



HYDROGEOLOGICAL ASSESSMENT

FOR
PROPOSED DEVELOPMENT
AT
“BARRINGTON TOWER”
BRENNANSTOWN RD., DUBLIN 18

March 2022

ON BEHALF OF
CAIRN HOMES PROPERTIES LIMITED

Prepared by

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DOCUMENT CONTROL SHEET

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1 INTRODUCTION

Enviroguide Consulting (hereafter referred to as Enviroguide) was appointed by Cairn Homes Properties Limited (hereafter referred to as the Client) to prepare a hydrogeological assessment for the Proposed Development at "Barrington Tower", Brennanstown Road, Dublin 18 (referred to hereafter as the Proposed Development and the Site).

The Proposed Development is a 'Build-to-Rent' (BTR) development that will consist of the construction of 8 no. blocks in heights up to 10 storeys with a double basement.

1.1 Project Objectives and Scope

The project objective was to establish the baseline hydrogeological conditions at the site and to identify the potential for any impacts associated with the Proposed Development and specifically:

- Establish the hydrogeological regime at the Site;
- Determine if dewatering will be required during construction and if there will be any potential impact on the receiving environment and sensitive receptors downgradient and adjoining the Site; and,
- Determine if the Proposed Development could impact on the Water Framework Directive Status of the receiving water bodies hydraulically connected with the Site.

The scope of the assessment included the following tasks:

- A desk-based review of published information and information pertaining to the Site and Proposed Development provided by the Client.
- Site walkover survey of the Proposed Development Site and attendance during borehole drilling carried out by Priority Geotechnical Limited (PGL) in January / February 2022.
- Develop a hydrogeological conceptual site model (CSM) for the Proposed Development.
- Identify and assess any potential impacts associated with the Proposed Development on sensitive receptors associated with the receiving water environment.

This assessment is reliant on the design information for the Proposed Development provided by the Client.

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Site Description and Location

The Proposed Development Site occupies a total area of 3.81 Hectares (Ha) on lands which are located south of Brennanstown Road, Dublin 18 (Refer to Figure 2-1). The Proposed Development Site is generally undeveloped with two unoccupied buildings located in the north-western portion of the Site.

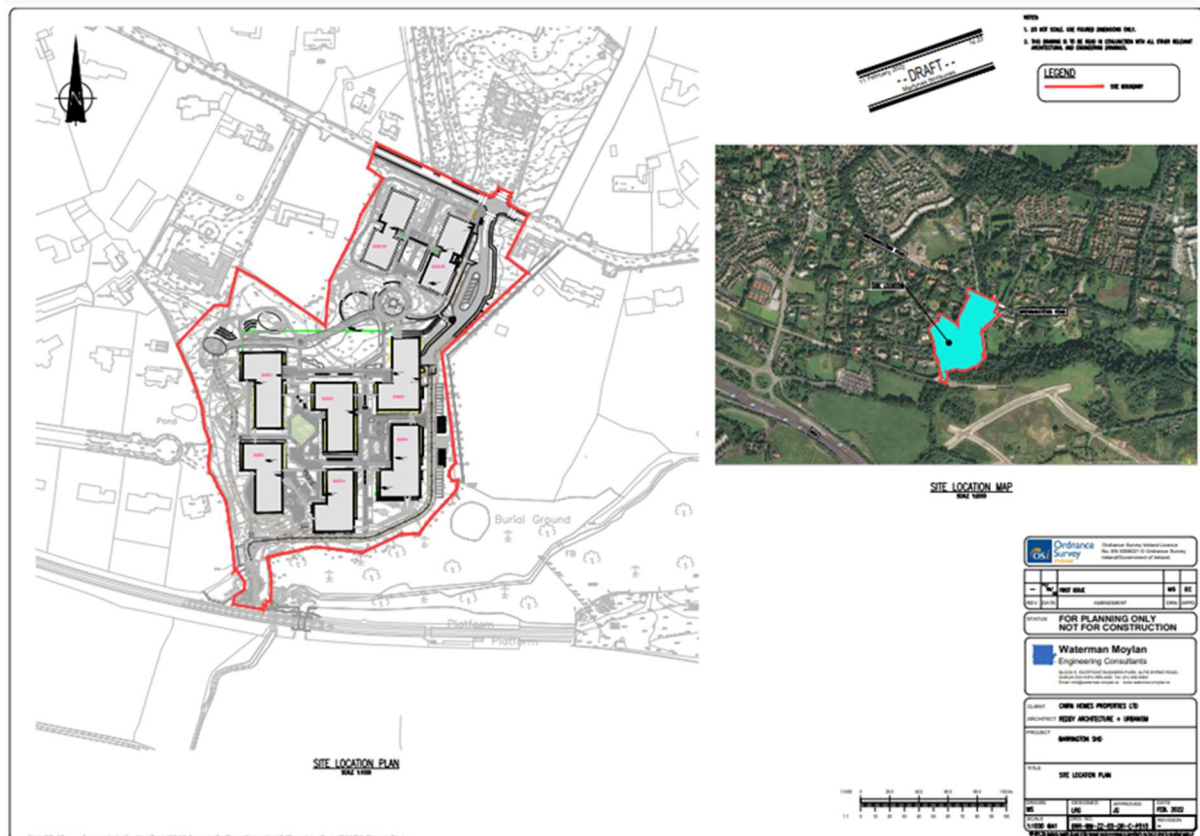


Figure 2-1 Site Location and Layout (Waterman Moylan, 2022 Drg No P010)

2.2 Proposed Development

The proposed 'Build-to-Rent' (BTR) development will consist of the construction of 8 no. blocks in heights up to 10 storeys comprising 534 residential units, a creche, a retail unit, residential support facilities and residential services and amenities. The proposal also includes car and cycle parking, public and communal open spaces, landscaping, waste management areas, plant areas, substations, switch rooms, and all associated site development works and services provision.

The Proposed Development includes a double basement and subsurface drainage and other structures that will require excavation of 65,100m³ of soil and bedrock. Suitable soil and bedrock will be retained for re-use as fill and for landscaping. It is estimated that 1,410m³ will be reused and 63,690m³ of surplus soil and bedrock will be removed from the Site.

The proposed level for the lower basement level is 66.175mOD and the invert levels of the attenuation tanks are 73.125mOD in the north and range between 64.650mOD beneath the basement and 62.150mOD and 64.050mOD in the south of the Site (Waterman Moylan, 2022; Drg No P200).

Surface water collected onsite will be treated and attenuated onsite prior to discharge to the Carrickmines Stream via a newly constructed outfall. Surface water drainage at the Site has been designed to incorporate the principles of Sustainable Urban Drainage Systems (SUDS). In accordance with the requirements of Dun Laoghaire Rathdown County Council (DLRCC) guidelines 'surface water should be managed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Volume 6, for New Developments and CIRIA documents' (Waterman Moylan, 2022). The SUDS measures will include where appropriate: green roofs and podium, permeable pavements, swales and filter drains and all water will discharge via Class 1 petrol interceptors to a series of attenuation tanks. Attenuated water will discharge via hydrobrake to the Carrickmines Stream at the new outfall.

New foul water drainage will be constructed at the Proposed development Site. A connection will be made to the existing 225mm/300mm gravity sewer line located approximately 120m south of the Site. As specified in the Engineering Assessment Report (Waterman Moylan, 2022a) Irish Water responded with the Confirmation of Feasibility (COF) on 4th February 2022, with reference no. CDS2000317, stating that an upgrade of the existing 225mmØ and 300mmØ gravity sewer (from the development connection point up to the 900mm trunk sewer) may be required. Any upgrade works will be confirmed following future surveys to be undertaken to establish the integrity and capacity of the existing foul sewer line. The developer will be required to fund any works. It is understood that this foul sewer connects to the Shanganagh Waste Water Treatment Plant (WWTP) (License ref.: D0038-02) located approximately 3.17km east of the Site in Bray (GSI, 2022).

Proposed foul and surface water drainage is shown in Figure 2-2.

It is proposed to supply the Proposed Development Site from watermains using 200mm connections which will connect to the existing 6-inch uPVC watermain which is located along the Brennanstown road at northern boundary of the Proposed Development Site. Irish Water provided a response dated 4th February 2022 states connection to the water supply network is feasible and will not require upgrades (Ref: CDS22000317) for the connection as specified in the Engineering Assessment Report (Waterman Moylan, 2022a).

All construction activities will be undertaken in accordance with a Construction Environmental Management Plan (CEMP) and Construction and Demolition Waste Management Plan (CDWMP) to be prepared by the Contractor based on the CEMP (AWN, 2022) and Resource and Waste Management Plan (AWN, 2022) submitted with the planning application for the Proposed development.

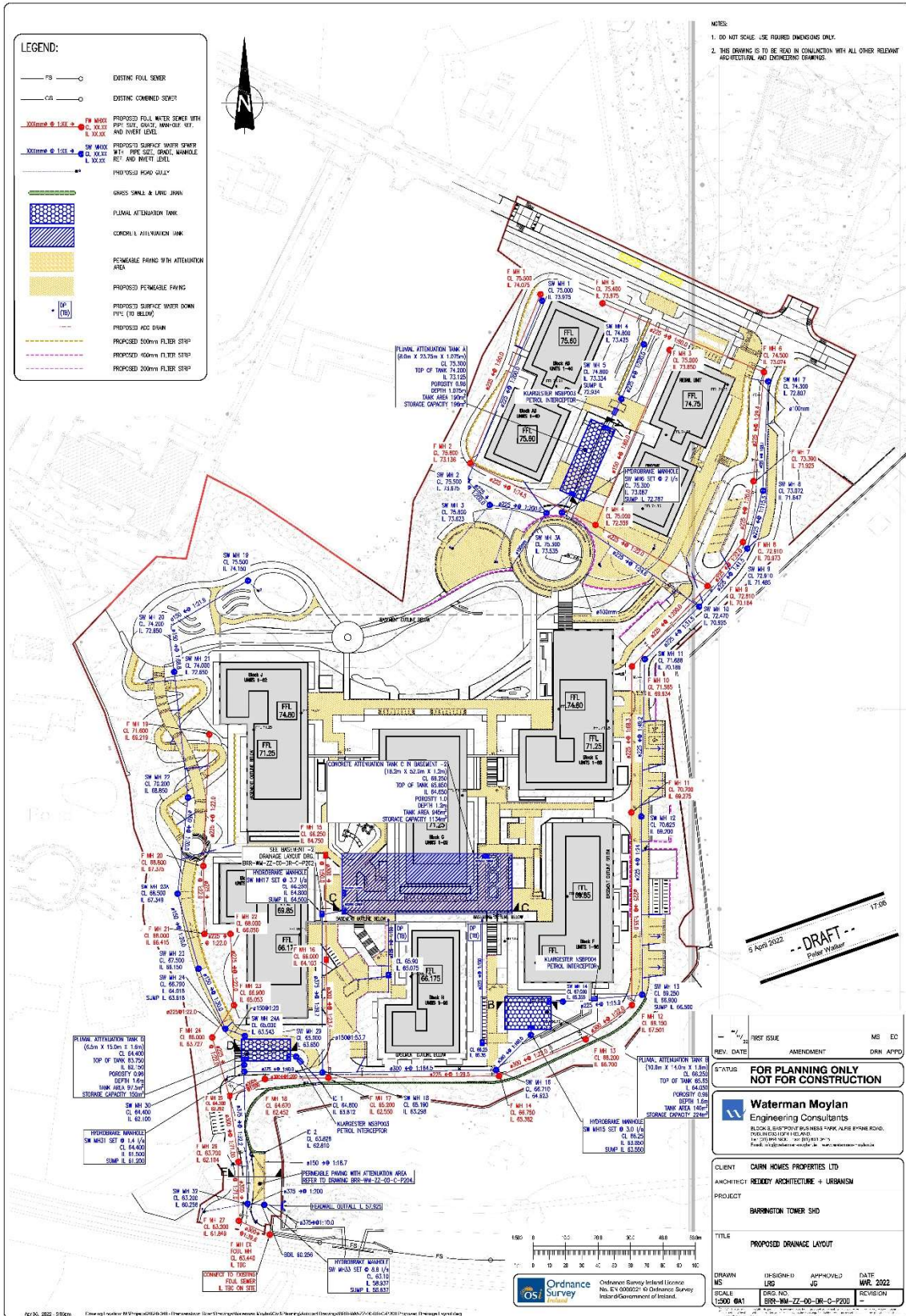


Figure 2-2 Proposed Drainage (refer to DRG NO. P200, Waterman Moylan, Feb 2022)

3 SITE SETTING

3.1 Topography

The regional topography generally slopes towards the Irish Sea to the east of the Site from the local high point at Kerry Mount (90mOD) located 0.3km north-west of the Proposed Development Site. The topography at the Site slopes from north-west toward the south and elevation ranges from 79.9maOD to 62.37maOD (Refer to Waterman Moylan Engineering Consultants Ltd., 2022 Drawing No.: BRR-WM-ZZ-XX-DR-C-P010).

