK
15 minute summer	C2 Swale - 35m	1	110.800	0.000	0.0	0.0000	0.0000	OK
30 minute summer	PP C2	20	107.466	0.066	10.2	2.3910	0.0000	OK
30 minute summer	PP C1	20	110.731	0.081	31.3	5.8503	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	3	20.7	1.458	0.308	0.3103
15 minute summer	2	2	3	28.5	1.017	0.778	0.5625
15 minute summer	3	3	4	82.7	2.325	0.868	3.1205
5760 minute summer	4	4	8	3.7	0.440	0.047	4.3612
15 minute summer	5	5	7	29.0	1.911	0.329	0.9449
15 minute summer	6	6	7	44.3	1.826	0.398	0.8884
15 minute summer	7	7	8	108.9	3.411	0.884	1.4143
5760 minute summer	8	8	10	8.7	0.406	0.038	5.1613
15 minute summer	9	9	10	37.8	1.517	0.650	0.6953
5760 minute summer	10	10	Central Basin	10.9	0.492	0.034	1.5657
5760 minute summer	Central Basin	11	Central Soakaway	13.1	0.667	0.040	2.2047
5760 minute summer	Central Soakaway	Infiltration		2.6			
15 minute summer	C1 Swale - 30m	7.000	9	10.8	1.044	0.608	0.1636
15 minute summer	C1 Swale - 30m	Infiltration		0.0			
15 minute summer	C2 Swale - 35m	6.000	7	0.0	0.000	0.000	0.0000
15 minute summer	C2 Swale - 35m	Infiltration		0.0			
30 minute summer	PP C2	8.000	10	5.5	0.753	0.382	0.0686
30 minute summer	PP C2	Infiltration		0.0			
30 minute summer	PP C1	1.000	3	19.8	2.087	0.544	0.2264
30 minute summer	PP C1	Infiltration		0.0			

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Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 82.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	9	110.995	0.120	34.9	0.2354	0.0000	OK
15 minute summer	2	11	111.078	0.503	48.0	1.1457	0.0000	SURCHARGED
15 minute summer	3	11	110.908	1.325	123.2	2.0477	0.0000	SURCHARGED
15 minute summer	4	10	108.160	1.618	147.9	3.9075	2.3233	FLOOD
15 minute summer	5	11	111.098	0.123	48.5	0.2823	0.0000	OK
15 minute summer	6	11	110.965	0.201	74.6	0.5857	0.0000	OK
15 minute summer	7	11	110.554	1.417	180.6	3.6988	0.0000	FLOOD RISK
5760 minute summer	8	4020	107.810	1.728	14.3	6.2058	0.0000	SURCHARGED
5760 minute summer	9	4020	107.810	0.297	1.7	0.6699	0.0000	SURCHARGED
5760 minute summer	10	4020	107.810	1.891	17.7	3.9326	0.0000	SURCHARGED
5760 minute summer	Central Basin	4020	107.810	1.990	18.2	320.0919	0.0000	FLOOD RISK
5760 minute summer	Central Soakaway	4020	107.810	2.129	14.3	665.1663	0.0000	OK
15 minute summer	C1 Swale - 30m	11	107.932	0.132	20.4	1.6802	0.0000	OK
15 minute summer	C2 Swale - 35m	1	110.800	0.000	0.0	0.0000	0.0000	OK
5760 minute summer	PP C2	4020	107.810	0.410	1.6	38.9556	0.0000	SURCHARGED
30 minute summer	PP C1	21	110.789	0.139	59.2	17.1202	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	3	33.4	1.627	0.496	0.6670
15 minute summer	2	2	3	43.3	1.118	1.183	0.7999
15 minute summer	3	3	4	87.3	2.340	0.916	3.5387
15 minute summer	4	4	8	128.4	1.823	1.639	4.3612
15 minute summer	5	5	7	46.7	1.914	0.530	1.9098
15 minute summer	6	6	7	71.6	2.008	0.642	1.3818
15 minute summer	7	7	8	134.4	3.380	1.091	1.7621
5760 minute summer	8	8	10	14.2	0.435	0.062	5.1613
5760 minute summer	9	9	10	1.7	0.600	0.029	1.1093
5760 minute summer	10	10	Central Basin	17.7	0.533	0.055	1.5657
5760 minute summer	Central Basin	11	Central Soakaway	14.3	0.685	0.044	2.2047
5760 minute summer	Central Soakaway	Infiltration		3.0			
15 minute summer	C1 Swale - 30m	7.000	9	17.8	1.134	1.000	0.2615
15 minute summer	C1 Swale - 30m	Infiltration		0.0			
15 minute summer	C2 Swale - 35m	6.000	7	0.0	0.000	0.000	0.1083
15 minute summer	C2 Swale - 35m	Infiltration		0.0			
5760 minute summer	PP C2	8.000	10	-1.1	0.373	-0.076	0.1648
5760 minute summer	PP C2	Infiltration		0.2			
30 minute summer	PP C1	1.000	3	37.4	2.325	1.026	0.4125
30 minute summer	PP C1	Infiltration		0.1			

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	15.400	Minimum Backdrop Height (m)	0.200
Ratio-R	0.320	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.019	4.00	113.800	1200	672098.698	713355.172	1.400
2	0.071	4.00	113.200	1200	672107.922	713344.924	1.427
3		4.00	108.938	1200	672198.239	713367.760	1.425
4	0.027	4.00	109.176	1200	672194.154	713377.537	1.716
5	0.142	4.00	108.700	1200	672186.167	713394.034	1.545
6	0.135	4.00	112.500	1200	672075.505	713398.440	1.466
7	0.132	4.00	108.090	1350	672171.083	713434.970	1.655
8	0.117	4.00	106.916	1200	672242.353	713429.014	1.476
9	0.159	4.00	107.660	1350	672231.852	713458.405	2.526
10	0.087	4.00	107.317	1350	672282.075	713476.850	2.718
North Basin			106.000		672278.595	713488.459	1.522
Northern Soakaway			106.000		672272.944	713501.575	1.665
PP N5	0.021	4.00	107.700		672262.388	713396.967	1.350
PP N2	0.029	4.00	108.250		672185.115	713435.325	1.250
PP N1	0.017	4.00	107.800		672244.011	713456.418	1.350
PP N3	0.027	4.00	112.500		672077.230	713390.351	1.350
PP N4	0.045	4.00	113.800		672116.688	713362.990	1.350
N1 Swale - 45 m		4.00	108.090		672138.217	713430.211	1.090
13			107.523	1200	672253.829	713397.918	1.420
31	0.021	4.00	107.300	1200	672304.488	713417.103	1.425

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	1	2	13.788	0.600	112.400	111.773	0.627	22.0	225	4.08	50.0
2	2	4	92.194	0.600	111.773	107.675	4.098	22.5	225	4.82	50.0
3	3	4	10.596	0.600	107.513	107.460	0.053	200.0	225	4.19	50.0
4	4	5	18.329	0.600	107.460	107.155	0.305	60.0	225	5.00	50.0
5	5	7	43.627	0.600	107.155	106.610	0.545	80.0	225	5.50	50.0
6	6	7	102.321	0.600	111.034	106.585	4.449	23.0	225	4.82	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	2.801	111.4	3.4	1.175	1.202	0.019	0.0	27	1.271
2	2.770	110.1	24.4	1.202	1.276	0.135	0.0	72	2.237
3	0.921	36.6	0.0	1.200	1.491	0.000	0.0	0	0.000
4	1.691	67.2	29.3	1.491	1.320	0.162	0.0	104	1.637
5	1.463	58.2	55.0	1.320	1.255	0.304	0.0	175	1.657
6	2.740	108.9	29.3	1.241	1.280	0.162	0.0	80	2.335

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Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
7	7	9	65.131	0.600	106.435	106.001	0.434	150.0	375	6.23	50.0
8	8	9	31.211	0.600	105.440	105.284	0.156	200.0	225	4.96	50.0
9	9	10	53.504	0.600	105.134	104.599	0.535	100.0	375	6.72	50.0
10	10	North Basin	12.119	0.600	104.599	104.478	0.121	100.0	375	6.83	50.0
11	North Basin	Northern Soakaway	14.281	0.600	104.478	104.335	0.143	100.0	375	6.97	50.0
7.000	PP N5	13	8.612	0.600	106.350	106.178	0.172	50.0	150	4.10	50.0
6.000	PP N2	7	14.036	0.600	107.000	106.906	0.094	150.0	150	4.29	50.0
8.000	PP N1	9	12.320	0.600	106.450	106.244	0.206	59.8	150	4.16	50.0
4.000	PP N3	6	8.271	0.600	111.150	111.109	0.041	200.0	150	4.20	50.0
1.000	PP N4	2	20.081	0.600	112.450	112.130	0.320	62.8	150	4.26	50.0
5.000	N1 Swale - 45 m	7	33.209	0.600	107.000	106.779	0.221	150.0	150	4.68	50.0
7.001	13	8	33.146	0.600	106.103	105.440	0.663	50.0	225	4.40	50.0
9.000	31	10	63.813	0.600	105.875	105.556	0.319	200.0	225	5.16	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
7	1.477	163.1	113.4	1.280	1.284	0.628	0.0	231	1.591
8	0.921	36.6	25.0	1.251	2.151	0.138	0.0	137	0.989
9	1.812	200.1	170.3	2.151	2.343	0.942	0.0	267	2.023
10	1.812	200.1	189.8	2.343	1.147	1.050	0.0	293	2.048
11	1.812	200.1	189.8	1.147	1.290	1.050	0.0	293	2.048
7.000	1.426	25.2	3.9	1.200	1.195	0.021	0.0	40	1.034
6.000	0.818	14.5	5.3	1.100	1.034	0.029	0.0	63	0.756
8.000	1.303	23.0	3.1	1.200	1.266	0.017	0.0	37	0.912
4.000	0.707	12.5	4.9	1.200	1.241	0.027	0.0	65	0.665
1.000	1.271	22.5	8.1	1.200	0.920	0.045	0.0	62	1.171
5.000	0.818	14.5	0.0	0.940	1.161	0.000	0.0	0	0.000
7.001	1.854	73.7	3.9	1.195	1.251	0.021	0.0	35	0.986
9.000	0.921	36.6	3.8	1.200	1.536	0.021	0.0	49	0.598

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1	13.788	22.0	225	Circular	113.800	112.400	1.175	113.200	111.773	1.202
2	92.194	22.5	225	Circular	113.200	111.773	1.202	109.176	107.675	1.276
3	10.596	200.0	225	Circular	108.938	107.513	1.200	109.176	107.460	1.491
4	18.329	60.0	225	Circular	109.176	107.460	1.491	108.700	107.155	1.320
5	43.627	80.0	225	Circular	108.700	107.155	1.320	108.090	106.610	1.255
6	102.321	23.0	225	Circular	112.500	111.034	1.241	108.090	106.585	1.280
7	65.131	150.0	375	Circular	108.090	106.435	1.280	107.660	106.001	1.284

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
2	2	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
3	3	1200	Manhole	Adoptable	4	1200	Manhole	Adoptable
4	4	1200	Manhole	Adoptable	5	1200	Manhole	Adoptable
5	5	1200	Manhole	Adoptable	7	1350	Manhole	Adoptable
6	6	1200	Manhole	Adoptable	7	1350	Manhole	Adoptable
7	7	1350	Manhole	Adoptable	9	1350	Manhole	Adoptable

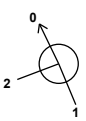
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Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
8	31.211	200.0	225	Circular	106.916	105.440	1.251	107.660	105.284	2.151
9	53.504	100.0	375	Circular	107.660	105.134	2.151	107.317	104.599	2.343
10	12.119	100.0	375	Circular	107.317	104.599	2.343	106.000	104.478	1.147
11	14.281	100.0	375	Circular	106.000	104.478	1.147	106.000	104.335	1.290
7.000	8.612	50.0	150	Circular	107.700	106.350	1.200	107.523	106.178	1.195
6.000	14.036	150.0	150	Circular	108.250	107.000	1.100	108.090	106.906	1.034
8.000	12.320	59.8	150	Circular	107.800	106.450	1.200	107.660	106.244	1.266
4.000	8.271	200.0	150	Circular	112.500	111.150	1.200	112.500	111.109	1.241
1.000	20.081	62.8	150	Circular	113.800	112.450	1.200	113.200	112.130	0.920
5.000	33.209	150.0	150	Circular	108.090	107.000	0.940	108.090	106.779	1.161
7.001	33.146	50.0	225	Circular	107.523	106.103	1.195	106.916	105.440	1.251
9.000	63.813	200.0	225	Circular	107.300	105.875	1.200	107.317	105.556	1.536