3.2 Rainfall

Monthly rainfall data for the site available for 1km x 1km grids (for the period 1981 to 2010) was sourced from Met Éireann (Walsh, 2012) and is presented in Table 3-1. The closest synoptic meteorological station to the Site is at the Casement Aerodrome, Co. Dublin which is located approximately 18.65km north-west of the Site. The average annual potential evapotranspiration (PE) from the Casement Aerodrome station for the period 2021 to 2022 is recorded as 796.7mm (Met Éireann, 2022).

Table 3-1: Long-term mean monthly rainfall data (mm) (Walsh, 2012)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual
88	64	67	62	69	67	51	70	69	94	99	91	892
Note: 1km x 1km Irish Grid Coordinates selected for the Site = X (Easting): 322000, Y (Northing): 224000 Mean monthly rainfall data as mm												

3.3 Hydrology and Catchment

The Proposed Development Site is within the Ovoca-Vartry Catchment and Hydrometric Area (Catchment I.D: 10, Hydrometric Area 10) (GSI, 2022). The Proposed Development is within the local Dargle_SC Sub-catchment (Sub-catchment I.D: 10_5) (GSI, 2022).

The closest mapped surface water feature to the Proposed Development Site is the Carrickmines Stream (River waterbody Code: IE_EA_10C040350; EPA code: 10C04 (EPA, 2022)) located approximately 0.05km south of the Site boundary. and flows eastwards discharging to Shanganagh River (River waterbody Code: IE_EA_10S010600; EPA code: 10S01) approximately 2km south-east of the Site. The Shanganagh River flows eastwards and discharges to the Southwestern Irish Sea – Killiney Bay coastal waterbody (EU Code: IE_EA_100_0000) approximately 3.28km east of the Proposed Development Site at Hackett Island Bay Beach, east of Killiney (EPA, 2022). The off-site watercourses relevant to the Proposed Development Site by the EPA database along with the assigned Water Framework Directive (WFD) Risk status and water body status are presented in Figure 3-1.

There are no mapped stream or river waterbodies mapped in the vicinity of the Proposed Development Site and no surface waterbodies or drainage was identified across the Proposed Development Site on the 31st January 2022 by the onsite Enviroguide Consultant. No existing connection from the Proposed Development Site was identified from the Site walkover to the local surface waterbodies.

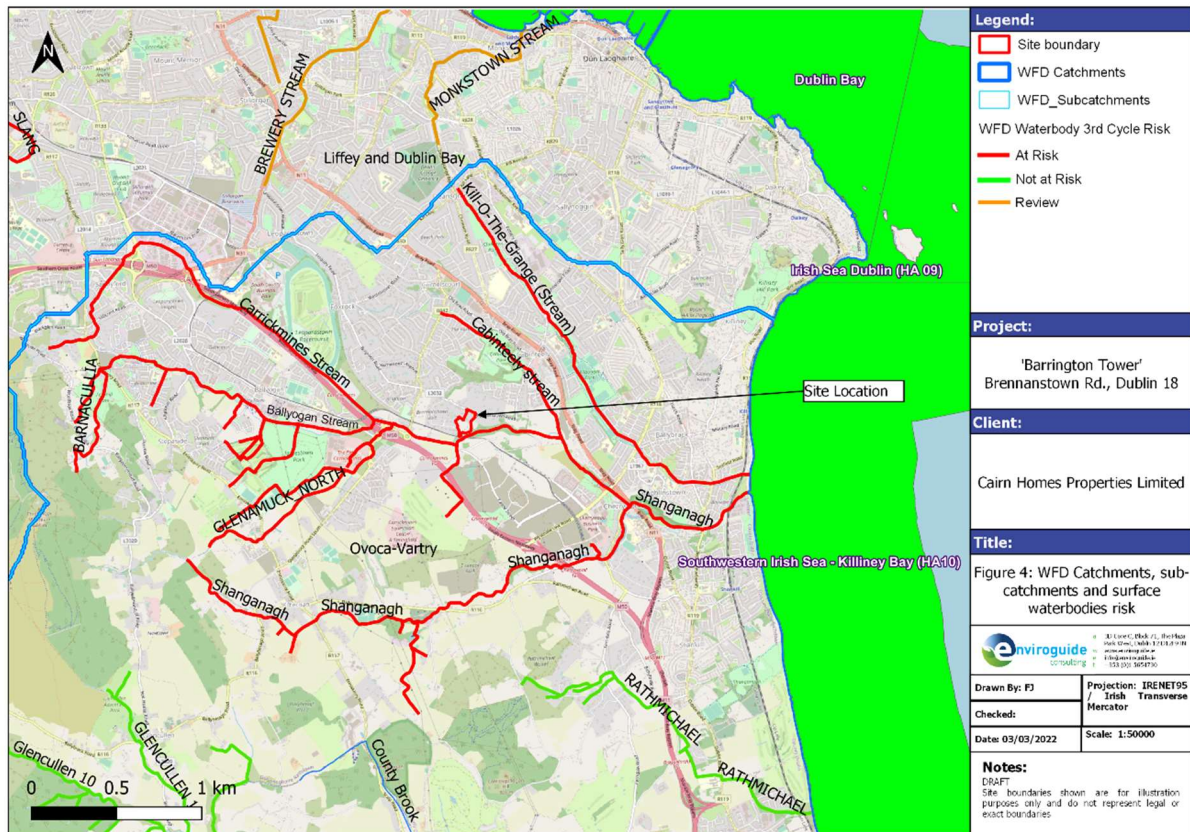


Figure 3-1 Surface Water Features and WFD Status

3.4 Soil and Subsoil

The soil beneath the majority of the Site is mapped as Deep and Shallow well drained mineral (AminDW and AminSW) described as “derived from mainly non-calcareous parent materials” (GSI, 2022). Soil beneath the central portion and along the northern boundary of the Site is mapped as Made Ground (Made) (GSI, 2022).

The quaternary sediments beneath the majority of the site are mapped as Bedrock outcrop or subcrop (Rck) indicating that subsoil is generally absent in those areas of the Site. The subsoil beneath the area along the northern boundary of the Site is mapped as Till derived from granites (TGr) (GSI, 2022). The GSI mapped quaternary soils are shown in Figure 3-2.

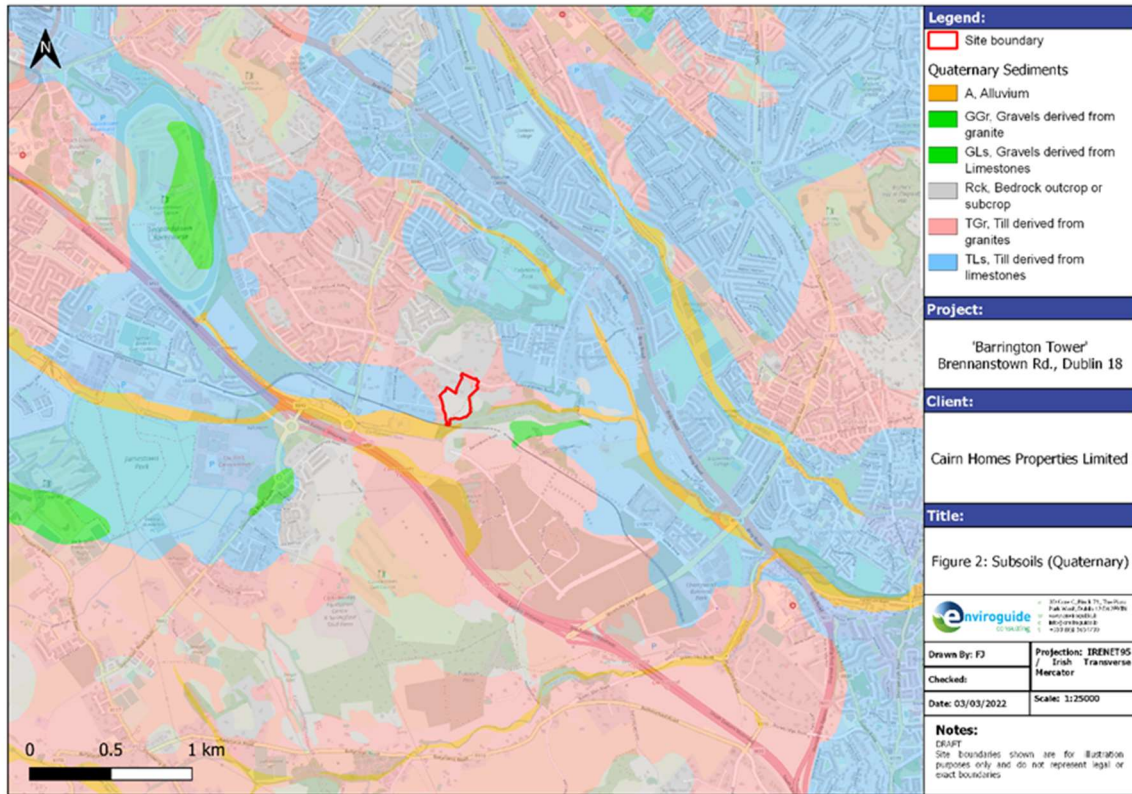


Figure 3-2 Quaternary Sediments

3.5 Bedrock Geology

The GSI has mapped the bedrock beneath the majority of the Proposed Development Site as the Type 2e equigranular formation (New Code: IDNLGRE; Stratigraphic Code: Nt2e) which is described as “pale grey fine to coarse grained granite” and is recorded as being part of the Caledonian formation Granite System (GSI, 2022).

The GSI bedrock geology map is presented in Figure 3-3

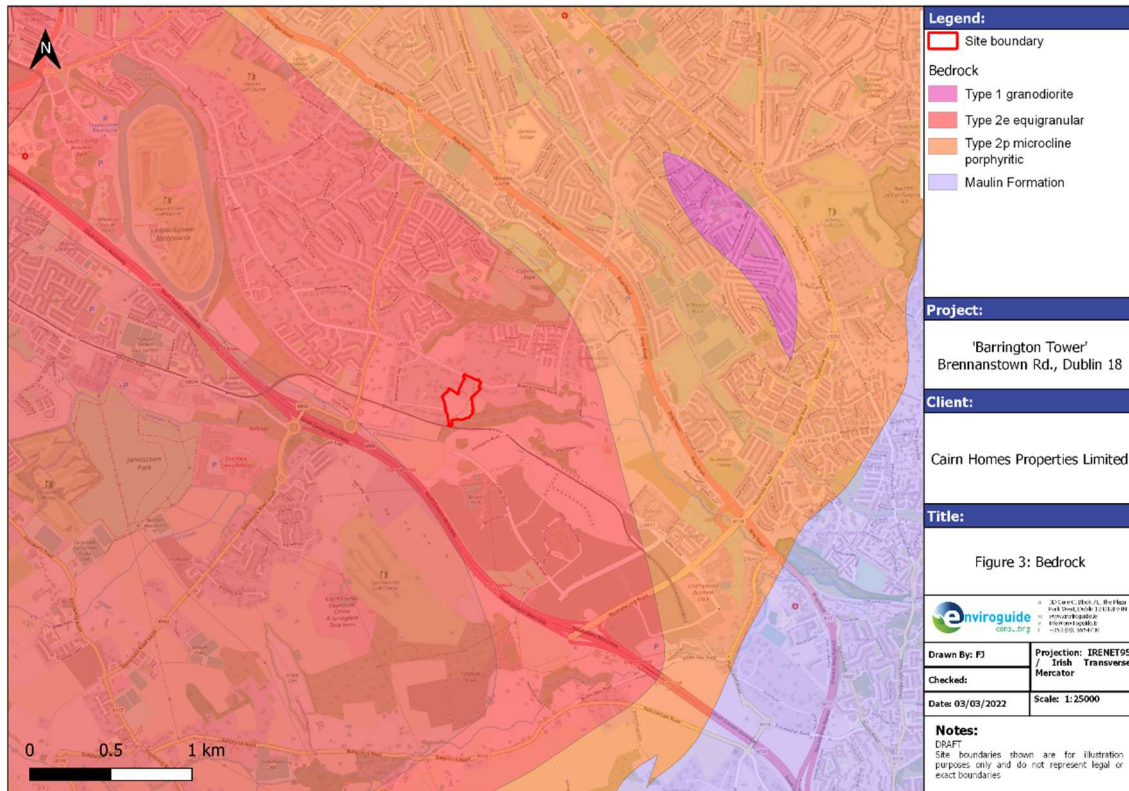


Figure 3-3: Bedrock Geology

3.6 Aquifer Classification and Vulnerability Rating

The bedrock of the Type 2e equigranular Formation is classified as a Poor Aquifer (PI) (i.e., bedrock which is generally unproductive except for Local Zones) (GSI, 2022).

The GSI has assigned a groundwater vulnerability rating of “Extreme” (X) for the groundwater beneath the majority of the Proposed Development Site while a portion towards the eastern site boundary are assigned a rating of “Rock at or near Surface”. During site investigation groundwater was encountered within the overburden towards the northern portion of the Site. The GSI Groundwater Aquifer Classification map is provided in Figure 3-4 and the Groundwater Vulnerability map is presented in Figure 3-5.

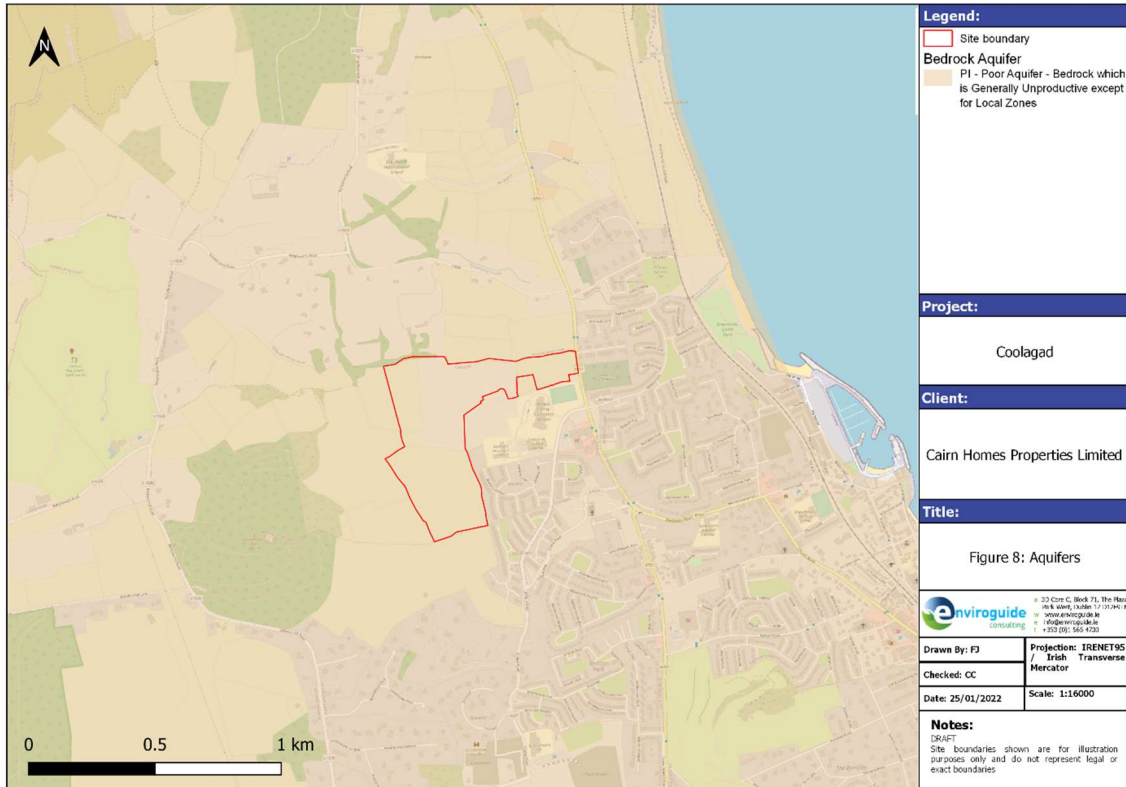


Figure 3-4: Aquifer Classification

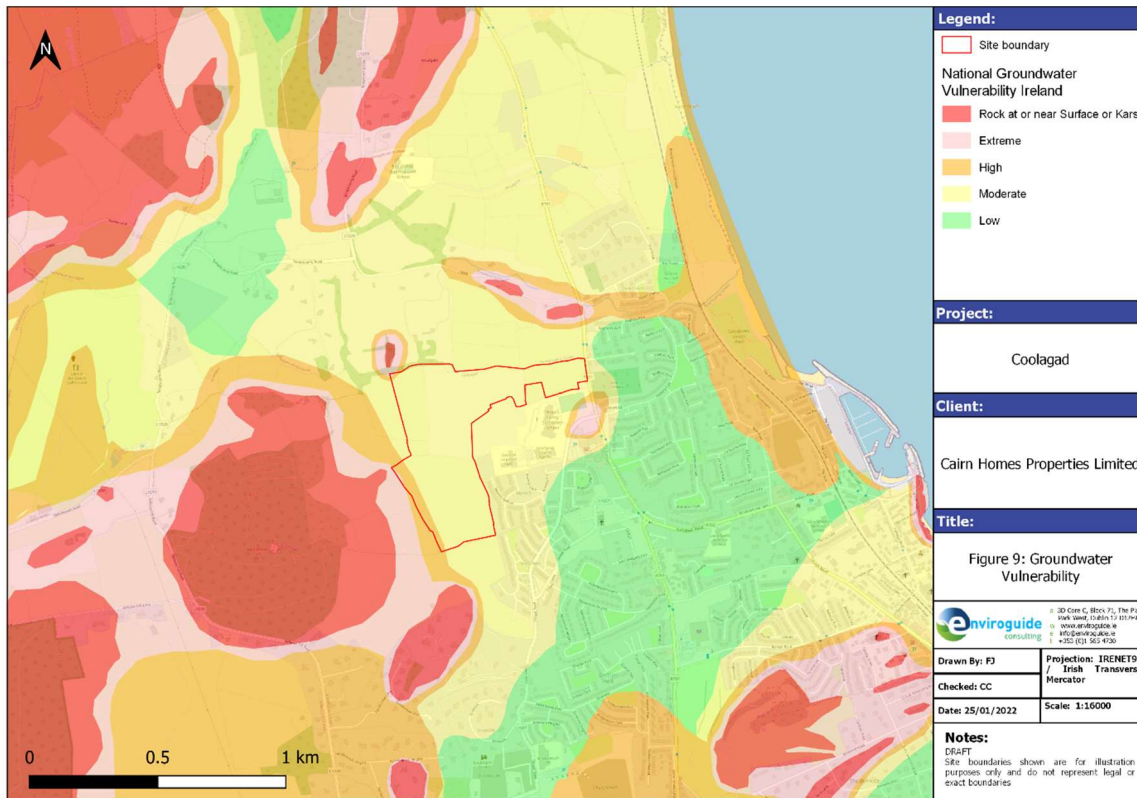


Figure 3-5: Groundwater Vulnerability

3.7 Groundwater Use and Source Protection

Within a 2km radius of the Proposed Development Site there is one (1 No.) groundwater source recorded approximately 0.8km southeast of the Site and thirty-four (34 No.) boreholes located between 1.85km and 2km north of the Proposed Development Site recorded for 'unknown' use (GSI, 2022).

There are no groundwater source protection areas within 2km of the Site.

3.8 Recharge

The GSI have calculated an effective rainfall (ER) value of 583.1mm/year and a recharge coefficient of 60% for the area of the Proposed Development Site (GSI, 2022).

A recharge cap of 100mm/year has been applied to the majority of the Proposed Development Site as it is underlain by a poor aquifer which is generally unproductive except for local zones (PI), thereby indicating a low capacity of the aquifer at the Proposed Development Site to accept recharge via infiltration of rainfall.

3.9 Regional Hydrogeology

The bedrock aquifer beneath the Site is within the Wicklow GWB (EU Code: IE_EA_G_076) which covers an area of 1396km² across Co. Dublin, Co. Wicklow and Co. Wexford (GSI, 2022).

The GSI description of the Wicklow GWB identifies that the dominant recharge process will be diffuse recharge from water percolating through the overlying tills and into the aquifer. High rates of potential recharge are expected in the hilly areas where there are very thin subsoils and high rainfall. A large portion of this potential recharge will be rejected because the rocks in this area are considered to be poor aquifers with low storativity. In addition, the steep slopes in the area will increase surface runoff. Therefore, the rapid runoff component to streams will be higher.

Groundwater flow is considered to recharge and discharge on a local scale. Groundwater discharges to the numerous small streams crossing the aquifer, to springs and seeps and also directly to the Irish Sea (GSI, 2022). The GSI (Wicklow GWB Report) identifies that the majority of groundwater flow direction in the aquifer will take place in the upper weathered of the rocks with lateral flow towards discharge points to rivers, streams and towards the coast. Where structural deformation is greater may be a flow within a fracture network which will allow groundwater movement at greater depths. Only flow in isolated fractures is expected below 30m depth.

3.10 Designated and Protected Sites (Natura 2000)

The Designated and Protected Sites including Natura 2000 sites located within 15km of the Site are presented in *Figure 3-6*.

The Shanganagh River, into which the Carrickmines Stream discharges, flows through the Loughlinstown Woods Proposed Natural Heritage Area (pNHA),

There is a potential hydraulic connection with identified Natura 2000 sites in the Irish Sea via the Carrickmines Stream that discharges to the Shanganagh River and ultimately discharges to the Irish Sea at Hackett Island Bay Beach. There is a potential direct hydraulic connection

with the Dalkey Island Special Protection Area (SPA) (Site Code:004172), with the Rockabill to Dalkey Island Special Area of Conservation (SAC) (Site Code:003000) and the Bray Head SAC (Site Code:000714) which are located approximately 3.26km north, 1.5km east and 5.62km south respectively from where the Shanganagh River discharges to Irish Sea.