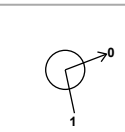
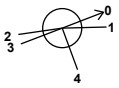
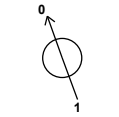
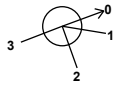
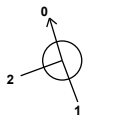
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
8	8	1200	Manhole	Adoptable	9	1350	Manhole	Adoptable
9	9	1350	Manhole	Adoptable	10	1350	Manhole	Adoptable
10	10	1350	Manhole	Adoptable	North Basin		Junction	
11	North Basin		Junction		Northern Soakaway		Junction	
7.000	PP N5		Junction		13	1200	Manhole	Adoptable
6.000	PP N2		Junction		7	1350	Manhole	Adoptable
8.000	PP N1		Junction		9	1350	Manhole	Adoptable
4.000	PP N3		Junction		6	1200	Manhole	Adoptable
1.000	PP N4		Junction		2	1200	Manhole	Adoptable
5.000	N1 Swale - 45 m		Junction		7	1350	Manhole	Adoptable
7.001	13	1200	Manhole	Adoptable	8	1200	Manhole	Adoptable
9.000	31	1200	Manhole	Adoptable	10	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	672098.698	713355.172	113.800	1.400	1200		0	1	112.400	225
2	672107.922	713344.924	113.200	1.427	1200		1	1	111.773	225
							2	1.000	112.130	150
							0	2	111.773	225
3	672198.239	713367.760	108.938	1.425	1200		0	3	107.513	225
4	672194.154	713377.537	109.176	1.716	1200		1	3	107.460	225
							2	2	107.675	225
							0	4	107.460	225
5	672186.167	713394.034	108.700	1.545	1200		1	4	107.155	225
							0	5	107.155	225

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
6	672075.505	713398.440	112.500	1.466	1200		1	4.000	111.109	150
							0	6	111.034	225
7	672171.083	713434.970	108.090	1.655	1350		1	6.000	106.906	150
							2	5.000	106.779	150
							3	6	106.585	225
							4	5	106.610	225
							0	7	106.435	375
8	672242.353	713429.014	106.916	1.476	1200		1	7.001	105.440	225
							0	8	105.440	225
9	672231.852	713458.405	107.660	2.526	1350		1	8.000	106.244	150
							2	8	105.284	225
							3	7	106.001	375
							0	9	105.134	375
10	672282.075	713476.850	107.317	2.718	1350		1	9.000	105.556	225
							2	9	104.599	375
							0	10	104.599	375
North Basin	672278.595	713488.459	106.000	1.522			1	10	104.478	375
							0	11	104.478	375
Northern Soakaway	672272.944	713501.575	106.000	1.665			1	11	104.335	375
PP N5	672262.388	713396.967	107.700	1.350			0	7.000	106.350	150
PP N2	672185.115	713435.325	108.250	1.250			0	6.000	107.000	150
PP N1	672244.011	713456.418	107.800	1.350			0	8.000	106.450	150
PP N3	672077.230	713390.351	112.500	1.350			0	4.000	111.150	150
PP N4	672116.688	713362.990	113.800	1.350			0	1.000	112.450	150
N1 Swale - 45 m	672138.217	713430.211	108.090	1.090			0	5.000	107.000	150

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Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
13	672253.829	713397.918	107.523	1.420	1200	1	7.000	106.178	150
						0	7.001	106.103	225
31	672304.488	713417.103	107.300	1.425	1200				
						0	9.000	105.875	225

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	15.400	Starting Level (m)	
Ratio-R	0.320	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	30	0	0

Node PP N5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.350	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	43.200	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node Northern Soakaway Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	104.335	Depth (m)	2.200
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	3654	Inf Depth (m)	2.200
Safety Factor	2.0	Pit Width (m)	2.500	Number Required	4
Porosity	0.95	Pit Length (m)	30.000		

Node North Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	105.000
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	441.0	441.0	1.000	841.0	850.7	1.001	0.0	850.7

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Node PP N2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.000	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	52.800	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node PP N1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	106.450	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	57.600	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node PP N3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	111.150	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	62.000	Inf Depth (m)	0.350
Porosity	1.00	Length (m)	5.000		

Node PP N4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	112.450	Slope (1:X)	40.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	0.350
Safety Factor	2.0	Width (m)	57.600	Inf Depth (m)	0.350
Porosity	0.40	Length (m)	5.000		

Node N1 Swale - 45 m Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	107.000	Depth (m)	1.000
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)	0	Inf Depth (m)	1.000
Safety Factor	2.0	Pit Width (m)	1.000	Number Required	1
Porosity	0.40	Pit Length (m)	45.000		

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m^3)	
Full Bore Velocity	✓		

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	112.425	0.025	2.9	0.0350	0.0000	OK
15 minute summer	2	10	111.833	0.060	18.0	0.1283	0.0000	OK
15 minute summer	3	10	107.547	0.034	0.7	0.0388	0.0000	OK
15 minute summer	4	10	107.546	0.086	21.2	0.1244	0.0000	OK
15 minute summer	5	11	107.300	0.144	42.9	0.4294	0.0000	OK
15 minute summer	6	10	111.102	0.068	21.9	0.2010	0.0000	OK
15 minute summer	7	11	106.630	0.195	84.5	0.5894	0.0000	OK
15 minute summer	8	10	105.561	0.121	20.5	0.3276	0.0000	OK
15 minute summer	9	11	105.357	0.223	125.2	0.6006	0.0000	OK
8640 minute summer	10	5400	105.149	0.550	4.5	1.1376	0.0000	SURCHARGED
8640 minute summer	North Basin	5400	105.149	0.671	14.0	66.7571	0.0000	SURCHARGED
8640 minute summer	Northern Soakaway	5400	105.149	0.814	6.7	231.9324	0.0000	OK
15 minute summer	PP N5	11	106.383	0.033	3.4	0.3926	0.0000	OK
30 minute summer	PP N2	20	107.043	0.043	4.1	0.8200	0.0000	OK
15 minute summer	PP N1	12	106.479	0.029	2.7	0.3909	0.0000	OK
60 minute summer	PP N3	38	111.183	0.033	2.8	1.3349	0.0000	OK
15 minute summer	PP N4	12	112.496	0.046	7.1	1.0260	0.0000	OK
15 minute summer	N1 Swale - 45 m	1	107.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	13	12	106.132	0.029	2.6	0.0323	0.0000	OK
15 minute summer	31	11	105.917	0.042	3.3	0.0604	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	2	2.9	0.595	0.026	0.0752
15 minute summer	2	2	4	17.1	2.021	0.155	0.7793
15 minute summer	3	3	4	-0.7	-0.111	-0.019	0.0941
15 minute summer	4	4	5	21.0	1.026	0.312	0.3746
15 minute summer	5	5	7	41.4	1.572	0.711	1.1487
15 minute summer	6	6	7	21.2	2.128	0.195	1.0202
15 minute summer	7	7	9	83.6	1.485	0.512	3.6670
15 minute summer	8	8	9	19.3	0.927	0.527	0.6545
15 minute summer	9	9	10	126.8	1.737	0.634	3.9027
8640 minute summer	10	10	North Basin	6.7	0.411	0.034	1.3367
8640 minute summer	North Basin	11	Northern Soakaway	-7.2	0.413	-0.036	1.5752
8640 minute summer	North Basin	Infiltration		0.2			
8640 minute summer	Northern Soakaway	Infiltration		1.1			
15 minute summer	PP N5	7.000	13	2.6	0.912	0.103	0.0245
15 minute summer	PP N5	Infiltration		0.0			
30 minute summer	PP N2	6.000	7	2.6	0.620	0.179	0.0587
15 minute summer	PP N1	8.000	9	1.8	0.776	0.079	0.0288
60 minute summer	PP N3	4.000	6	1.3	0.457	0.101	0.0228
60 minute summer	PP N3	Infiltration		0.0			
15 minute summer	PP N4	1.000	2	4.6	0.997	0.204	0.0923
15 minute summer	N1 Swale - 45 m	5.000	7	0.0	0.000	0.000	0.0000
15 minute summer	N1 Swale - 45 m	Infiltration		0.0			
15 minute summer	13	7.001	8	2.5	0.298	0.035	0.4020
15 minute summer	31	9.000	10	2.8	0.552	0.078	0.3281

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	112.437	0.037	6.5	0.0514	0.0000	OK
15 minute summer	2	10	111.866	0.093	39.8	0.1975	0.0000	OK
15 minute summer	3	12	107.930	0.417	1.9	0.4714	0.0000	SURCHARGED
15 minute summer	4	12	107.906	0.446	54.3	0.6438	0.0000	SURCHARGED
15 minute summer	5	11	107.793	0.638	83.4	1.8951	0.0000	SURCHARGED
15 minute summer	6	10	111.139	0.105	48.6	0.3104	0.0000	OK
15 minute summer	7	11	106.764	0.329	169.7	0.9960	0.0000	OK
15 minute summer	8	11	106.202	0.762	45.6	2.0705	0.0000	SURCHARGED
15 minute summer	9	11	106.076	0.942	243.0	2.5345	0.0000	SURCHARGED
4320 minute summer	10	3000	105.445	0.846	12.1	1.7498	0.0000	SURCHARGED
4320 minute summer	North Basin	3000	105.445	0.967	17.6	224.0851	0.0000	SURCHARGED
4320 minute summer	Northern Soakaway	3000	105.445	1.110	7.8	316.2598	0.0000	OK
15 minute summer	PP N5	11	106.400	0.050	7.4	0.8676	0.0000	OK
30 minute summer	PP N2	20	107.066	0.066	9.2	1.8572	0.0000	OK
15 minute summer	PP N1	11	106.493	0.043	6.1	0.8655	0.0000	OK
60 minute summer	PP N3	38	111.198	0.048	6.2	2.9193	0.0000	OK
15 minute summer	PP N4	12	112.521	0.071	15.7	2.3452	0.0000	OK
15 minute summer	N1 Swale - 45 m	1	107.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	13	12	106.215	0.112	6.8	0.1265	0.0000	OK
15 minute summer	31	11	105.940	0.065	7.4	0.0929	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	2	6.5	0.736	0.058	0.1352
15 minute summer	2	2	4	39.5	2.413	0.359	2.5040
15 minute summer	3	3	4	8.0	0.404	0.218	0.4214
15 minute summer	4	4	5	47.0	1.181	0.699	0.7290
15 minute summer	5	5	7	74.2	1.865	1.275	1.7130
15 minute summer	6	6	7	48.5	2.325	0.445	2.5767
15 minute summer	7	7	9	164.2	1.685	1.007	6.3965
15 minute summer	8	8	9	43.8	1.119	1.195	1.2413
15 minute summer	9	9	10	242.4	2.198	1.212	5.9013
4320 minute summer	10	10	North Basin	12.0	0.514	0.060	1.3367
4320 minute summer	North Basin	11	Northern Soakaway	-8.6	0.647	-0.043	1.5752
4320 minute summer	North Basin	Infiltration		0.9			
4320 minute summer	Northern Soakaway	Infiltration		1.4			
15 minute summer	PP N5	7.000	13	5.6	1.128	0.222	0.0427
15 minute summer	PP N5	Infiltration		0.0			
30 minute summer	PP N2	6.000	7	5.6	0.763	0.385	0.1026
15 minute summer	PP N1	8.000	9	4.0	0.972	0.174	0.0507
60 minute summer	PP N3	4.000	6	2.7	0.563	0.216	0.0396
60 minute summer	PP N3	Infiltration		0.0			
15 minute summer	PP N4	1.000	2	9.8	1.222	0.437	0.1615
15 minute summer	N1 Swale - 45 m	5.000	7	0.0	0.000	0.000	0.0000
15 minute summer	N1 Swale - 45 m	Infiltration		0.0			
15 minute summer	13	7.001	8	14.2	0.417	0.193	0.9851
15 minute summer	31	9.000	10	6.7	0.708	0.183	0.6036

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Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 99.58%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	112.448	0.048	11.0	0.0665	0.0000	OK
15 minute summer	2	10	111.897	0.124	66.3	0.2649	0.0000	OK
15 minute summer	3	11	108.938	1.425	18.7	1.6117	1.4004	FLOOD
15 minute summer	4	11	108.981	1.521	81.4	2.1973	0.0000	FLOOD RISK
15 minute summer	5	11	108.700	1.545	124.9	4.5917	2.6778	FLOOD
15 minute summer	6	10	111.179	0.144	82.0	0.4288	0.0000	OK
15 minute summer	7	11	107.386	0.951	241.6	2.8808	0.0000	SURCHARGED
15 minute summer	8	11	106.842	1.402	68.8	3.8101	0.0000	FLOOD RISK
15 minute summer	9	11	106.710	1.576	303.8	4.2399	0.0000	SURCHARGED
4320 minute summer	10	3060	105.800	1.201	19.2	2.4850	0.0000	SURCHARGED
4320 minute summer	North Basin	3060	105.800	1.322	19.2	456.9830	0.0000	FLOOD RISK
4320 minute summer	Northern Soakaway	3060	105.800	1.465	11.9	417.5266	0.0000	OK
30 minute summer	PP N5	22	106.517	0.167	38.2	9.0590	0.0000	SURCHARGED
15 minute summer	PP N2	13	107.137	0.137	39.8	7.9096	0.0000	OK
15 minute summer	PP N1	12	106.553	0.103	29.1	4.9288	0.0000	OK
30 minute summer	PP N3	22	111.213	0.063	14.4	5.0209	0.0000	OK
15 minute summer	PP N4	12	112.544	0.094	26.5	4.1676	0.0000	OK
15 minute summer	N1 Swale - 45 m	13	107.108	0.108	15.1	1.9457	0.0000	OK
15 minute summer	13	11	106.723	0.620	34.9	0.7013	0.0000	SURCHARGED
15 minute summer	31	10	105.962	0.087	12.4	0.1244	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
15 minute summer	1	1	2	11.0	0.836	0.099	0.1971
15 minute summer	2	2	4	65.6	2.524	0.596	2.8699
15 minute summer	3	3	4	-18.7	0.662	-0.511	0.4214
15 minute summer	4	4	5	59.4	1.493	0.883	0.7290
15 minute summer	5	5	7	92.1	2.316	1.583	1.7351
15 minute summer	6	6	7	81.8	2.408	0.751	3.4125
15 minute summer	7	7	9	189.9	1.722	1.164	7.1838
15 minute summer	8	8	9	48.0	1.208	1.312	1.2413
15 minute summer	9	9	10	281.2	2.550	1.406	5.9013
4320 minute summer	10	10	North Basin	19.2	0.584	0.096	1.3367
4320 minute summer	North Basin	11	Northern Soakaway	11.9	0.663	0.059	1.5752
4320 minute summer	North Basin	Infiltration		1.6			
4320 minute summer	Northern Soakaway	Infiltration		1.9			
30 minute summer	PP N5	7.000	13	-27.5	-1.632	-1.091	0.1516
30 minute summer	PP N5	Infiltration		0.1			
15 minute summer	PP N2	6.000	7	-25.6	-1.499	-1.770	0.2392
15 minute summer	PP N1	8.000	9	-20.7	1.364	-0.900	0.1879
30 minute summer	PP N3	4.000	6	4.4	0.648	0.356	0.0568
30 minute summer	PP N3	Infiltration		0.0			
15 minute summer	PP N4	1.000	2	15.6	1.359	0.694	0.2305
15 minute summer	N1 Swale - 45 m	5.000	7	-15.1	-1.111	-1.045	0.5180
15 minute summer	N1 Swale - 45 m	Infiltration		0.0			
15 minute summer	13	7.001	8	-32.4	0.893	-0.439	1.3183
15 minute summer	31	9.000	10	11.4	0.821	0.312	0.8900

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UK and Ireland Office Locations





Flood Risk Assessment

Phase 2 of Proposed Residential Development at Southgreen, Co. Kildare

July 2025

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Client Name: Pousterle Limited
Document Reference: 25-003r.002
Project Number: 25-003

Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

Issue	Date	Prepared by	Checked by	Approved by
No. 1	11 July 25	C Maher	P Ingle	

Comments

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1. Introduction

This Flood Risk Assessment has been prepared by Waterman Moylan Engineering Consultants, on behalf of the Client, Pousterle Ltd, as part of a planning submission for a proposed 153 No. housing development at the proposed Phase 2 Development of Southgreen, Co. Kildare.

This FRA has been carried out in accordance with the Department of Housing and Local Government (DEHLG) and the Office of Public Works (OPW) document *"The Planning Process and Flood Risk Management Guidelines for Planning Authorities"* published in November 2009. This Flood Risk Assessment references the Eastern CFRAM Study Catchment Analysis. This Assessment identifies and sets out possible mitigation measures against potential risks of flooding from various sources. Sources of possible flooding include coastal, fluvial, pluvial (direct heavy rain), groundwater and human/mechanical error.

This report provides an assessment of the subject site for flood risk purposes only.

Supplementary documentation referred to when compiling this report, includes:

- Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Volume 2, for New Developments
- The SuDS Manual (CIRIA C753)
- Kildare Town Local Area Plan 2023-2029
- Kildare County Development Plan 2023-2029
- Strategic Flood Risk Assessment of the Kildare County Development Plan 2023-2029
- Strategic Flood Risk Assessment of the Kildare Town Local Area Plan 2023-2029
- Kildare Town Surface Water Study Stage 1 (November 2022)
- Kildare Town Surface Water Study Stage 2 (January 2023)
- Kildare County Council (KCC) Sustainable Drainage Systems (SuDS) Guidance Document.

2. Subject Site

2.1 Existing Site Location

The site is located at Southgreen Road, approximately c. 750 m northwest of Kildare Town in Co. Kildare (as the crow flies) as shown in Figure 2-1, below. The site is bound by Southgreen Road to the west, open lands to the north, Old Road (L7016) to the east, and by the Internal Link Road (SILR) and South Green Phase 1 to the south.

The lands, which are currently in agricultural use, slope generally from west to east. The site area, and area of the redline boundary, is approximately c. 5.74 hectares (ha).

Refer to Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0010 – Site Location Map for the precise site location and surrounding lands.

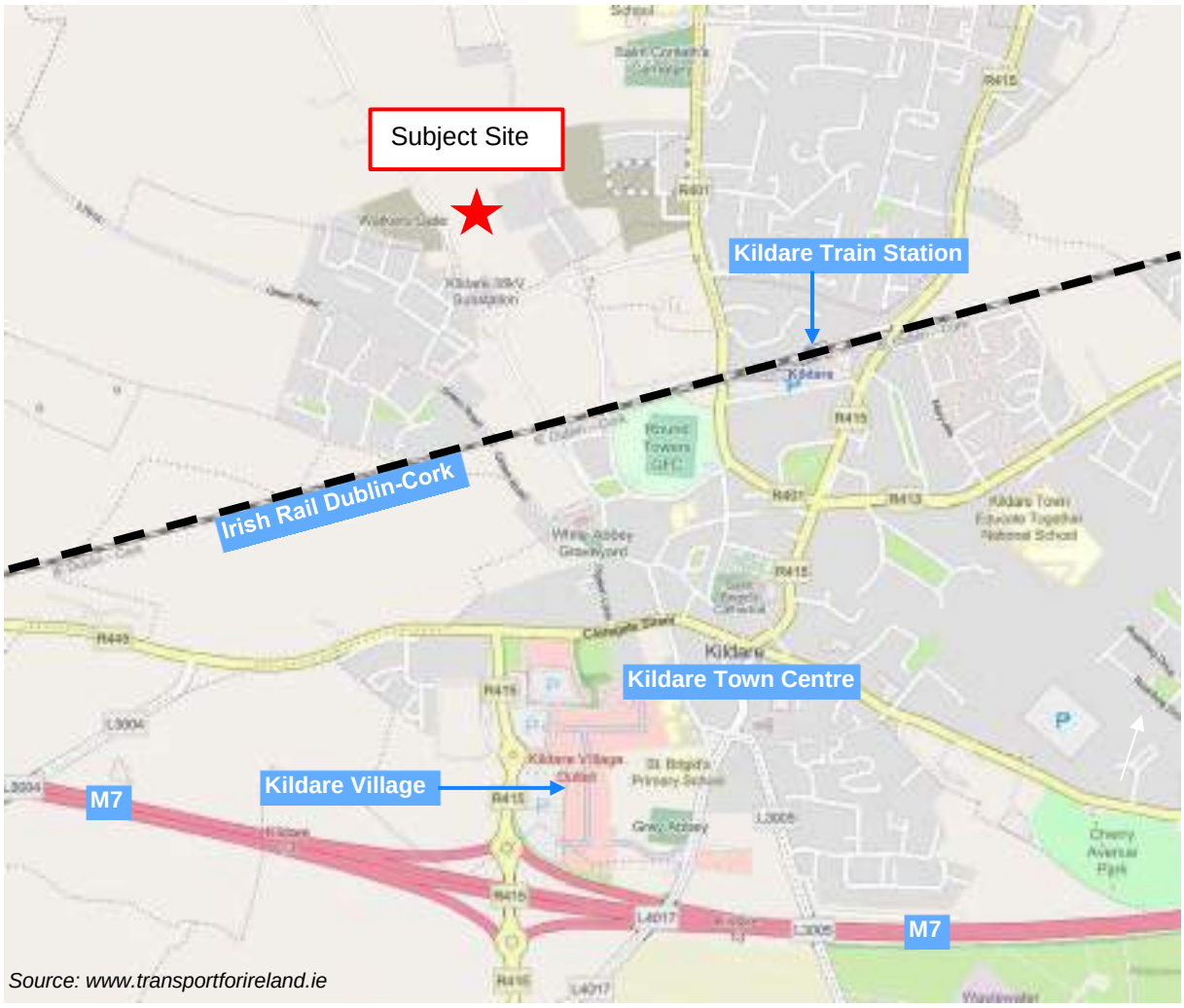


Figure 2-1: Site Location Map

An aerial view of the subject site can be seen in Figure 2-2, below.



Figure 2-2: Aerial View of Subject Site (Google Maps)

2.2 Existing Site Description

The site has an area, and redline boundary, of c. 5.74 ha and is currently 100% greenfield. The site falls from west to east with a steep gradient of approximately 1 in 25, and less. The site is currently in greenfield condition and is used for agricultural purposes.

The existing topography consists of naturally high ground elevations along the western boundary of the site, with levels ranging from 111.19m OD Malin to 113.79m OD Malin. The site falls to the east where the lowest ground elevations are distributed, these levels range from 106.85m OD Malin to 104.03m OD Malin. The local high point on the site (113.79m OD Malin) is located in the northwest portion of the lands and the local low point (104.03m OD Malin) is located in the central far east area of the lands.

Refer to Figure 2-3 for an illustration of the subject site and existing ground elevations within same.