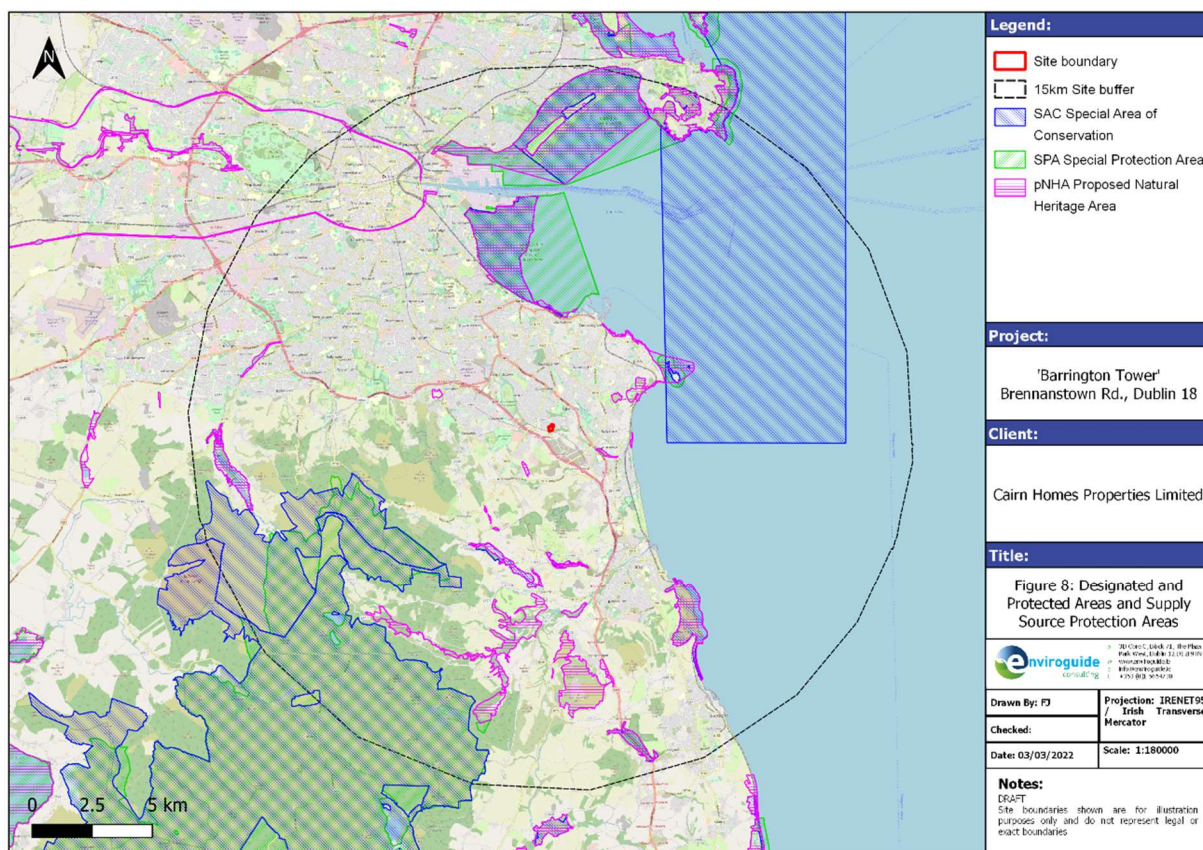


Figure 3-6 Designated and Protected Areas

3.11 Water Framework Directive Status

The Waterbody Status for river, groundwater, transitional and coastal water bodies relevant to the Site as recorded by the EPA (2022) in accordance with European Communities (Water Policy) Regulations 2003 (SI no. 722/2003) are provided in Table 3-2.

Table 3-2: WFD Risk and Water Body Status

Waterbody Name	Water body; EU code	Location from Site	Distance from Site (km)	WFD water body status (2013-2018)	WFD 3 rd cycle Risk Status	Hydraulic Connection to the Site
Surface Water Bodies						
Carrickmines Stream	IE_EA_10C04 0350; 10C04	South	0.05	Moderate	At risk	Downstream of Site
Shanganagh River	IE_EA_10S01 0600; 10S01	South-east	2	Moderate	At risk	Downstream River Network to the Carrickmines Stream

Waterbody Name	Water body; EU code	Location from Site	Distance from Site (km)	WFD water body status (2013-2018)	WFD 3 rd cycle Risk Status	Hydraulic Connection to the Site
Carrickmines Great Stream	10C66	South-west	0.74	Moderate	At risk	Upstream tributary of the Glenamuck North Stream
Glenamuck North Stream	10G19	South-west	1.37	Moderate	At risk	Upstream tributary of the Carrickmines Stream
Jamestown 10 Stream	10I01	South-west	1.37	Moderate	At risk	Upstream tributary of the Glenamuck North Stream
Barnacullia River/ Ballyogan Stream	10B99	West	0.985	Moderate	At risk	Upstream tributary of the Carrickmines Stream
Cabinteely Stream	IE_EA_10K02 0200; 10K02	North	0.75	Moderate	At risk	Downstream tributary of the Carrickmines Stream
Laughlanstown Stream	10L07	East	0.125	Moderate	At risk	Upstream tributary of the Carrickmines Stream
Coastal Water Bodies						
Southwestern Irish Sea – Killiney Bay (HA10)	IE_EA_100_0000	East	3.28	Good	Not at Risk	Downstream waterbody to the Carrickmines Stream and Shanganagh river waterbodies
Groundwater Bodies						
Wicklow Groundwater Body	IE_EA_G_076	N/A	N/A	High	Review	Underlying groundwater-body

4 SITE INVESTIGATION RESULTS

Site investigation including a geophysical survey (MGL, 2021), three intrusive ground investigation surveys (SIL, 2020; SIL, 2021 and PGL, 2022) which included the following:

- 23 No. cable percussive boreholes;
- 17 No. rotary boreholes;
- 22 No. trial pits;
- No. infiltration tests;
- 2 No. foundation pits;
- 13 No. California Bearing Ration tests; and
- 4 No. Soil samples
- 6 No. groundwater monitoring well installation (rotary boreholes);
- 6 No. permeability tests;
- Groundwater level monitoring; and
- 2 No. groundwater samples for chemical analysis.

4.1 Ground Conditions and Geology

The ground conditions encountered during the geophysical and intrusive site investigations are summarised as follows:

Topsoil was encountered across the Proposed Development Site from ground level to a maximum depth of 0.3mbGL with the exception of one location along the eastern Site boundary where tarmacadam was recorded (TP17S).

Made Ground was recorded in very localised areas of the Site only at areas that were previously developed including along the north and east boundaries (BH15S, TP17S TP18s, TP19S and TP21S); near the existing buildings (TP01S, TP02S and TP03S) and at one location (TP09S) along the roadway through the Site. Made ground generally comprised of GRAVEL and slightly silty, sandy, CLAY to a maximum depth of 1.5mbGL with trace inclusions of anthropogenic material (i.e., fragments of concrete, brick, plastic and ceramic) (SIL, 2020).

Brown, slightly sandy, slightly gravelly, silty CLAY was encountered at locations across the site to a maximum depth of 5.7mbGL (BH10) located in the northern portion of the Proposed Development Site. Brown to grey, sandy GRAVEL with some cobbles was encountered beneath the clay at some localised areas along the northern, eastern and western boundaries (of the Proposed Development Site to a maximum depth of 2.9mbGL (TP20).

White to light brown, weathered granite bedrock was encountered between 0.3mbGL and 2.1mbGL in the south of the Site and between 0.9mbGL and 5.7mbGL in the northern portion of the Proposed Development Site. Based on the available data, rock head generally slopes to the southeast with rockhead elevation ranging from 75.35mOD along the north-west of the Site (RC08S) to between 59.31mOD in the southern portion.

Bedrock was generally described as 'strong to very strong' and discontinuities were generally between sub-horizontal and 60 degrees with occasional subvertical discontinuities in the borehole logs (SIL, 2020; SIL, 2021). The general geological profile at the Site is presented in Figure 4-1.

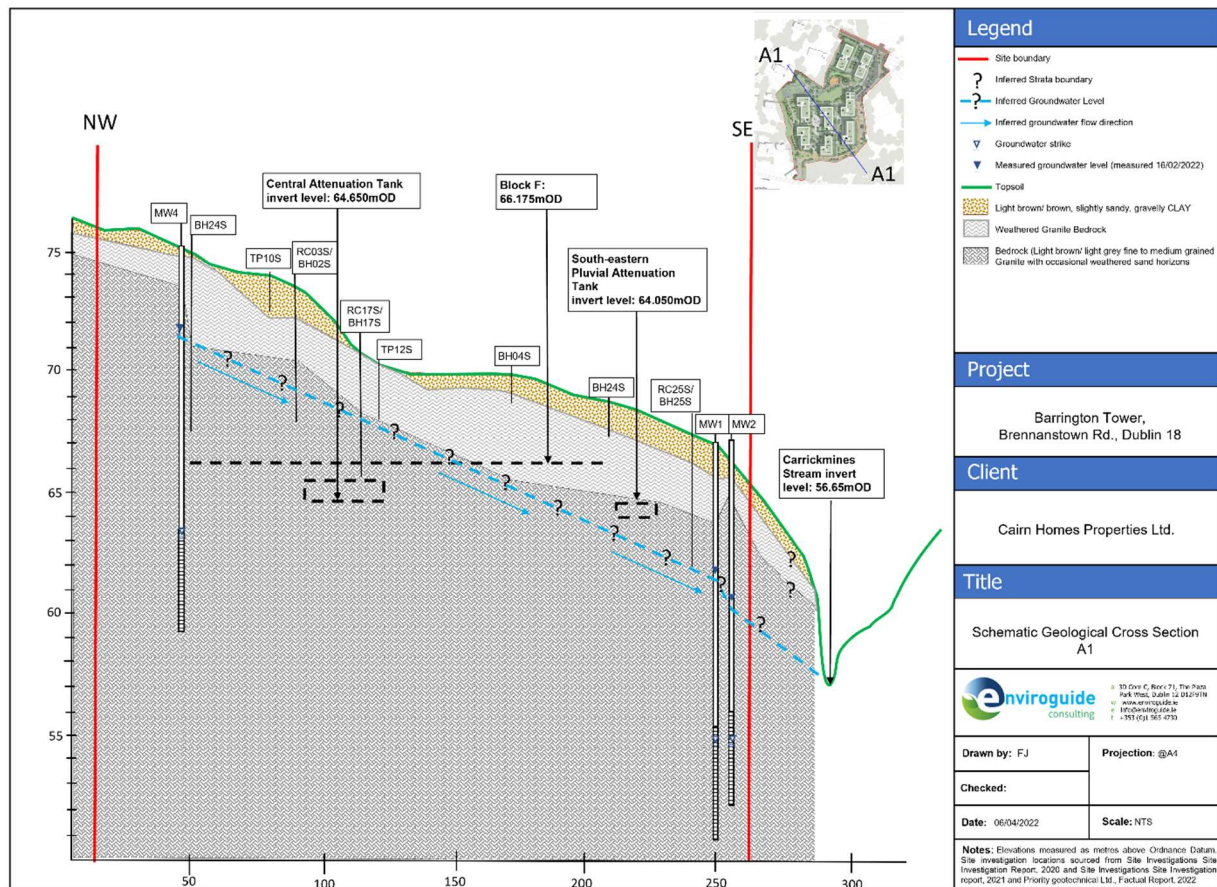


Figure 4-1 Geological Cross Section

4.2 Groundwater Encountered During Drilling

Ground conditions were typically dry in the overburden and weathered bedrock at 74 investigation locations with the exception of very localised occurrences of perched water recorded within the upper 2.9mbGL of granular overburden. Isolated occurrences of shallow groundwater were recorded as 'seepage' at TP18, TP19 (SIL, 2020) and at TP21, described as a 'medium' water ingress (SIL, 2020) and at MW5 and MW6 (PGL, 2022) in the north of the Site. A single occurrence was recorded at the western boundary at TP08 (SIL, 2020).

Groundwater was encountered during borehole drilling within the fractured bedrock at depths of 9.5mbGL (63.939mOD (MW6)) and 13mbGL (62.612mOD (MW4)) during drilling (PGL, 2022). The borehole logs for the groundwater monitoring wells MW1 through MW6 are provided in Appendix A.

4.3 Groundwater Levels and Flow

Six groundwater monitoring wells were installed at the Proposed Development Site between the 31st January to the 4th February 2022 at locations presented in Figure 4-2.

Groundwater levels were recorded at the six monitoring wells (MW1 to MW6) between the 4th February 2022 and the 16th February 2022 including continuous groundwater

level monitoring using data loggers during that period. Measured groundwater levels are provided in Table 4-1 and groundwater hydrograph from data loggers is provided in Figure 4-3.

Table 4-1: Measured Groundwater Levels (PGL, 2022)

Monitoring Location ID.	Groundwater Level (mbTOC*) 16/02/2022	Groundwater Elevation (mOD)
MW1	4.52	61.106
MW2	6.31	59.918
MW3	9.2	60.04
MW4	4.36	71.432
MW5	2.04	71.45
MW6	1.77	71.669
*mbTOC = m below top of casing		

Based on the measured groundwater elevations groundwater flow direction is inferred to be to the southeast towards the Carrickmines Stream (refer to *Figure 4-2*).