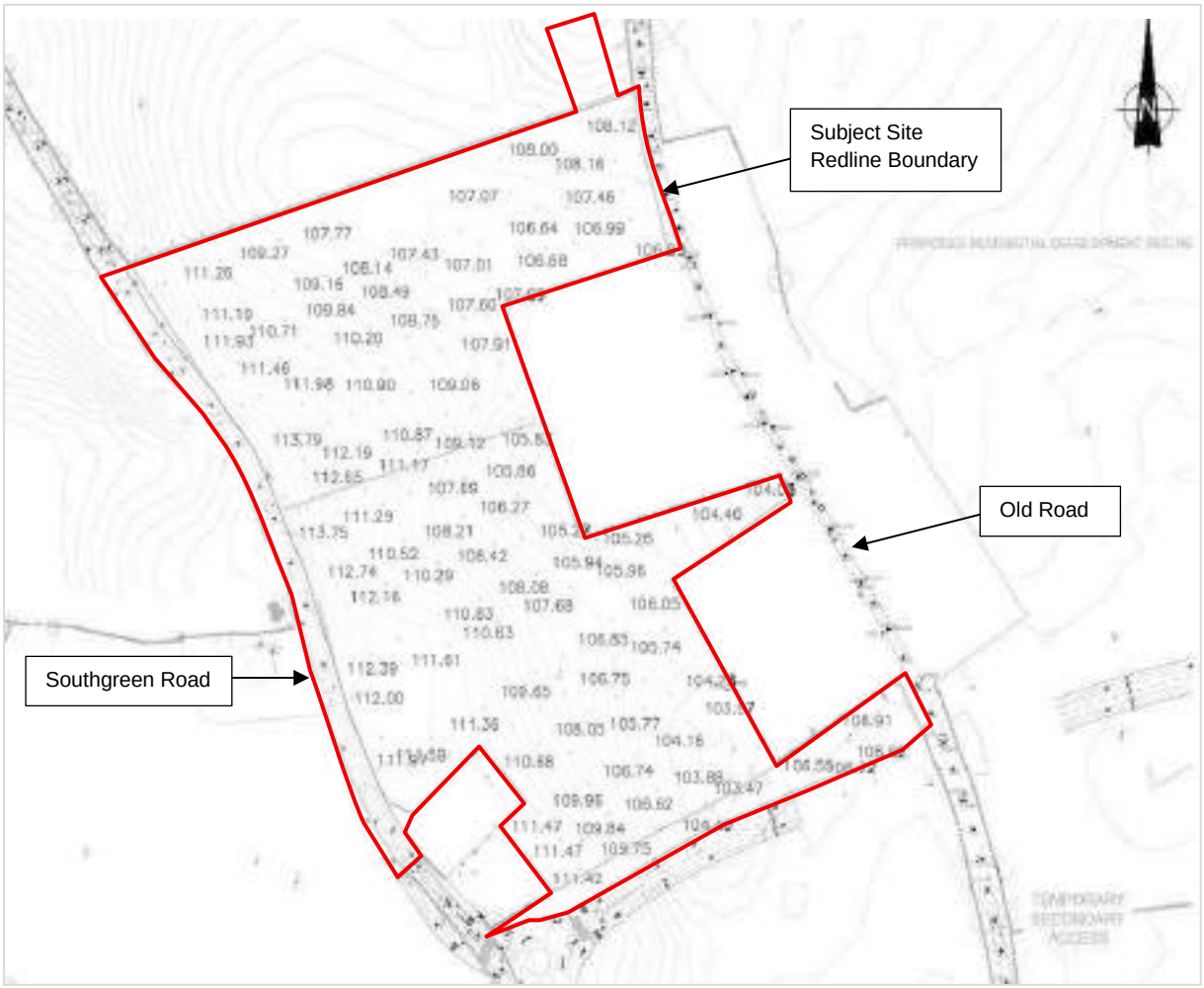


Figure 2-3: Subject Site Topography and Spot Elevations

2.3 Existing Watercourses

The subject development is not situated adjacent to any major watercourses. The surrounding area is primarily characterised by urban and agricultural land with limited surface water features. The nearest notable watercourse is the Tully Stream, located south of the M7 motorway, which flows away from the site and does not have a direct hydrological connection to it. No rivers, streams, or open drainage channels traverse or border the subject lands. As such, the influence of fluvial sources on the site's flood risk is considered to be low.

Refer to Figure 2-4 for an extract from the Environmental Protection Agency (EPA) website, showing a location of the subject lands in relation to the existing watercourse mentioned above.



Figure 2-4: Subject Site Location relative to Existing Watercourses

2.4 Proposed Development

Pousterle Limited intend to apply for permission for development of a Large - Scale Residential Development (LRD) on a site of approx. 5.74 ha at Southgreen Road, Kildare, Co. Kildare. The site is generally bounded to the north by agricultural fields; to the south by the recently constructed Southern Internal Link Road; to the west by Southgreen Road and an existing Electricity Station; and to the east by Old Road and existing residential properties.

The proposed development will consist of:

- The construction of a new residential scheme of 153 no. house type units ranging in height from 1-2 storeys as follows:
  - 141 no. houses (4 no. 2 bed units; 107 no. 3 bed units; and 30 no. 4 bed units) in a mixture of bungalow, detached, semi-detached, and terrace style units.
  - 12 no. duplex apartment units (4 no. 1 beds and 8 no. 2 beds)
- Each residential unit will be afforded with private open space in the form of a front/rear/side garden.
- Public open space (approx. 7,214 sq m) is proposed in the form of 2 no. new large public open space areas within the site (approx. 3,401 sq m and 3,813 sq m respectively).

- A total of 332 no. car parking spaces (303 no. for residents and 29 no. for visitors). This provision includes 1 no. accessible visitor space and 29 no. standard visitor spaces. All residential spaces will be provided with EV charging on curtilage. Residential spaces off curtilage will also be provided with EV charging facilities. 4 no. EV visitor spaces will be provided.
- A total of 331 no. cycle parking spaces (260 no. for residents and 71 no. for visitors) are provided. Resident cycle parking is proposed in the form of secure bicycle store enclosures to the front of terraced units; on curtilage spaces to the rear of units with side access; and a bicycle store for duplex units. Visitor parking is proposed in the form of Sheffield stands.
- The development shall be served via a new vehicular access point from Southgreen Road. An additional private vehicular access point is proposed via Old Road to service 1 no. new bungalow 4 bed residential unit.
- Pedestrian and Cyclist access is also proposed via Southgreen Road and via a new secondary access point from the Southern Internal Link Road to the south of the site and Old Road to the east of the site.
- A double-lane cycle track and footpath are also proposed along Southgreen Road adjacent to the proposed scheme.
- The associated site and infrastructural works include provision for an ESB Sub Station; water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works; boundary treatment; internal roads and footpaths; waste storage areas, all electrical services and all associated site development works.

3. Flood Risk

3.1 Introduction

The flood risk assessment of a development should be carried out in accordance with the Planning System and Flood Risk Management Guidelines for Planning Authorities (2009), published by the Department of Environment, Heritage and Local Government in conjunction with the Office of Public Works (EHLG/OPW). This document will be referred to as the 'Guidelines (EHLG/OPW)' in this report.

The types of possible flooding to be considered in the identification and assessment of flood risk are described in Chapter 2 of the Guidelines (EHLG/OPW) and are summarised below:

- Coastal – flooding from higher sea levels than normal
- Fluvial – flooding from watercourses
- Pluvial – flooding from heavy rainfall/surface water
- Ground Water – flooding from springs / raised groundwater
- Human/mechanical error – flooding due to human or mechanical error

Each type will be investigated from a Source, Pathway and Receptor perspective, followed by an assessment of the likelihood of a flood occurring, and the possible consequences. An illustration of this model can be seen in Figure 3-1, taken directly from the Guidelines (EHLF/OPW).

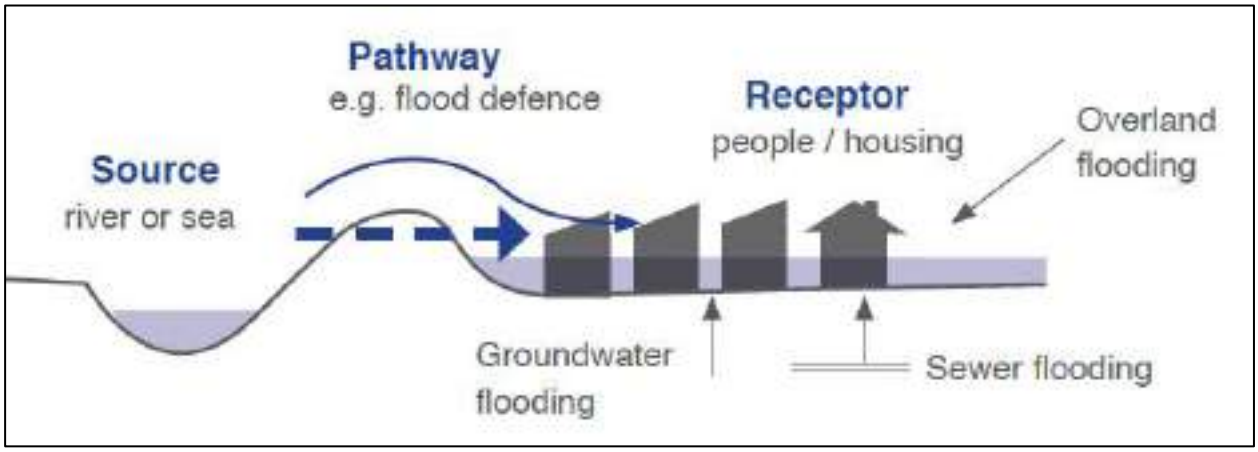


Figure 3-1: Source-Pathway-Receptor S-P-R Model

A flood risk assessment combines these above components and maps or describes the risks on a spatial scale so that the consequences can then be analysed.

The likelihood and the consequences of flooding (overall risk) fall into three categories; low, moderate and high, as described in the Guidelines (EHLF/OPW) and set out in Table 3-2.

The aim of a flood risk assessment is to establish the risk of flooding for a subject site, this can be assessed using two components, summarised below:

Flood Risk = Likelihood of flooding X Consequences of flooding

3.1.1 Assessing Likelihood

The likelihood of flooding falls into the categories of low, moderate and high, which are described in the Guidelines (EHLF/OPW) as follows:

Table 3-1: Guidelines for Assessing Likelihood

LIKELIHOOD	LOW	MODERATE	HIGH
Coastal	Probability < 0.1%	0.5% > probability > 0.1%	Probability > 0.5%
Fluvial	Probability < 0.1%	1.0% > probability > 0.1%	Probability > 1.0%
Pluvial	Probability < 0.1%	1.0% > probability > 0.1%	Probability > 1.0%

Note: Probability denotes the likelihood of occurrence in a given year.

For groundwater flooding and flooding from human/mechanical error, the limits of probability are not defined and therefore professional judgement is used. However, the likelihood of flooding is still categorised as low, moderate and high for these components.

3.1.2 Assessing Consequence

There is no defined method used to quantify a value for the consequences of a flooding event. Therefore, in order to determine a value for the consequences of a flooding event, the elements likely to be adversely affected by such flooding will be assessed, with the likely damage being stated, and professional judgement will be used to determine a value for consequences. Consequences will also be categorized as low, moderate, and high.

3.1.3 Assessing Risk

Based on the determined 'likelihood' and 'consequences' values of a flood event and the above equation of Flood Risk = Likelihood of flooding x Consequences of flooding, the 3x3 Risk Matrix seen in Table 3-2 will then be used to determine the overall risk of a flood event.

Table 3-2: 3x3 Risk Matrix

		CONSEQUENCES		
		LOW	MODERATE	HIGH
LIKELIHOOD	LOW	Extremely Low Risk	Low Risk	Moderate Risk
	MODERATE	Low Risk	Moderate Risk	High Risk
	HIGH	Moderate Risk	High Risk	Extremely High Risk

3.2 Flood Zones

Flood zones are used to identify the likelihood, and therefore vulnerability, of flooding in a particular area. The zones are geographical areas with associated ranges of the likelihood of flooding and are essential in the creation of flood risk management plans. According to the Guidelines (DEHLG/OPW) flood zones can be categorised into 3 types or levels of flood zones, namely:

Table 3-3: Flood Zone Types according to the Guidelines (DEHLF/OPW)

Type	Description	Probability of flooding
Zone A	Where the probability of flooding from rivers and the sea is highest	Greater than 1% (1:100 year) for fluvial flooding, or greater than 0.5% (1:200 year) for coastal flooding
Zone B	Where the probability of flooding from rivers and the sea is moderate	Between 0.1% (1:1000 year) & 1% (1:100 year) for fluvial flooding, and 0.1% (1:1000 year) & 0.5% (1:200 year) for coastal flooding
Zone C	Where the probability of flooding from rivers and the sea is low	Less than 0.1% (1:1000 year) for both fluvial and coastal flooding

Flood zone maps are used to establish the level of flooding for a site, an example of this can be seen in the indicative map shown in Figure 3-2.



Figure 3-2: Indicative flood zone map extract from the Guidelines (DEHLF/OPW)

3.3 Sequential Approach and Justification Test

3.3.1 Sequential Approach

A sequential approach to planning is a vital tool in ensuring that development, particularly new development, is first and foremost directed towards the land that is at low risk of flooding. Sequential approaches are already established and working effectively in other areas in the plan-making and development management processes. The sequential approach principles are described in Figure 3-3, taken from the

Guidelines (DEHLF/OPW). The sequential approach should be applied to all stages of the planning and development management process, particularly the planning stage. The mechanism for use of the sequential approach can be seen in Figure 3-4.