The calculated hydraulic gradient at the Site is of 0.082 m/m.

The hydraulic conductivity calculated from permeability tests completed at MW1 through MW6 ranged from 7.65×10^{-8} m/s to 1.98×10^{-6} m/s with an average of 8.92×10^{-7} m/s for wells installed in the bedrock and 4.89×10^{-6} m/s for the well installed in overburden/weathered bedrock (MW5).

A response to rainfall was noted in a slight variation in groundwater levels over the monitoring period of 4th February 2022 and the 16th February 2022 as shown in Figure 4-3 . As is typical for the fractured aquifer with limited capacity to accept recharge there is only a slight fluctuation noted with the exception of MW01. However, a data set compiled over a longer monitoring period would be required to determine how groundwater levels at the Site respond to rainfall or other recharge.

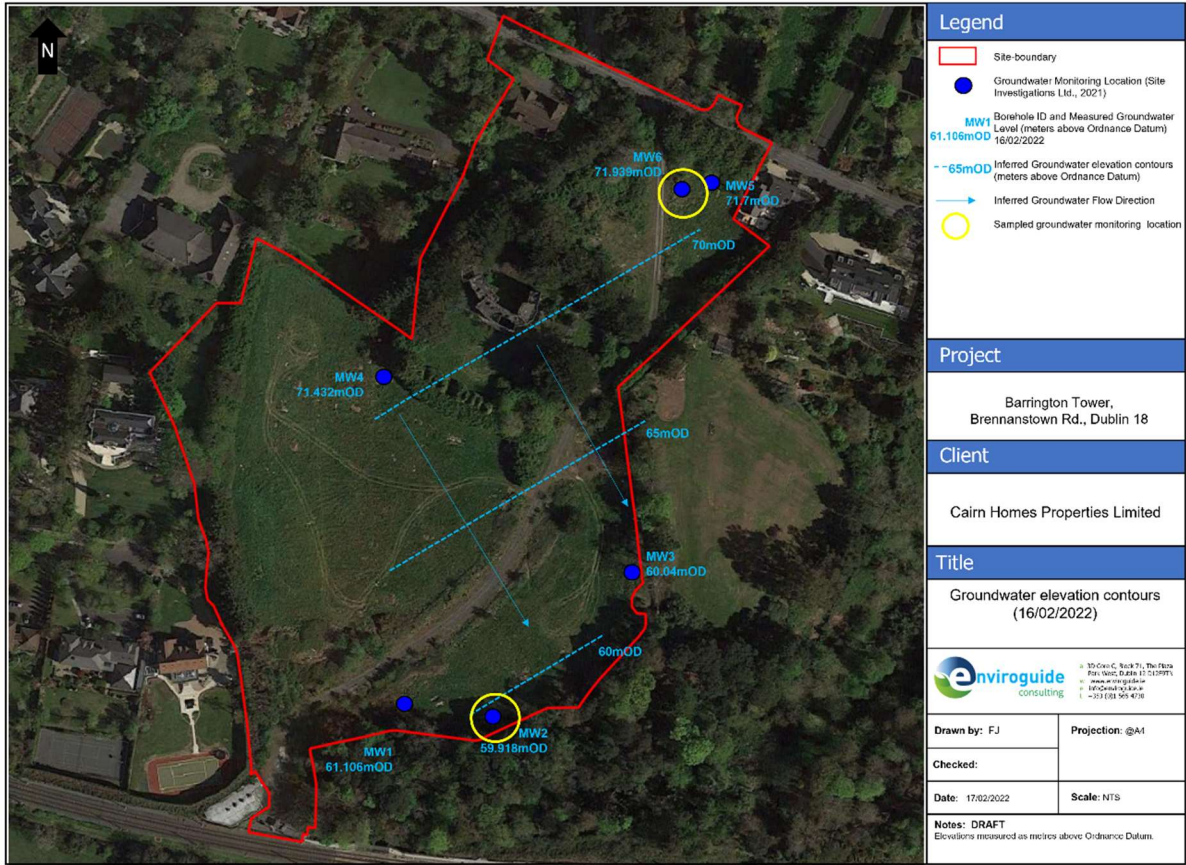


Figure 4-2 Groundwater Flow Direction

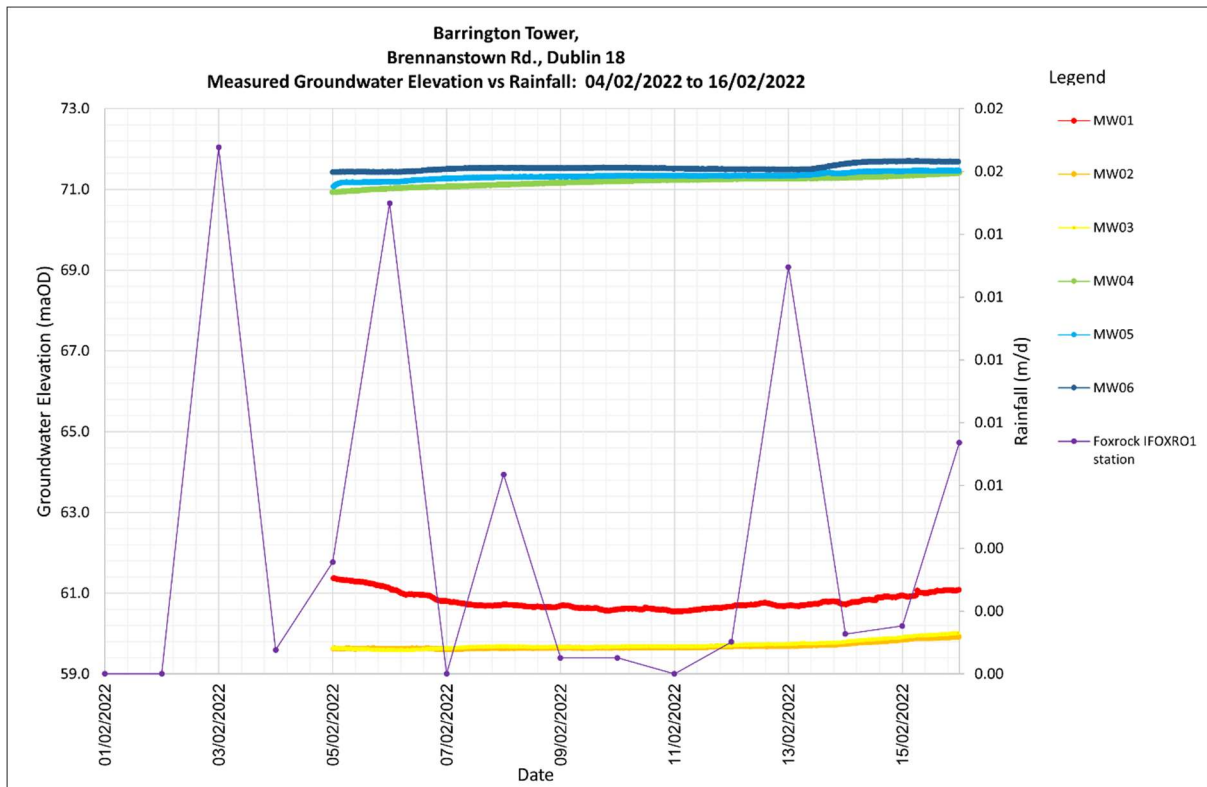


Figure 4-3: Groundwater Levels and Rainfall Data

5 SITE HYDROCHEMISTRY AND WATER QUALITY

5.1 Surface Water Quality

The EPA water quality monitoring data for the stations on the Carrickmines Stream located closest to the Site is summarised in Table 5.1. The reported Q-value results indicate that water quality in the Carrickmines Stream in the vicinity of the Site is poor to moderate. The EPA data indicates that there is an upward trend in Total Ammonia and Ortho-phosphate (as P) for the water course for the period 2013-2018 (EPA, 2022). It is also noted that the Ballyogan Landfill facility (Licence Number W0015-01) is located upstream of the Site and the most recent available Annual Environmental Report (AER) for 2020 indicates no non-compliance issues.

Table 5.1: EPA monitoring stations and assigned Q values

EPA Monitoring Station name	Station Code	Location from Site	Distance from Site	Assigned Q value
Carrickmines Stream – Glenamuck rd Br (Friarsland/Priorsland)	RS10C040200	West - upstream	0.55	3 "Poor"
Carrickmines Stream – Br Nr Glendruid Ho	RS10C040300	East – downstream	0.34	3-4 "Moderate"

5.2 Groundwater Quality

Groundwater monitoring and sampling was undertaken at the Site on the 4th February 2022 at the sample locations are shown on *Figure 4-2*. The laboratory analytical results are included in the documents provided in Appendix A.

Groundwater quality results were screened against the following assessment criteria:

- SI. No. 122/2014 - European Union (Drinking Water) Regulations 2014 including amendments S.I. No. 464/2017 (DW PVs);
- S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010 and amendment S.I. No.366/2016 (GW GTVs); and
- S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 including amendments S.I. No. 327/2012, S.I. No. 386/2015 and S.I. No. 77/2019 (SW AA-EQS and/or MAC EQS).

Analytical results were reported as being within the applicable values specified in the GW GTVs, DW PVs or SW EQS as appropriate. The reported results for petroleum hydrocarbons were reported as below the laboratory limit of detection (i.e. not detected) for all samples.

6 HYDROGEOLOGICAL RISK ASSESSMENT

6.1 Risk Impact Assessment

A risk-based and receptor-focussed approach was adopted for this assessment of any impact to the receiving hydrological and hydrogeological (water) environment associated with the Proposed Development. The basis for a risk assessment is the Conceptual Site Model (CSM) or Source-Pathway-Receptor (S-P-R) model which underpins the Directive 2000/60/EC (Water Framework Directive; WFD) on which both surface water and groundwater regulations are based as well as EPA guidelines on the protection of groundwater and surface water resources including associated aquatic ecosystems and human health receptors (e.g., groundwater supply users).

A risk assessment is undertaken to provide an understanding of the risk associated with the presence of any potentially contaminating materials and/or activities on a site. If one or more of the three elements of the pollutant linkages are missing, the exposure pathway is considered incomplete and there is no risk associated with the activity or contaminant source (i.e., it does not present a means of exposure).

The 'prevent or limit' objective is the key element of the WFD and groundwater quality objectives and in principle, prevent or limit measures are the first line of defence in restricting inputs of pollutants from the Proposed Development (i.e., 'source' removal) and thereby avoiding or reducing any potential impact to the receiving water environment.

In this assessment all three elements Source-Pathway-Receptor model or CSM will be considered, and any potential linkages evaluated and assessed to determine if the Proposed Development could potentially impact upon any identified receptors namely designated and protected sites.

6.2 Hydrogeological Conceptual Site Model

The local groundwater flow direction broadly follows topography and is to the southeast towards the Carrickmines Stream.

There is limited capacity in the granite bedrock aquifer of the Wicklow GWB to accept recharge (GSI, 2022). Overland flow with limited infiltration to ground and bedrock and groundwater flow through fracture zones in bedrock are the dominant mechanisms for transport of water through the Site.

Shallow groundwater in soil and overburden was generally not identified at the Site with predominantly dry ground conditions in soil and overburden with the exception of a very localised area in the northeast of the Site adjoining the boundary with Brennanstown Road in the north of the Site (TP18, TP19, TP08, MW5 and MW6) and an isolated occurrence at the Southwest boundary (TP21) where shallow groundwater was encountered in the upper 2.9mbGL. Groundwater was encountered during borehole drilling within the fractured bedrock at depths of 9.5mbGL (63.939mODmOD (MW6)) and 13mbGL (62.612mOD (MW4)) during drilling (PGL, 2022).

Measured groundwater elevation at the Site ranged from 71.67mOD (MW6) in the north and northeast to 59.9mOD (MW2) (measured on 16th February 2022). Slight fluctuation of groundwater levels in response to rainfall in the granite bedrock beneath the Site appears to

reflect the low recharge capacity of the Wicklow GWB however this interpretation is based on a limited dataset collected from 4th to 16th February 2022. Longer term groundwater monitoring would be required to determine the response to rainfall and seasonal variations in groundwater levels at the Site.

6.3 Risk Assessment

A risk-based assessment of the Source-Pathway-Receptor Model and the potential risk linkages associated with the construction and post construction phase of the Proposed Development was undertaken. The results were evaluated to determine if the Proposed Development could potentially impact any potential receptors associated with the Site.

Table 6-1 - Conceptual Site Model (Source- Pathway Receptor) and Risk Evaluation

Source	Pathway	Receptor	Risk Evaluation and Avoidance
Construction Phase			
Basement construction and dewatering during excavation	Groundwater flow regime	Groundwater flow offsite Surface water flow offsite	Low risk Any required groundwater dewatering will not impact on the existing surface water flow across the Site. The dewatering strategy will ensure the expected localised temporary impact on groundwater levels will be maintained within the work area onsite and not extent offsite. Groundwater drainage will be installed to prevent any localised mounding of groundwater upgradient of subsurface structures (i.e. basement / tanks).
Surface water runoff	Surface water flow regime	Downstream habitats at Site boundaries Receiving surface water features (Carrickmines Stream)	Low risk Any local diversion of surface water required to enable construction will not impact on offsite flow regime. Temporary surface water drainage during construction to ensure water flow across the site is not impeded.
Discharge of contaminants to ground / groundwater	Vertical and Lateral Groundwater Migration in bedrock aquifer	Downgradient aquifer Carrickmines Stream and associated downstream water courses Natura 2000 sites	Low to Moderate Risk (worst-case unmitigated scenario) Potential for infiltration of contaminants to groundwater from surface is limited due to the nature of the bedrock aquifer. During basement excavation in a worst-case unmitigated scenario there is potential for infiltration to groundwater and migration offsite. Appropriate design avoidance and mitigation measures will prevent any potential impact to the receiving water quality.
Discharge of entrained	Lateral migration across the Site and offsite	Carrickmines Stream and associated	Moderate Risk (worst-case unmitigated scenario)

contaminants in surface runoff		downstream water courses Natura 2000 sites Sensitive receptors at Site boundaries (e.g. habitats and landscape features)	Potential risk of runoff with contaminants migrating offsite. Appropriate design avoidance and mitigation for the construction works will prevent or limit any potential impact to offsite receptors and the receiving water quality: <ul style="list-style-type: none"> • Exclusion zone around water courses and at Site boundaries where existing landscape will be retained; • Construction measures including pollution control measures and surface water management.
Instream works for construction of the surface water outfall	Discharge to Carrickmines Stream	Carrickmines Stream and associated downstream water courses Natura 2000 sites	High Risk (worst-case unmitigated scenario) Potential risk of runoff with contaminants migrating offsite in the absence of mitigation. Appropriate design avoidance and mitigation for the construction works will prevent or limit any potential impact to offsite receptors and the receiving water quality: <ul style="list-style-type: none"> • Environmental/Ecological Clerk of works will oversee works. • Construction measures including use of pre-cast materials. • Silt curtains or similar to be used where necessary. • All works to be carried out in accordance with IFI guidelines (2016).
Operational Phase			
Discharge of entrained contaminants in surface runoff (e.g. fuel spill in carpark areas)	<ul style="list-style-type: none"> • Surface water drainage and discharge offsite outfall to: Carrickmines Stream • Foul drainage 	Carrickmines Stream and associated downstream water courses Natura 2000 sites	Low Risk All drainage from the car park area (basement) will be discharged to foul sewer via a petrol interceptor. Surface runoff from roofs and paved areas will be managed and treated in accordance with SUDS and pass through petrol interceptor and attenuation tanks prior to discharge to the Carrickmines Stream.
Foul water discharge	Foul to sewer and the discharge from Shanganagh WWTP	Irish Sea and Rockabill to Dalkey Island SAC	Low Risk Discharge to foul sewer will be diluted in sewer network and treated at Shanganagh WwTP which operates in accordance with conditions of statutory consents that are protective of the receiving water environment.

6.3.1 Design Avoidance and Mitigation

The assessment of the potential impacts on the receiving environment takes account of the embedded design avoidance measures and standard good practice construction methods to

reduce the potential for impacts to the water environment. These are outlined below together with additional specific measures based on the findings of this assessment.

Groundwater level monitoring is recommended to establish longer term groundwater levels at the Site and any temporal or seasonal variations.

The dewatering methodology to be implemented by the contractor will ensure that any dewatering is confined to the localised zone and does not extend towards the site boundaries.

Standard design and construction measures that include incorporating groundwater drainage around impermeable subsurface structures (i.e. basement, tanks, temporary barriers during construction) will minimise impacts of groundwater mounding at the upgradient side of the structures and potential buoyancy issues. The design and use of pluvial attenuation tanks in locations that may be seasonally below groundwater level should consider the potential loss of effective attenuation volume and capacity due to groundwater submergence. The use of impermeable geotextile membranes should be considered. The surface water drainage design for the Proposed Development incorporates SUDS measures to ensure conveyance of water across the Site.

Surface water runoff management will be required to prevent runoff entering excavations during construction. Surface water will require diversion around the open excavations using standard temporary drainage methods to ensure that surface water is effectively conveyed around works areas and with no impacts to the overall existing surface water flow regime.

Construction exclusions zones will be required to be required along the Site boundaries and outside of works areas where existing features will be incorporated into the landscape design proposals. It is noted that there will be no impact to drainage in those areas and no associated impact on the receiving environment. This will ensure that there is no impact to water flow through the Site and in particular along Site boundaries and areas where potentially sensitive receptors are identified.

A CEMP prepared in accordance with industry best practice standards including CIRIA - C532 including detailed measures to protect water quality and associated ecological habitats and receptors will be required to be implemented by the contractor during the construction phase. The measures will address the main activities of potential impact which include:

- Control and management of water and surface runoff;
- Control and management of groundwater during excavation and dewatering;
- Management and control of works in and adjoining water courses;
- Management and control of imported soil and aggregates from off-site sources;
- Fuel and Chemical handling, transport and storage; and
- Accidental release of contaminants.

The CEMP will outline measures for the control and treatment of water encountered during construction and methodology for the treatment of water to ensure that there are no prior to discharge from the Site.

A watching brief by an Environmental /Ecological Clerk of Works is recommended during critical stages of the construction works associated with surface water in particular works adjoining the Carrickmines Stream.

All instream works or works carried out adjacent to the Carrickmines Stream, will follow the measures outlined in the CEMP and the guidelines published by Inland Fisheries Ireland (IFI) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters (2016) and The National Roads Authority (now Transport Infrastructure Ireland) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.

All below (below ground) drainage infrastructure will be constructed in accordance with current IW requirements to ensure that there are no potential impacts to groundwater quality.

Discharges from the Site will be in accordance with relevant statutory approvals from Irish Water for discharges to sewer and DLRCC for discharges to surface water.

6.3.2 Groundwater Levels and Dewatering

Any dewatering required will be temporary and will not impact downgradient offsite receptors.

Local groundwater mounding may occur upgradient of any temporary impermeable barriers required to facilitate construction and permanent subsurface structures that are below the groundwater table (i.e., basements and attenuation tanks). Standard construction measures will ensure that groundwater flow across the Site is maintained and that there will be no impact on groundwater levels.

6.3.3 Water Quality

There is a potential risk to water quality during the works required adjoining and in the Carrickmines Stream and work where groundwater may be encountered including the bulk excavation works and construction of the basement and drainage infrastructure.

Groundwater impacts could occur; however, based on the depth to groundwater and the hydrogeological conditions of the fractured bedrock classified as a poor aquifer, limited potential to accept infiltration, it is considered that there is some protection of groundwater from migration of dissolved phase contaminants to the aquifer. However, in a worst-case scenario such as a fuel spill within a deeper excavation where groundwater may be encountered there could be potential for migration of petroleum hydrocarbons into the bedrock aquifer and impacts to groundwater quality.

Surface runoff of deleterious material including fuels and materials being used on-site during the construction works could potentially impact the receiving water quality in the Carrickmines Stream. In particular taking account of the potential limited capacity for attenuation due to the baseline water quality and potential for in-combination effects with other developments and facilities within the catchment of the water course including the Ballyogan Landfill site. In the event of a worst-case unmitigated scenario such as an accidental fuel spill or release of sediment during construction of the outfall at the Carrickmines Stream, this would impact on the downstream Carrickmines Stream, Shanganagh River and the receiving Irish Sea.

There is limited potential for discharge of any contaminated runoff to the receiving water courses during the operation of the Proposed Development due to the design for surface water retention and treatment included in the SuDS measures prior to discharge to the Carrickmines

Stream. Drainage from the basement carpark which is considered a high-risk area of the Proposed Development will not be discharged to a water course and will be treated in a petrol interceptor and discharged to the foul sewer in accordance with connection agreement from Irish Water.

Foul water from the Proposed Development will be discharged via a connection to the existing Irish Water sewer in accordance with a connection agreement from Irish Water and ultimately discharged to the Irish Sea following treatment at Shanganagh WWTP. The WWTP operates under existing statutory consents and the most recent available data in the 2020 AER verifies that discharges from the WWTP were compliant during that period. Foul water from the Proposed Development will only be discharged to public sewer under agreement from Irish water and other applicable statutory consents verifying capacity at the WWTP for the Proposed Development. Therefore, there will be no impacts, including cumulative, on the receiving water environment associated with foul water discharges from the Proposed Development.

6.3.4 Protected and Designated Sites (Natura 2000)

The closest Natura 2000 sites that are hydraulically connected with the Site are located in the Irish Sea, the closest of which is the Rockabill to Dalkey Island SAC which is approximately 1.5km from the point where the Shanganagh River discharges to the sea. It is considered that in the absence of any mitigation or avoidance measures that there would be a potential impact on water quality within the Carrickmines Stream, and the downstream water bodies including the immediate area where the Shanganagh River discharges to the Irish Sea. While there is likely considerable dilution and attenuation due to tidal fluxes within the Irish Sea, in applying the precautionary principle the potential impact to associated Natura 2000 sites including the Rockabill to Dalkey Island SAC in an unmitigated scenario warrants consideration and potentially mitigation.

Foul water from the Site will discharge via the Shanganagh WWTP to the Irish Sea via the long sea outfall and short sea outfall. The WWTP is operated in accordance with relevant statutory approvals and therefore, there would be no impact on baseline conditions at any Natura 2000 sites associated with foul discharges from the Proposed Development including the Rockabill to Dalkey Island SAC.

The Construction Phase will be managed in accordance with a robust Construction Environmental Management Plan that will be implemented by the contractor to include appropriate avoidance and mitigation measures to prevent any potential impact on the receiving water bodies, water quality and associated Natura 2000 sites.

6.3.5 Water Framework Directive Status

The findings of the risk-based assessment identified that in the absence of any mitigation or avoidance measures there could be a potential impact on the water quality within receiving water bodies associated with the Site.

Based on the design of the design of the Proposed Development, embedded avoidance measures and the identified mitigation measures that will prevent or limit impact and deterioration of water bodies the identified potential impact on WFD status of water bodies will be prevented.

There will be no impact to the existing WFD status of water bodies associated with the Proposed Development Site including the Carrikmines Stream, Shanganagh River, Southwestern Irish Sea – Killiney Bay and the Wicklow GWB as a result of the Proposed Development taking account of design avoidance and mitigation measures.

7 CONCLUSIONS

Enviroguide Consulting undertook a hydrogeological assessment of the Proposed Development at Barrington Tower, Brennanstown Road, Dublin 18.