Figure 3-3: Sequential Approach Principles in Flood Risk Management

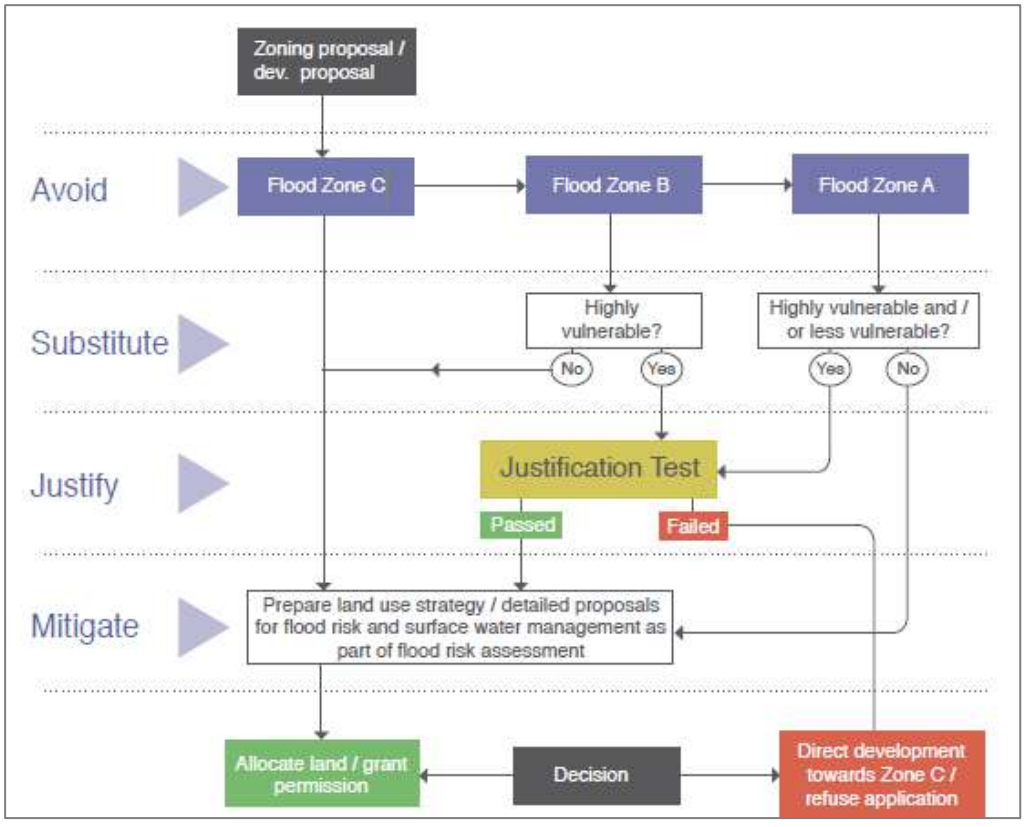


Figure 3-4: Sequential Approach Mechanisms

If the subject site does not fall within the 'Avoid' or 'Substitute' tiers of the sequential approach principle, a Justification test is required.

3.3.2 Justification Test

A matrix of vulnerability versus flood zone clearly outlines which types of development require a Justification Test.

The vulnerability of a site is categorized into 3 levels, highly vulnerable, less vulnerable, and water compatible. Figure 3-5 taken from the Guidelines (DEHLG/OPW) illustrates these categories.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).
*Uses not listed here should be considered on their own merits	

Figure 3-5: Vulnerability Classes

The resulting matrix of vulnerability vs. flood zone, taken from the Guidelines (DEHLG/OPW), illustrates which type of developments require a Justification Test, and can be seen below.

- **The Subject Site's Vulnerability Class**

  As this subject site falls within the 'Highly-vulnerable development' category according to Figure 3-5, when assessing the matrix vs. vulnerability of the development – with a Flood Zone C development – it is considered to be an "appropriate" development and therefore does not require a Justification Test be completed. Refer to Table 3-4 for the matrix of vulnerability vs. flood zone relevant to the subject site.

Table 3-4: Matrix of vulnerability vs. flood zone - Justification Test

Type	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water compatible development	Appropriate	Appropriate	Appropriate

Thus, it is considered an appropriate development and **does not require a Justification Test** or further flood mitigation measures other than what is described in this report.

Details pertaining to the Flood Zone of the subject site, Flood Zone C, are discussed in detail in the sections to follow within this report.

4. Coastal Flooding – Irish Sea

4.1 Source

Coastal flooding occurs due to elevated sea levels, mainly driven by storm surges. This results in the overflowing of the sea or tidally influenced rivers onto the land. This type of flooding is primarily influenced by high tides and storm surges, which are caused by factors like low atmospheric pressure and strong winds, along with wave action.

4.2 Pathway

The Irish Sea is approximately c. 56 km east of the subject site. The lowest FFL of the proposed development is set at 106 m OD Malin. The location of the subject lands in relation to the Irish Sea is shown in a Google Maps image extracted to Figure 4-1.

Given the position and elevation of the subject site in relation to the Irish Sea, there is no risk of coastal flooding. It is therefore evident that a pathway does not exist between the source and the receptor. A risk from coastal flooding is therefore considered negligible and no flood mitigation measures need to be implemented.



Figure 4-1: Google Earth Extract showing Subject Lands in relation to the Irish Sea

4.3 Receptor

As there is no possible or practical pathway for coastal flooding to the subject site, no receptor of coastal flooding exists.

4.4 Likelihood

There is no likelihood of flooding from coastal sources to the subject site as there is no pathway of this type of flooding.

The Kildare Town Local Area Plan 2023-2029 – Strategic Flood Risk Assessment (SFRA) indicates no areas in the town of Kildare are at risk of flooding from coastal or fluvial sources and that the town in its entirety is within Flood Zone C. An extract of Figure 5-3 from the referenced document can be seen in Figure 4-2 below. The map includes flooding events for the following:

- Catchment-based Flood Risk Assessment and Management (CFRAM) 0.1% Annual Exceedance Probability (AEP)
- CFRAM 1% AEP
- CRFRAM 10% AEP

The 0.1% AEP would illustrate the most severe of the flooding possibilities of the above flood events and corresponds to the 1-in-1000-year flood event for both the coastal and fluvial flooding events. As can be seen in the below figure, the subject site is not at risk of the 0.1% AEP flood event from coastal flooding.



Figure 4-2: Predictive Flood Map for Kildare Town (Source: Kildare Town LAP SFRA)

4.5 Consequence

With no likelihood of coastal flooding, the consequence is thus considered negligible.

4.6 Risk

With a negligible likelihood and negligible consequence of flooding from coastal sources, the resultant risk is also considered to be negligible for the subject development.

4.7 Flood Risk Mitigation Measures

None required.

5. Fluvial Flooding

5.1 Source

Fluvial flooding is caused by rivers, watercourses or ditches exceeding their capacity and excess water spilling out onto the adjacent floodplain.

5.2 Pathway

The potential pathway for fluvial flooding from existing watercourses would involve overland flow through developed lands and across the M7 motorway, originating from flood extents to the south, where the Tully Stream is located. The estimated length of this potential flood pathway is approximately 2.1 kms.

5.3 Likelihood

According to Google Earth, the estimated ground level at the closest segment of the Tully Stream to the subject site is c. 89 m OD Malin. Considering the unlikely potential pathway through open lands and the M7 and considering the lowest proposed FFL of the development is set at 106 m OD Malin, c. 20 m above the stream level, the likelihood of flooding from this fluvial source is considered to be low.

Referring again to Figure 4-2 of the to the Kildare LAP 2023-2029 SFRA's predictive flood map for the Town of Kildare, the subject site is not at risk of the 0.1% AEP flood event from fluvial flooding.

5.4 Consequence

The consequence of fluvial flooding would include flooding of the internal roads network and open green space areas. The consequence of such flooding is considered to be low.

5.5 Risk

With a low likelihood and low consequence of flooding from fluvial sources, referring to Table 3-2, the resultant risk is considered to be low for the subject development.

5.6 Flood Risk Mitigation Measures

As the risk is considered low, there are no mitigation measures required.

6. Pluvial

6.1 Source

The source of pluvial flooding is heavy rainfall.

6.2 Pathways & Receptors

During periods of extreme prolonged rainfall, pluvial flooding may occur through the following pathways:

Table 6-1: Pluvial Pathway and Receptor Summary

	Pathway	Receptor
1	Surcharging of the proposed internal drainage systems during heavy rain events leading to internal flooding.	Proposed development – internal roads, footpaths and green space areas
2	Surcharging from the existing surrounding drainage system leads to flooding within the subject site by surcharging surface water pipes	Proposed development – internal roads, footpaths and green space areas
3	Surface water discharging from the subject site to the existing drainage network leads to downstream flooding	Downstream properties and public roads
4	Overland flooding from surrounding areas flowing onto the subject site	Proposed development – internal roads, footpaths and green space areas
5	Overland flooding from the subject site flowing onto surrounding areas	Downstream properties and roads

6.3 Likelihood

Areas where potential pluvial flood risk exists (i.e. flooding caused by high intensity overland rainfall) in the town of Kildare is outlined in Map 10.2 of the Kildare Town LAP (2023-2029) Appendix A Maps, extracted to Figure 6-1, below. According to the figure, the northeast corner of the subject development falls under an area of potential risk of pluvial flooding. The subject lands will be assessed for pluvial flood risk and appropriate mitigation measures discussed, under this Chapter of the report.

According to the Kildare Town LAP SFRA, several areas within Kildare Town have been identified as experiencing infiltration capacity issues. These areas, where surface water infiltration into the ground is limited, are illustrated in Figure 6-2**,** below.

Figure 6-2 also highlights locations at risk of pluvial flooding as a result of these infiltration constraints. It is noted that the subject lands are not situated within any of the areas identified as being at risk of pluvial flooding from infiltration constraints.

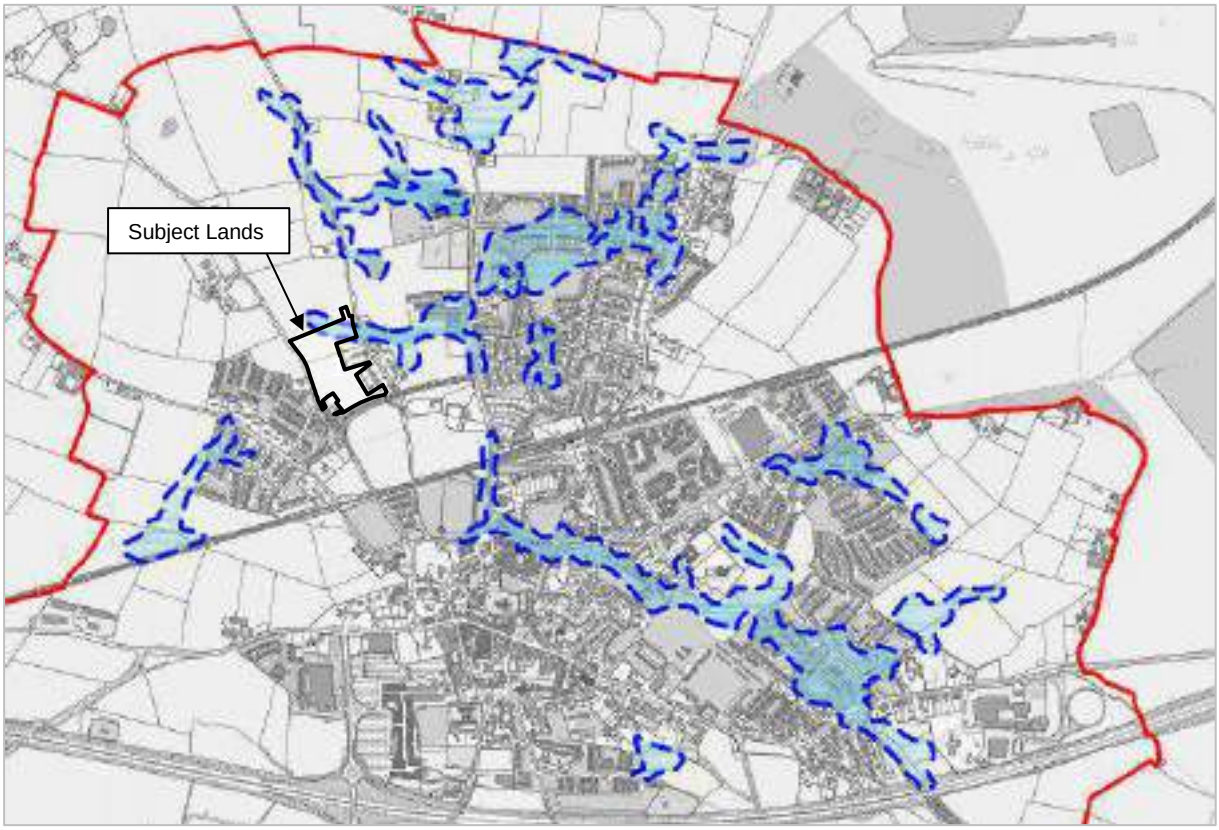


Figure 6-1: Extract of Kildare LAP Map 10.2 Pluvial Flood Risk Areas Map

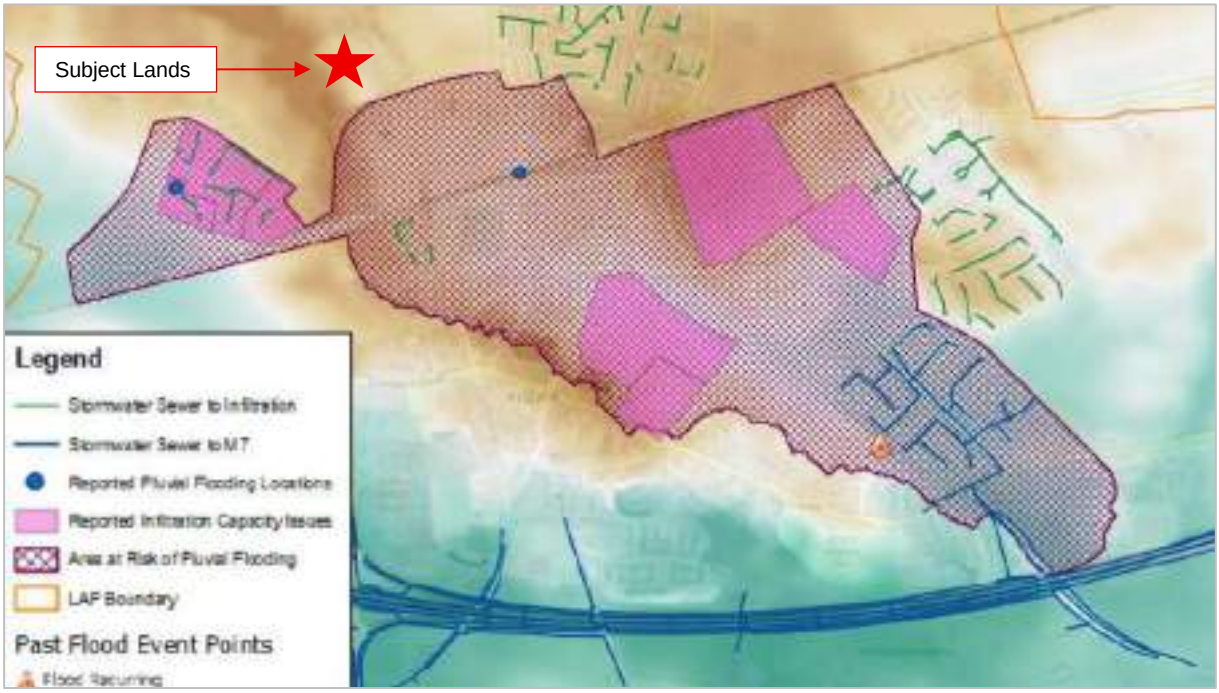


Figure 6-2: Extract of Kildare LAP SFRA Pluvial Flood Risk Map due to lack of Infiltration Capacity

Flooding may occur through any of the pathways outlined in Figure 6-1, the likelihood of flooding via. each of the pluvial pathways is discussed below.

6.3.1 Surcharging of the proposed internal drainage systems leads to internal flooding

The proposed on-site drainage strategy includes the discharge of surface water into attenuation areas that include an above ground detention basin and below ground infiltration system within each sub-catchment (3 No. sub-catchments are proposed). The system has been preliminarily sized to accommodate flows from a 1-in-100-year storm event, incorporating an additional 30% allowance for climate change and 10% for urban creep, in line with best practice guidance.

Given that the drainage network is designed primarily for attenuation and infiltration, surcharging of the on-site system during higher return period storm events is unlikely to result in surface flooding, provided the infiltration performance is achieved in practice.

A detailed hydrogeological investigation of the subject lands will be undertaken to provide an understanding of the groundwater system within the lands. The infiltration rate of the soil will be established from the hydrogeological assessment at 3 No. locations corresponding with the proposed attenuation systems (infiltration areas).

The sustainable urban drainage systems (SuDS) proposed for the subject development include swales located adjacent to hardstanding roads and footpaths areas, permeable paving below all parking spaces and private driveways, bio-retention tree pits strategically placed adjacent to hardstanding areas, above ground detention basins, and below ground infiltration systems.

The use of distributed SuDS features offers a resilient solution by capturing and managing runoff close to source, reducing the load on conventional pipe networks. Therefore, the risk of resultant flooding is considered low due to the robustness and redundancy built into the proposed attenuation and infiltration systems.

In addition, the designed levels fall away from the buildings to route any surcharged surface water away from structures and overland, either flowing towards the attenuation areas or exiting the subject lands via an appropriate exceedance route. An existing and modified flow route analysis has been completed for the proposed development. The existing flow route analysis for the subject lands is included in Figure 6-3, below. This analysis represents the direction of rainfall runoff within the subject lands based on the existing contours and site slopes.



Figure 6-3: Existing Ground Contours of the Subject Lands (Existing Flow Route Analysis)

The modified flow route analysis, also representing the exceedance route, of the proposed development based on the designed site levels can be seen in Figure 6-4, below. Figure 6-4 is extracted from Waterman Moylan Drawing No. SOU-WMC-PH2-XX-DR-C-P0235 Existing & Modified Flow Paths, submitted as part of the subject application. As shown in the below figure, surface water flows overland within the subject development to the internal roads network. As part of the surface water management strategy, an

exceedance route is included to the north of the development, into the open green space area and the norther attenuation area (above ground detention basin and below ground infiltration system). A secondary exceedance route exists with runoff conveyed to the 2 No. open green space and attenuation areas within the proposed development and ultimately to the existing road south of the development, external to the site.

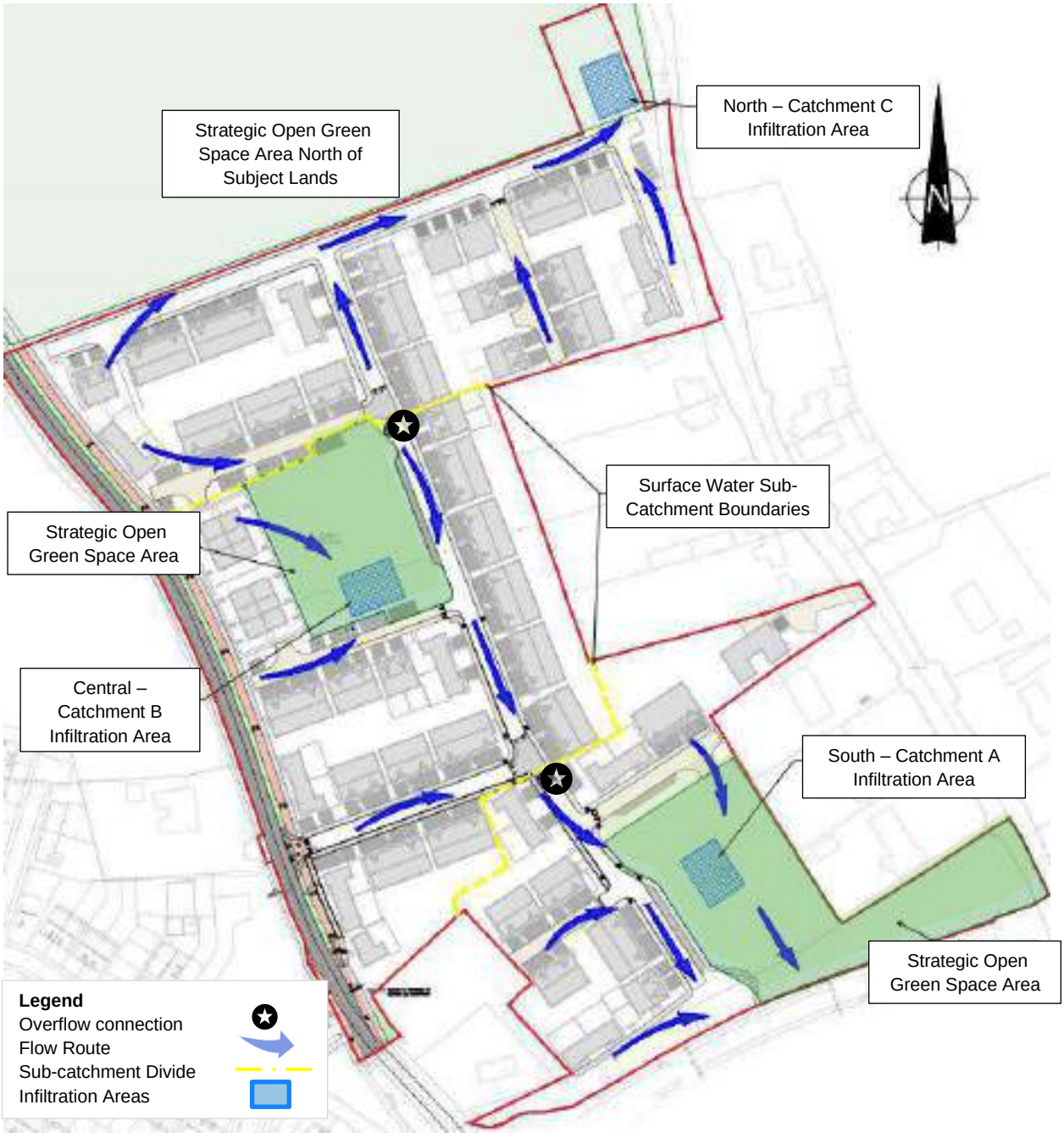


Figure 6-4: Modified Flow Route Analysis of Development

The likelihood of the subject development flooding due to surcharging of the proposed internal drainage system is considered to be low.

6.3.2 Surcharging from the existing surrounding drainage system leads to internal flooding

There is no existing surface water drainage surrounding the subject site and therefore the likelihood of flooding is low.

Surcharging of the subject lands from the areas at risk of pluvial flooding due to infiltration overload (Figure 6-2) does not present a flood risk to the subject lands, owing to the existing site levels and topographical contours. In general, the lands located north of the Kildare Railway Line slope from north to south, directing surface water away from the subject site.

The likelihood of flooding on the subject development due to surcharging from the existing surrounding drainage system is considered to be low.

6.3.3 Surface water discharge from the subject site leads to downstream flooding

The proposed development site is 100% greenfield. The development, as designed, will increase the impermeable area on site. As a result, the volume and rate of run-off from the site will increase. However, in order to mitigate this, various SuDS features are proposed as part of the surface water management strategy for the proposed development, as discussed under Chapter 6.3.1, above. These SuDS features will capture, collect, slow, and reduce the volume of run-off within the site during storm events. The surface water will be attenuated on site and allowed to percolate into the ground fully at the designated attenuation areas within each sub-catchment.

No rainfall runoff is intended to leave the site. However, as part of due diligence, in the event of a system failure, an exceedance route is designed within the proposed development to convey runoff overland, on the internal roads network. The overland flood route leads to the proposed attenuation areas or externally to existing roads networks where runoff will fall with the slope of the roads network.

The likelihood of the proposed development resulting in pluvial flooding downstream of the site is therefore considered moderate.

The control measures implemented to prevent flooding and to ensure that access is maintained along the internal estate road network during high rainfall events include the following:

- Attenuation areas designed to cater for up to the 1-in-100-year storm event with an additional 30% climate change and a 10% urban creep factor. This will result in runoff being stored within the attenuation area during the extreme storm event and not within the road network.
- Adequate exceedance routes through the site to which diverts runoff towards the attenuation areas.
- Setting of finished floor levels generally at least 500 mm above the proposed top of water level in the proposed detention basins and 300 mm above road levels. This provides adequate freeboard in the event of surface water surcharging of the surface water network. The surcharged surface water will flow within the road network and be diverted towards the attenuation areas or the external roads network through flood routing.

6.3.4 Overland flooding from surrounding areas

The Office of Public Works (OPW) records for predictive and historic flood maps have been consulted for recorded flood events in the vicinity of the subject site. There is a singular. historic flood event in the vicinity of the subject site (within a 2.0 km radius). Refer to Figure 6-5 for an extract of the past flood event local area summary report retrieved from floodinfo.ie, for details.

The nearest reoccurring flood event to the subject lands has a flood ID of 1487. Figure 6-1 indicates various historical flooding events within the Kildare Town area. There are 1 recorded recurring instances of flooding in this area. This flood location is c. 1.8 km from the subject site (as the crow flies) and does not reflect a flood risk to the development. Based on available and recorded information as outlined, the development site is considered not to have been subject to flooding in recent history.

The likelihood of overland flowing of the subject development from surrounding areas is thus considered to be low.



Figure 6-5: OPW Past Flood Event Summary

6.3.5 Overland flooding from the subject site causes downstream flooding

Similarly to Chapter 6.3.1 discussed above, the control measures implemented to prevent flooding within the site and downstream flooding of external sites during high rainfall events include the following:

- Attenuation areas designed to cater for up to the 1-in-100-year storm event with an additional 30% climate change and a 10% urban creep factor. This will result in runoff being stored within the attenuation area during the extreme storm event and not within the road network.
- Adequate exceedance routes through the site to which diverts runoff towards the attenuation areas.
- Setting of finished floor levels generally at least 500 mm above the proposed top of water level in the proposed detention basins and 300 mm above road levels. This provides adequate freeboard in the event of surface water surcharging of the surface water network. The surcharged surface water will flow within the road network and be diverted towards the attenuation areas or the external roads network through flood routing.