Based on the data made available to Enviroguide Consulting pertaining to the existing hydrogeological conditions at the Site and design for the Proposed Development, the following can be concluded:

- Surface water drainage from the Proposed Development will discharge to the Carrickmines Stream located to the south of the Site. surface water from the basement and all foul water will discharge to the Irish Water foul sewer.
- Groundwater strikes were recorded at depths ranging from 9.5mbGL to 13.0mbGL in the bedrock. Standing groundwater levels in bedrock wells range from 71mOD to 59mOD and groundwater flow is to the southeast towards the Carrickmines Stream. Longer term monitoring of groundwater levels would be required to determine if there is any seasonal or temporal variation in groundwater levels at the Site.
- Based on the observed conditions there is likely some infiltration and recharge to groundwater at the Site during rainfall events. There is no connection from groundwater to surface water within the Site, however groundwater likely discharges to the Carrickmines Stream.
- Interpreted groundwater levels indicate that the northwest or upgradient portion of the basement floor slab and the attenuation tank could be below the groundwater table.
- Standard design measures including groundwater drainage around subsurface structures is recommended to enable groundwater movement across the Site and to minimise the potential impacts of groundwater mounding upgradient or buoyancy of structures associated with hydrostatic pressure. Impermeable membrane should be incorporated in pluvial attenuation tanks to prevent loss of attenuation capacity due to groundwater ingress.
- Mitigation measures will be required during the construction works to ensure that there are no impacts on receiving water quality in particular during construction of the outfall to the Carrickmines Stream.
- Localised dewatering for basement construction may be required. It is anticipated that with the implementation of standard mitigation there will be no negative impact on groundwater flow regime or water quality at the Site and no impact to any sensitive receptors adjoining or downgradient of the Site.
- There is no identified impact on the Water Framework Directive Status of the Carrickmines Stream associated with the Proposed Development taking account of identified design avoidance and mitigation measures.

8 REFERENCES

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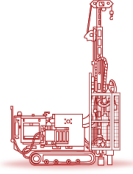
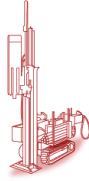
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Waterman Moylan Consulting Engineers Limited, Feb 2022b. Flood Risk Assessment Report Barrington Tower, Brennanstown Road, Dublin 18.

Appendix A



Our Ref: JMcS/Rp/P22023+ attachments (*.pdf)

08th March, 2022

Cairn Homes Properties Limited

7 Grand Canal,
Grand Canal Street Lower,
Dublin 2,
D02 KW81.

Re: Site Investigation at Barrington, Carrickmines, Dublin, Factual reporting.

Introduction

In February, 2022, Priority Geotechnical (PGL) were requested by Cairn Homes Properties Limited to undertake a site investigation at Barrington, Carrickmines, Co. Dublin. Enviroguide Consulting were acting as environmental specialists for the client.

Objectives

The objective of the site investigation is to characterise the ground, groundwater and environmental conditions of the site.

Scope

The original scope of works as determined by Cairn Homes Properties Limited consisted of;

- 06Nr. number of boreholes;
- Standpipe installations;
- Continuous groundwater monitoring (1 week);
- Groundwater sampling;
- Laboratory testing and
- Associated reporting.

Fieldworks

The fieldworks were carried out under the supervision of PGL Geologist(s) between the 31st January and 04th February 2022; in general accordance with BS 5930 (2015) Code of Practice for Site Investigation and Part 9 of BS 1377 (1990), Method of Tests for Soil for Civil Engineering Purposes, *in situ* Tests. The subsequent sections should be read in conjunction with the exploratory logs and laboratory test data accompanying this report.

Boreholes

Six (06) number boreholes were carried out using PGL's Soilmech PSM rotary rig and 131mm diameter casing to depths 5.5m bgl to 16.0m bgl. The exploratory records accompany this report.

Location	Final Depth, m bgl
MW01	15.0
MW02	15.0
MW03	15.0
MW04	16.0
MW05	5.5
MW06	13.0

Sampling

Two (02) water samples were recovered from the exploratory locations in accordance with Geotechnical Investigation and Sampling – Sampling Methods and Groundwater Measurements (EN ISO 22475-1:2006).

Falling head Tests

Six (06) *in situ* falling head permeability tests were carried out in exploratory borehole; in accordance with BS5930: 1999, Section 4: Cl. 25.4, within the superficial deposits over duration of one (1) hour. The processed test data was presented accompanying the relevant borehole logs presented, herein. The shape or intake factor, *f* was derived from the condition at the base of the borehole at the test depth and test geometry as per Hvorslev (1951).

$$k = \frac{A}{fd} \frac{\log_e(H_0/H_1)}{t}$$

Generally for all tests the specific depth range of the test was the deposits below the depth of casing. A mean k measured ($k_H = k_V$), permeability in the soil was assumed equal in both horizontal and vertical direction, ($k_H/k_V = 1.$). The test geometry provided a shape factor, f for the test undertaken in the standpipe well.

Survey and Drawings

Upon completion of the fieldworks, the 'as built' exploration locations were surveyed using Trimble 5700/5800 GPS equipment to the Ordinance Survey Irish Transverse Mercator system of co-ordinates (ITM) and elevations to Malin Head datum. The exploratory locations were shown on the exploratory location plans attached (P22023_SI_A & P22023_SI_01).

Location	Easting	Northing	Ground Level (mOD)	Final Depth (m bgl)	Date Start (dd/mm/yyyy)
MW01	722567.22	724119.05	65.47	15.00	31/01/2022
MW02	722602.10	724115.21	66.23	15.00	01/02/2022
MW03	722655.30	724171.90	68.99	15.00	02/02/2022
MW04	722557.92	724247.66	75.61	16.00	02/02/2022
MW05	722676.17	724318.01	73.44	5.50	03/02/2022
MW06	722687.65	724321.14	73.49	13.00	04/02/2022

Laboratory Testing

Laboratory testing was scheduled by Enviroguide Consulting and carried out by Eurofins Chemtest UK on behalf of PGL in accordance BS1377 (1990), Methods of test for soils for civil engineering purposes and the ISRM suggested methods for rock characterisation, testing and monitoring. The laboratory data accompanies this report and was summarised as follows;

SUMMARY OF LABORATORY TESTING

Type	Quantity, Nr.	Remarks
Environmental analysis (water)	02	See attached

Please note that all samples shall be retained for a period no longer than 28 days from the date of this report. Thereafter all remaining samples shall be appropriately disposed of unless a written instruction to the contrary is received by PGL prior to the date of this reporting and within the 28 day period outlined above. Laboratory testing will result in a reduction of sample quantity and in some cases the use of the full sample mass. Samples already tested may not be suitable or available for further testing.

Published Geology

A search of the Geological Survey data base and 1:100,000 mapping (Sheet 16) showed the study area to be underlain by type 2e equigranular (Nt2e) described as pale grey fine to coarse, Granite. Teagasc subsoil mapping indicated the area is underlain by glacial till derived from Limestones and Granite. Outcropping bedrock is shown in the area. The groundwater vulnerability mapping shows a high vulnerability across the site.

Ground and Groundwater Conditions

The full details of the ground conditions encountered are provided for on the exploratory records accompanying this report. The records provide descriptions, in accordance with BS 5930 (2015) and Eurocode 7, Geotechnical Investigation and Testing, Identification and classification of soils, Part 1, Identification and description (EN ISO 14688-1:2002),– Identification and Classification of Soil, Part 2: Classification Principles (EN ISO 14688-2:2004) and Identification and Classification of Rock, Part 1: Identification & Description (EN ISO 14689-1:2004) of the materials encountered, in situ testing and details of the samples taken, together with any observations made during the site investigation.

Groundwater was encountered during the period of investigation between depths 4.90m bgl and 14.90m bgl. Groundwater observations may be subject to diurnal, seasonal and climatic variations and can also be affected by drainage conditions, tidal variations etc. The groundwater regime should be assessed from standpipe well installations, where available. The exploratory locations were backfilled with their arisings.

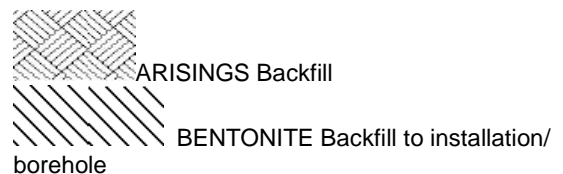
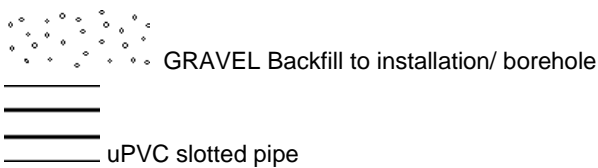
Six 50mm diameter HDPE standpipes were installed under the scope of works. A summary of standpipe construction is outlined below.

Location	Depth Top (m bgl)	Depth Base (m bgl)	Diameter	Pipe Type
MW01	0.00	10.00	50	PLAIN
	10.00	15.00	50	SLOTTED
MW02	0.00	10.00	50	PLAIN
	10.00	15.00	50	SLOTTED
MW03	0.00	10.50	50	PLAIN
	10.50	15.00	50	SLOTTED
MW04	0.00	11.00	50	PLAIN
	11.00	16.00	50	SLOTTED
MW05	0.00	2.00	50	PLAIN
	2.00	5.50	50	SLOTTED
MW06	0.00	7.00	50	PLAIN
	7.00	13.00	50	SLOTTED

A series of groundwater dips were collected on a subsequent visit and are presented below.

Location	16/02/2022
	Depth (m bgl)
MW01	4.52
MW02	6.31
MW03	9.2
MW04	4.36
MW05	2.04
MW06	1.77

Continuous monitoring of groundwater levels was undertaken using a Rugged Troll 100 data logger. The data is presented as digital (.xls) files and accompanies this factual report.



Should there be any queries in relation to the data collected, please do not hesitate to contact our office.

Yours sincerely,
For **Priority Geotechnical**,

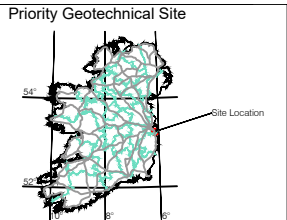


James McSweeney BSc
Engineering Geologist

No responsibility can be held by PGL for ground conditions between exploratory locations. The exploratory logs provide for ground profiles and configuration of strata relevant to the investigation depths achieved during the fieldworks. Caution shall be taken when extrapolating between such exploratory locations. No liability is accepted for ground conditions extraneous to the exploratory locations.

No account has been taken of potential subsidence or ground movement due to mineral extraction, mining works or karstification below or in proximity to the site, unless specifically addressed.

This report has been prepared for Employer and their Representative as outline, herein. The information should not be used without their prior written permission. PGL accepts no responsibility or liability for this document being used other than for the purposes for which it was intended.



JOB NAME:
Barrington, Carrickmines.

Sheet Title:
EXPLORATORY LOCATION LAYOUT

JOB NUMBER:
P21023

DRAWING NUMBER:
P21023-SI-A

DRAWN BY:
Gary Curtin

DATE:
17/02/2022

SCALE: 1:5000 ON A3	APPROVED: GH
------------------------	-----------------

REVISION:
D01





KEY:

MW00 Denotes Dynamic Probe location

Conditions shown on ITM.

MW01	722567.2	724119.1	65.466
MW02	722602.1	724115.2	66.228
MW03	722655.3	724171.9	68.989
MW04	722557.9	724247.7	75.612
MW05	722687.7	724321.1	73.49
MW06	722676.2	724318	73.439

JOB NAME:
Barrington, Carrickmines.