The likelihood of overland flooding from the subject development causing downstream flooding is considered to be moderate.

6.4 Consequence

The consequence of surface water flooding arising from the 5 No. pathway types mentioned above is moderate as internal roads, green space areas, potentially private driveways and rear gardens may be at risk of minor flooding. Downstream properties may experience similar flooding in the event of an extreme storm event and lack of mitigation measures outlined above.

6.5 Risk

Referencing Table 3-2: 3x3 Risk Matrix, the following risks are noted for the 5 No. pathway types:

6.5.1 Surcharging of the proposed on-site drainage systems leads to internal flooding

With a low likelihood and moderate consequence of flooding from this type of pluvial flooding and referring Table 3-2: 3x3 Risk Matrix, the resultant risk is low.

Mitigation measures are not required.

6.5.2 Surcharging from the existing surrounding drainage system leads to internal flooding

With a low likelihood and moderate consequence of flooding from this type of pluvial flooding and referring Table 3-2: 3x3 Risk Matrix, the resultant risk is low.

Mitigation measures are not required.

6.5.3 Surface water discharging from the subject site causes downstream flooding

With a moderate likelihood and moderate consequence of flooding from this type of pluvial flooding and referring Table 3-2: 3x3 Risk Matrix, the resultant risk is moderate.

Mitigation measures are required.

6.5.4 Overland flooding from surrounding areas leads to internal flooding

With a low likelihood and moderate consequence of flooding from this type of pluvial flooding and referring Table 3-2: 3x3 Risk Matrix, the resultant risk is low.

Mitigation measures are not required.

6.5.5 Overland flooding from the subject site causes downstream flooding

With a moderate likelihood and moderate consequence of flooding from this type of pluvial flooding and referring Table 3-2: 3x3 Risk Matrix, the resultant risk is moderate.

Mitigation measures are required.

6.6 Flood Risk Mitigation Measures

The following are flood risk management strategies proposed to minimise the risk of pluvial flooding for each risk:

6.6.1 Surcharging of the proposed on-site drainage systems

None required.

6.6.2 Surcharging from the existing surrounding drainage systems

None required.

6.6.3 Surface water discharging from the subject site

- Appropriately sized surface water attenuation systems and network
- Appropriate exceedance routes designed within subject development
- Appropriate FFLs set above adjacent road levels and top of water levels of detention basins.

6.6.4 Overland flooding from surrounding areas

None required.

6.6.5 Overland flooding from the subject site

- Appropriately sized surface water attenuation systems and network
- Appropriate exceedance routes designed within subject development
- Appropriate FFLs set above adjacent road levels and top of water levels of detention basins.

6.7 Residual Risk

Table 6-2: Pathway – Residual Risk Identified

	Pathway	Residual Risk
1	Surcharging of the proposed internal drainage systems during heavy rain events leading to internal flooding	Low
2	Surcharging from the existing surrounding drainage system leading to flooding within the subject site by surcharging surface water pipes	Low
3	Surface water discharging from the subject site to the existing drainage network leading to downstream flooding	Low
4	Overland flooding from surrounding areas flowing onto the subject site	Low
5	Overland flooding from the subject site flowing onto surrounding areas	Low

As a result of the design measures detailed above and summarized in Table 6-2, it is clear that the likelihood of these events happening is low, as there are no recorded events in the close proximity of the site. There is a low residual risk of flooding from each of the surface water risks. The flood risk management measures set out in will minimise the risk, ensuring that any overland flooding from surface water will result in the flooding of the internal roads only.

The overall residual risk of pluvial flooding is therefore considered to be low.

7. Groundwater

7.1 Source

During periods with prolonged rainfall, the groundwater can rise towards ground level.

7.2 Pathway

The pathway for groundwater flooding is from the ground. Note that although groundwater flooding is typically considered to be when the water table rises above the ground surface, underground services and building foundations could also be affected by high water tables that do not reach the ground surface.

7.3 Receptor

The receptors for ground water flooding would be underground services and the ground floor of the proposed building.

7.4 Likelihood

According to the Geological Survey Ireland (GSI) groundwater flooding map, flooding of this type has not occurred in or around the subject site. Refer to Figure 7-1 for an extract of the groundwater flooding map.

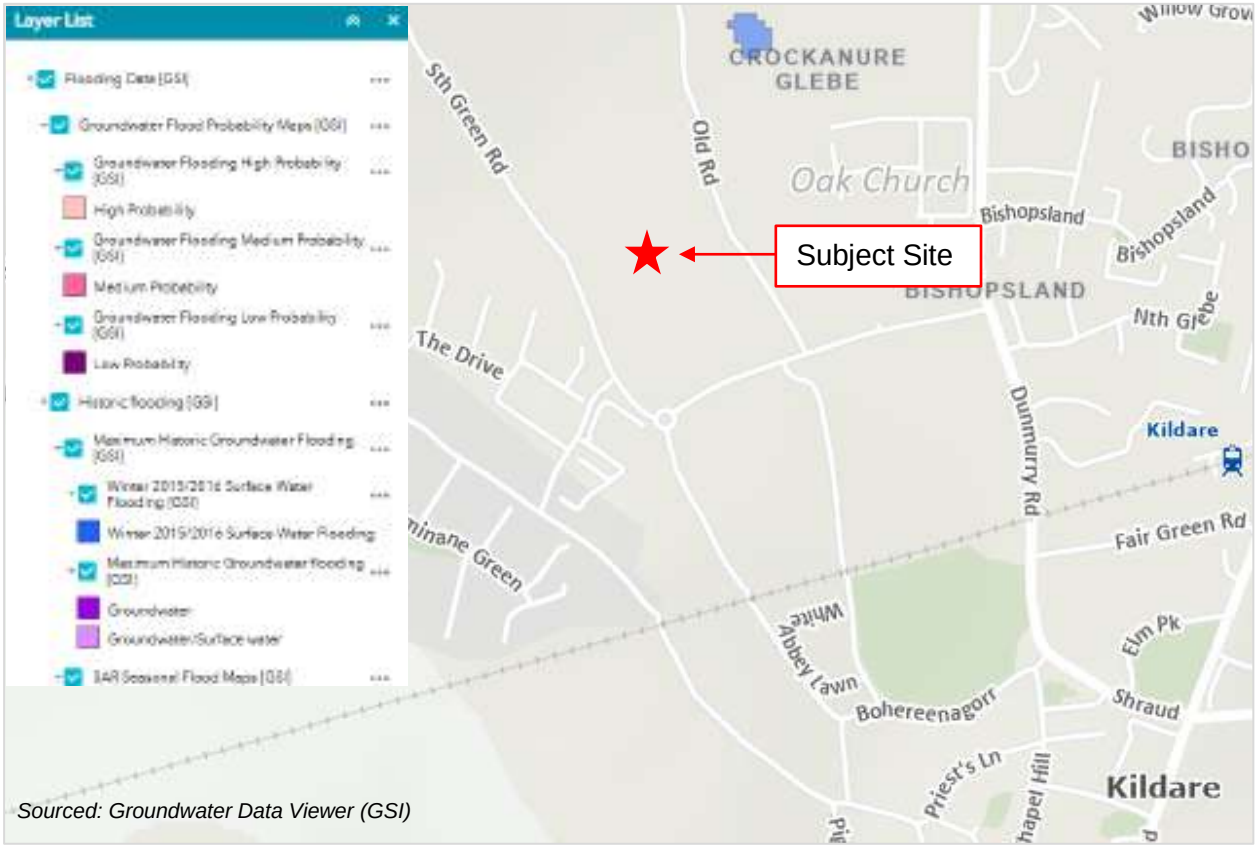


Figure 7-1: Extract of GSI Groundwater Flooding Map

The likelihood of flooding from groundwater is thus considered to be low.

Additionally, according to the GSI groundwater vulnerability map, the subject development is located within an area of high vulnerability, refer to Figure 7-2 for details.

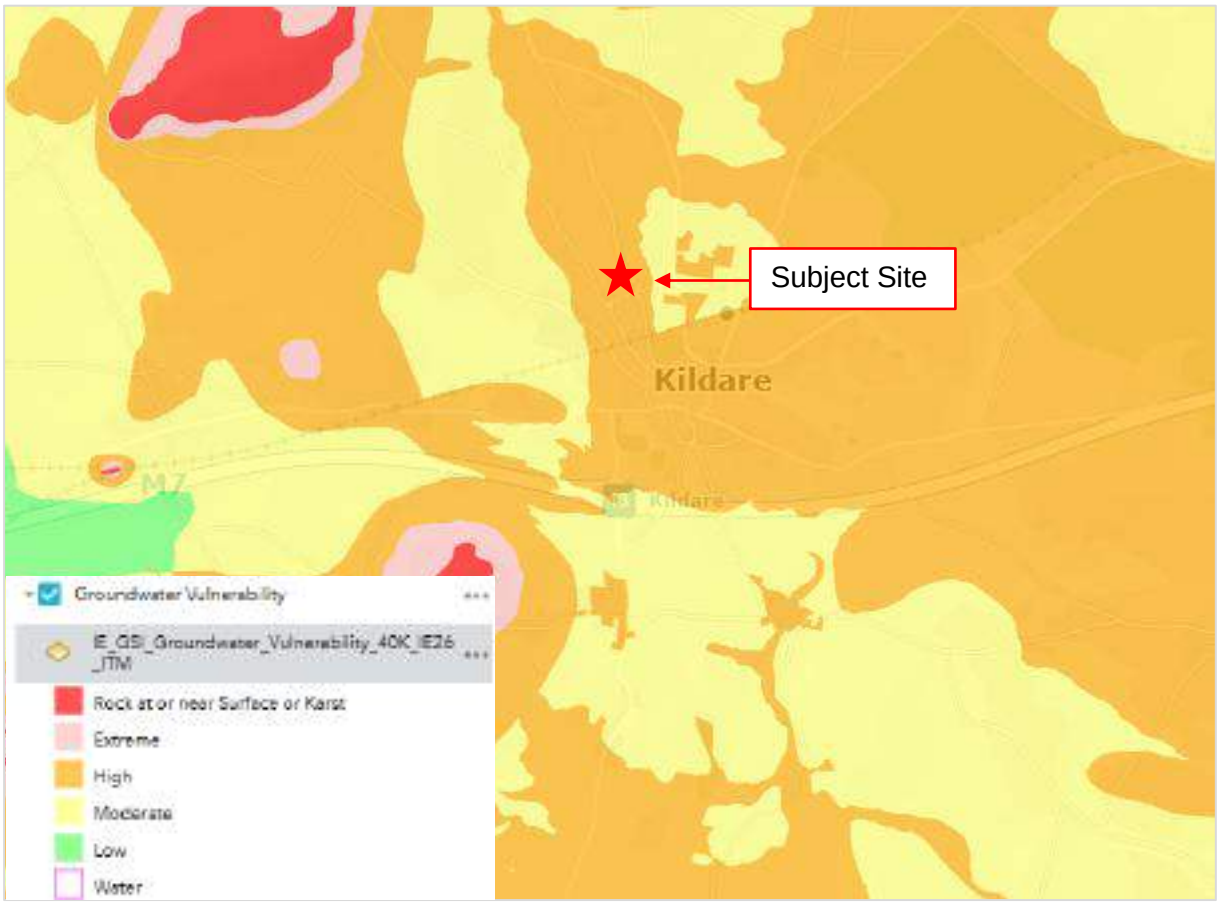


Figure 7-2: Extract of GSI Groundwater Vulnerability Map

7.5 Consequence

There is a moderate consequence from groundwater flooding, with underground services and building foundations exposed to the rising water levels.

7.6 Risk

Given a low likelihood and moderate consequence, referring to Table 3-2: 3x3 Risk Matrix, the resulting risk is considered low. Flood mitigation measures are not required, however any findings from the specialist hydrogeological report to be undertaken for the subject lands related to potential mitigations measures (if advised to be implemented for groundwater flooding) will be included within the design of the proposed development.

8. Human / Mechanical Errors

8.1 Source

This surface water network within the subject site is the source of possible flooding from the system if it was to become blocked.

8.2 Pathway

The pathway is via gulleys, manhole lids, and the above ground detention basins within the development.

8.3 Receptor

If the proposed private drainage system blocks this could lead to possible flooding within the open spaces, the internal roads, footpaths, and private gardens.

8.4 Likelihood

There is a high possibility of flooding on the subject site if the surface water network was to block.

8.5 Consequence

The surface water network would surcharge and overflow through gullies, and manhole lids and over the top of the proposed attenuation areas, it is therefore considered that the consequence of such flooding is moderate.

8.6 Risk

Referencing Table 3-2: 3x3 Risk Matrix, with a high likelihood and moderate consequence, there is a high risk of surface water overflowing within the development, should the surface water network block.

8.7 Flood Risk Mitigation Measures

The following flood mitigation measures have been implemented for the development:

- Levels on-site have been designed such that in the event of the surface water system surcharging, surface water can still escape from the site and away from building structures, onto the adjacent public road, by overland flood routing. This ensures flood routing without damaging properties.
- The FFLs of the proposed buildings are designed above the adjacent road levels.
- The surface water network must be inspected and maintained to ensure blockages do not occur.

8.8 Residual Risk

As a result of the flood risk management outlined above, there is a low residual risk of overland flooding from human/mechanical error.

9. Conclusions and Recommendations

The subject lands have been analysed for risks from flooding from the Irish sea, fluvial flooding (rivers), pluvial flooding (heavy rainfall), groundwater, and failures of mechanical systems. Through careful design and appropriate mitigation measures, the risks and consequences of flooding have been mitigated across the development.

Surface water runoff from the site does not impact developments upstream or downstream of the subject site. Refer to Table 9-1 for the summary of risks and mitigation measures for each of the potential flooding sources/types.

Table 9-1: Summary of Flood Risks for the Site

Source	Pathway	Receptor	Likelihood	Consequence	Risk	Mitigation Measure	Residual Risk
Coastal	Overland from East	Proposed Development	Negligible	Negligible	Negligible	None needed	**None**
Fluvial	Overland from South	Proposed Development	Low	Low	Extremely Low	None needed	**Low**
Pluvial	Private and Public Drainage Systems	Proposed Development	Low	Moderate	Low	Appropriate drainage design, setting FFLs & appropriate exceedance routes	**Low**
Ground Water	Ground	Proposed Development	Low	Moderate	Low	None needed	**Low**
Human / Mechanical Error	Drainage network	Proposed Development	High	Moderate	High	Appropriate drainage design, setting FFLs & appropriate exceedance routes	**Low**

UK and Ireland Office Locations

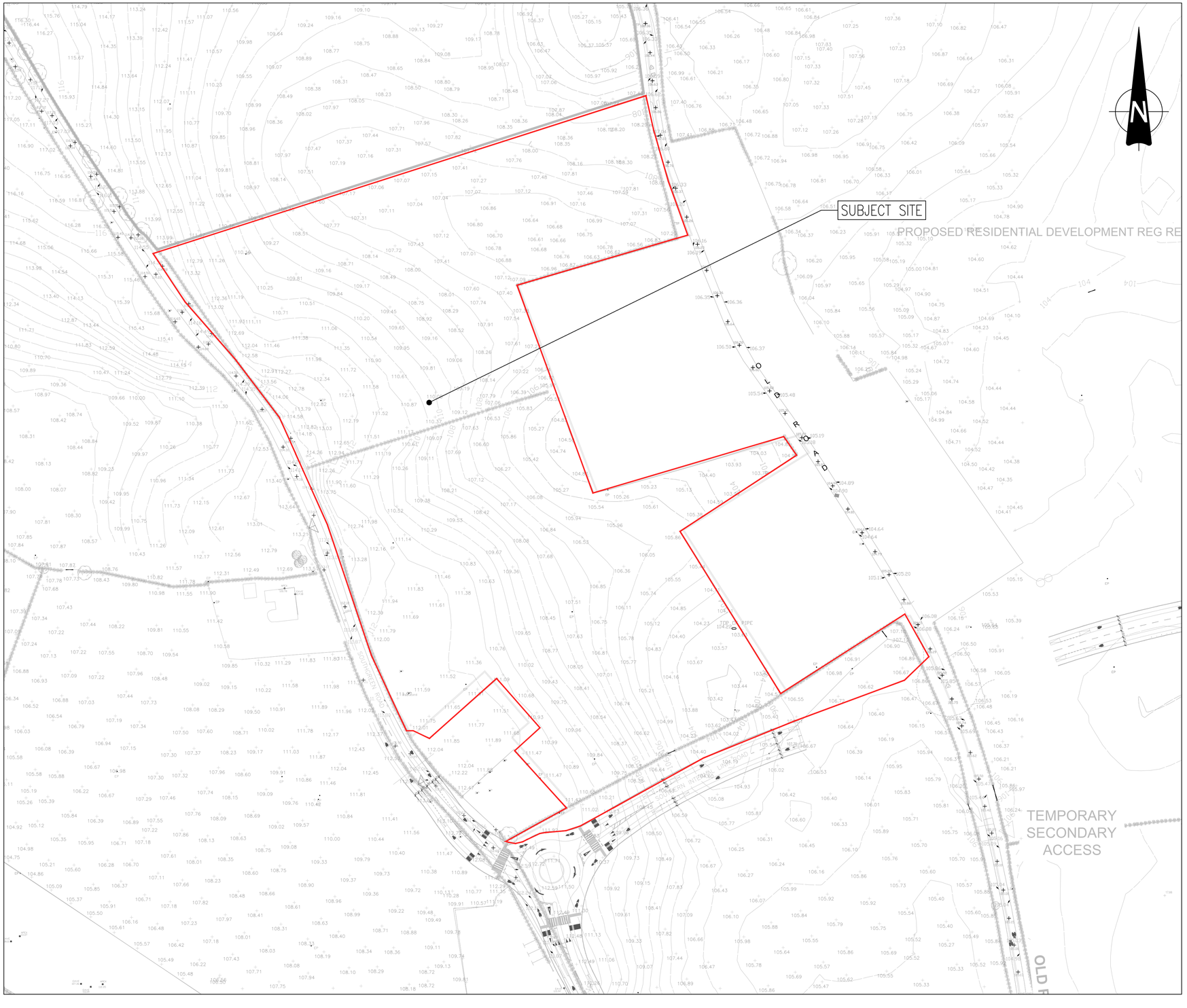


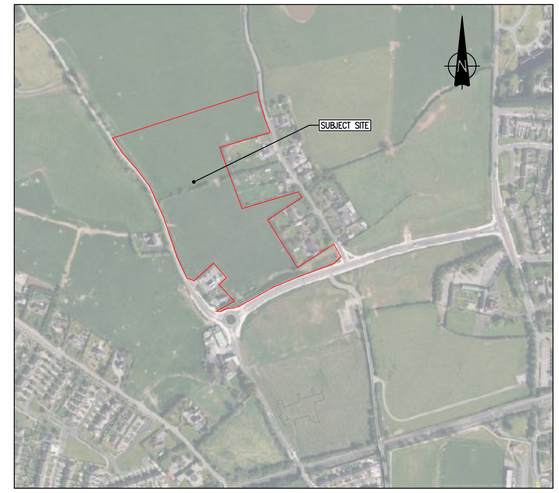
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NOTES:

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.





SITE LOCATION MAP
SCALE 1:5000

LEGEND

SITE BOUNDARY

1:5000 0 100m 200m 300m 400m 500m
1:1 0 10 20 30 40 50 60 70 80 90 100

1:1000 0 10m 20m 30m 40m 50m 60m 70m 80m 90m 100m
1:1 0 10 20 30 40 50 60 70 80 90 100

Rev	Date	Description	By	Chk

Amendments

Project
....,
SOUTH GREEN PH2,
KILDARE

Title
SITE LOCATION PLAN

Client
.....

waterman moylan
BLOCK S, EASTPOINT BUSINESS PARK, ALFIE BYRNE ROAD,
DUBLIN D03 H3F4 IRELAND. Tel: (01) 664 8900
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Status
PLANNING

Designed By	Approved	Waterman Ref
PI	IW	25-003
Drawn By	Date	Scales @ A1
IG	XXX 2025	AS SHOWN

Project - Originator - Volume - Level - Type - Role - Number	Revision
SOU - WMC - PH2 - XX - DR - C - P0010	P01

Drawing Location: N:\Projects\25\25-003 South Green Phase 2 Site Ol\Drawings\Waterman Moylan\Civil\Planning\Autocad Drawings\SOU-WMC-PH2-XX-DR-C-P0010 - Site Location Map.dwg
Date: Apr 24, 2026 - 9:33am

APPENDIX I

PROPOSED DEVELOPMENT & SURFACE WATER DRAINAGE MAP

NOTES:

1. DO NOT SCALE. USE FIGURED DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECTURAL AND ENGINEERING DRAWINGS.

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ATTENUATION BASIN "C"
ABOVE GROUND DETENTION BASIN:
- SIDE SLOPES 1: 4
- TOP OF BANK AREA & LEVEL: 620m² / 106.00m
- BOTTOM OF BANK AREA & LEVEL: 300m² / 105.00m
- DEPTH OF ABOVE GROUND BASIN: 1000mm
- TOP OF WATER LEVEL: 105.8 m
- ABOVE GROUND STORAGE VOLUME: 460m³

BELOW GROUND INFILTRATION TRENCHES:
NO. OF TRENCHES: 4
DEPTH OF TRENCHES: 2.2m
LENGTH OF TRENCHES: 30.0m
WIDTH OF TRENCHES : 2.5m
BELOW GROUND STORAGE VOLUME ACTIVATED: 420m³

TOTAL STORAGE OFFERED: 880m³

ATTENUATION BASIN "B"
ABOVE GROUND DETENTION BASIN:
- SIDE SLOPES 1: 4
- TOP OF BANK AREA & LEVEL: 805m² / 107.85m
- BOTTOM OF BANK AREA & LEVEL: 600m² / 107.35m
- DEPTH OF ABOVE GROUND BASIN: 500mm
- TOP OF WATER LEVEL: 107.73 m
- ABOVE GROUND STORAGE VOLUME: 350m³

BELOW GROUND INFILTRATION TRENCHES:
- NO. OF TRENCHES: 5
- DEPTH OF TRENCHES: 2m
- LENGTH OF TRENCHES: 28m
- WIDTH OF TRENCHES: 2.5m
- BELOW GROUND STORAGE VOLUME: 665m³

TOTAL STORAGE OFFERED: 1015m³

ATTENUATION BASIN "A"
ABOVE GROUND DETENTION BASIN:
- SIDE SLOPES 1: 4
- TOP OF BANK AREA & LEVEL: 395m² / 106.50m
- BOTTOM OF BANK AREA & LEVEL: 107m² / 105.50m
- DEPTH OF ABOVE GROUND BASIN: 1m
- TOP OF WATER LEVEL: 106.47 m
- ABOVE GROUND STORAGE VOLUME: 250m³

BELOW GROUND INFILTRATION TRENCHES:
- NO. OF TRENCHES: 3
- DEPTH OF TRENCHES: 2m
- LENGTH OF TRENCHES: 30m
- WIDTH OF TRENCHES: 2.5m
- BELOW GROUND STORAGE VOLUME: 315m³

TOTAL STORAGE OFFERED: 565m³

LEGEND:

- PROPOSED BOUNDARY LINE (TBC)
- PROPOSED PERMEABLE PAVING IN PRIVATE DRIVEWAYS
- INFILTRATION TRENCHES
- PROPOSED ABOVE GROUND ATTENUATION BASINS (500mm & 1000mm DEPTH)
- PROPOSED BIO-RETENTION TREE PITS
- PROPOSED PETROL INTERCEPTOR
- PROPOSED GRASS SWALE & LAND DRAIN WITH 100mm PERFORATED PIPE AND INSPECTION CHAMBER

1:500 0 10m 20m 30m 40m 50m
1:1 0 10 20 30 40 50 60 70 80 90 100

PRIVATE BELOW GROUND INFILTRATION TRENCH SYSTEM

OUTLINE OF ENTRANCE TO EXISTING ESB SUBSTATION

INSET A

Rev	Date	Description	By	Chk
P01	11/07/2025	ISSUED FOR STAGE 2A PLANNING	IG	IW

Amendments

Project
SOUTHGREEN PHASE 2, KILDARE TOWN, Co. KILDARE

Title
PROPOSED SUDS LAYOUT

Client
PAT CONLON

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Status
PLANNING

Designed By	Approved	Waterman Ref
PI	IW	25-003
Drawn By	Date	Scales @ A1
IG	JULY 2025	1:500

Project - Originator - Volume - Level - Type - Role - Number: SOU - WMC - PH2 - XX - DR - C - P0210
Revision: P01

Drawing Location: N:\Projects\25\25-003 South Green Phase 2 Site O\Drawings\Waterman Moylan\Civil\Planning\Autocad Drawings\SOU-WMC-PH2-XX-DR-C-P0210 - Proposed SuDS Layout.dwg
Date: Jul 11, 2025 - 9:40am