Sheet Title:
EXPLORATION LOCATION PLAN

JOB NUMBER:
P21023

DRAWING NUMBER:
P21023-SI-01

DRAWN BY:
Gary Curtin

DATE:
17/02/2022

SCALE: 1:1000 ON A3	APPROVED: GH
------------------------	-----------------

REVISION:
D01



KEY TO SYMBOLS ON EXPLORATORY HOLE RECORDS

All linear dimensions are in metres or millimetres

DESCRIPTIONS

** Drillers Description
Friable Easily crumbled

SAMPLES

U() Undisturbed 102mm diameter sample, () denotes number of blows to drive sampler
U()F, U()P F- not recovered, P-partially recovered
U38 Undisturbed 38mm diameter sample
P(F), (P) Piston sample - disturbed
B Bulk sample - disturbed
D Jar Sample - disturbed
W Water Sample
CBR California Bearing Ratio mould sample
ES Chemical Sample for Contamination Analysis
SPTLS Standard Penetration Test S lump sample from split sampler

CORE RECOVERY AND ROCK QUALITY

TCR Total Core Recovery (% of Core Run)
SCR Solid Core Recovery (length of core having at least one full diameter as % of core run)
RQD Rock Quality Designation (length of solid core greater than 100mm as % of core run)
Where there is insufficient space for the TCR, SCR and RQD, the results may be found in the remarks column
lf Fracture Spacing in mm (Minimum/Average/Maximum) NI - non intact, NR - no recovery
AZCL Assumed Zone of Core Loss
NI Non intact

GROUNDWATER

▽ Groundwater strike
▼ Groundwater level after standing period
Date/Water Date of shift (day/month)/Depth to water at end of previous shift shown above the date and depth to water at beginning of shift given below the date

INSITU TESTING

S Standard Penetration Test - split barrel sampler
C Standard Penetration Test - solid 60° cone
SW Self Weight Penetration
Ivp, HVp (R) In Situ Vane Test, Hand Vane Test (R) demonstrates remoulded strength
K(F), (C), (R), (P) Permeability Test
HP Hand Penetrometer Test

MEASURED PROPERTIES

N Standard Penetration Test - blows required to drive 300mm after seating drive
x/y Denotes x blows for y mm within the Standard Penetration Test
x*/y Denotes x blows for y mm within the seating drive
 c_u Undrained Shear Strength (kN/m^2)
CBR California Bearing Ratio

ROTARY DRILLING SIZES

Index Letter	Nominal Diameter (mm)	
	Borehole	Core
N	75	54
H	99	76
P	120	92
S	146	113



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Drilled By

KM

Logged By

N/A

Borehole No.

MW01

Sheet 1 of 2

Project Name: Barrington Site Investigation

Project No.
P22023

Co-ords: 722567E - 724119N

Hole Type
CP

Location: Carrickmines, Co. Dublin

Level: 65.47 m OD

Scale
1:50

Client: Cairn Homes Properties Limited

Date: 31/01/2022 - 31/01/2022

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					1.00	64.47		Open hole boring. Driller described: CLAY overburden. Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	1
								6.00m - 6.10m: Clay band.	6

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
10.30	10.00	20		See shift data.	15.00	96	131				
					Equipment:						
					Deltabase 520						

Remarks: MW01 terminated at 15.0m bgl. 50mm dia. standpipe installed. Response zone from 10.00m - 15.00m bgl. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:		GW (m bgl)	Shift	Depth (m bgl)	Remarks
	11.30	31/01/2022 18:00	15.00	08:00	15.00	Start of shift. End of borehole.



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Drilled By

KM

Logged By

N/A

Borehole No.

MW01

Sheet 2 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722567E - 724119N	Hole Type: CP
--	----------------------------	-----------------------------------	----------------------

Location: Carrickmines, Co. Dublin	Level: 65.47 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 31/01/2022 - 31/01/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					15.00	50.47	+++++ Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.		10
							+++++ 10.30m - 10.50m: Clay band.		11
							+++++ 13.40m - 13.60m: Clay band.		12
							+++++ End of Borehole at 15.000m		13
									14
									15
									16
									17
									18

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
10.30	10.00	20		See shift data.	15.00	96	131				
					Equipment:						
					Deltabase 520						

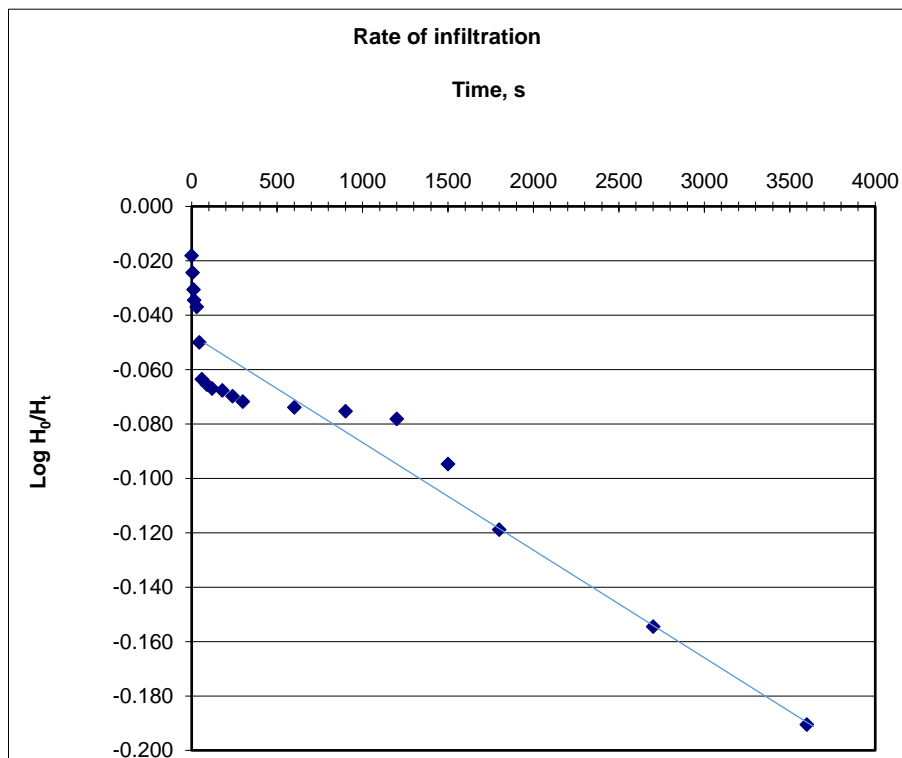
Remarks: MW01 terminated at 15.0m bgl. 50mm dia. standpipe installed. Response zone from 10.00m - 15.00m bgl. Watera tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:			
	GW (m bgl)	Shift	Depth (m bgl)	Remarks
	11.30	31/01/2022 08:00	0.00	Start of shift.
	11.30	31/01/2022 18:00	15.00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW01** H_w/H_o **7.35**
 Test **1**
 Casing diameter **96 mm**
 Casing depth **1 m**
 Borehole depth **15 m**
 Groundwater level **7.65 m bgl**
 Date **03/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_0/H_t$
0	0	0.300	0.00217	7.050	-0.018
0.083	5	0.400	0.00289	6.950	-0.024
0.17	10	0.500	0.00362	6.850	-0.031
0.25	15	0.560	0.00405	6.790	-0.034
0.5	30	0.600	0.00434	6.750	-0.037
0.75	45	0.800	0.00579	6.550	-0.050
1	60	1.000	0.00723	6.350	-0.064
1.5	90	1.030	0.00745	6.320	-0.066
2	120	1.050	0.00760	6.300	-0.067
3	180	1.060	0.00767	6.290	-0.068
4	240	1.090	0.00789	6.260	-0.070
5	300	1.120	0.00810	6.230	-0.072
10	600	1.150	0.00832	6.200	-0.074
15	900	1.170	0.00846	6.180	-0.075
20	1200	1.210	0.00875	6.140	-0.078
25	1500	1.440	0.01042	5.910	-0.095
30	1800	1.760	0.01273	5.590	-0.119
45	2700	2.200	0.01592	5.150	-0.154
60	3600	2.610	0.01888	4.740	-0.191

k_{mean} **4.16E-07 ms⁻¹**
 $k_H = k_V$





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Drilled By
KM

Logged By
N/A

Borehole No.

MW02

Sheet 1 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722602E - 724115N	Hole Type: CP
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Location: Carrickmines, Co. Dublin	Level: 66.23 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 01/02/2022 - 01/02/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					1.00	65.23		Open hole boring. Driller described: CLAY overburden. Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	1
									2
									3
									4
									5
									6
									7
									8
									9

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
12.00	11.70	20		See shift data.	15.00	96	131				
					Equipment: Delata base 520						

Remarks: MW02 terminated at 15.00m bgl. 50mm dia. standpipe installed. Response zone from 10.00m - 15.00m bgl. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:		GW (m bgl)	Shift	Depth (m bgl)	Remarks
	13.80	01/02/2022 18:00	15.00	01/02/2022 08:00	0.00	Start of shift.
					15.00	End of borehole.



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Drilled By
KM

Logged By
N/A

Borehole No.

MW02

Sheet 2 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722602E - 724115N	Hole Type: CP
--	----------------------------	-----------------------------------	----------------------

Location: Carrickmines, Co. Dublin	Level: 66.23 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 01/02/2022 - 01/02/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
							Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.		
						+++++		10	
						+++++		11	
						+++++		12	
						+++++		13	
						+++++		14	
				15.00	51.23	+++++		15	
							End of Borehole at 15.000m	16	
								17	
								18	

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
12.00	11.70	20		See shift data.	15.00	96	131				
					Equipment:						
					Delata base 520						

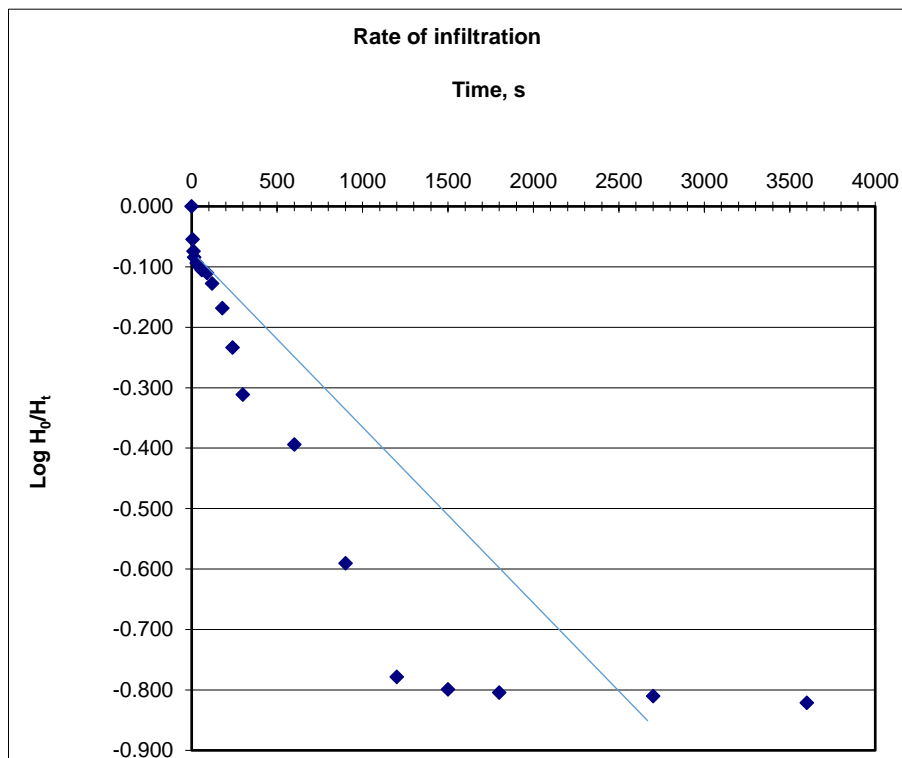
Remarks: MW02 terminated at 15.00m bgl. 50mm dia. standpipe installed. Response zone from 10.00m - 15.00m bgl. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:	GW (m bgl)	Shift	Depth (m bgl)	Remarks
		13.80	01/02/2022 08:00	0.00	Start of shift.
			01/02/2022 18:00	15.00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW02** H_w/H_o **5.10**
 Test **1**
 Casing diameter **96 mm**
 Casing depth **1 m**
 Borehole depth **15 m**
 Groundwater level **5.10 m bgl**
 Date **03/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_0/H_t$
0	0	0.000	0.00000	5.100	0.000
0.083	5	0.600	0.00434	4.500	-0.054
0.17	10	0.800	0.00579	4.300	-0.074
0.25	15	0.900	0.00651	4.200	-0.084
0.5	30	0.990	0.00716	4.110	-0.094
0.75	45	1.050	0.00760	4.050	-0.100
1	60	1.100	0.00796	4.000	-0.106
1.5	90	1.140	0.00825	3.960	-0.110
2	120	1.300	0.00940	3.800	-0.128
3	180	1.640	0.01186	3.460	-0.168
4	240	2.120	0.01534	2.980	-0.233
5	300	2.610	0.01888	2.490	-0.311
10	600	3.040	0.02199	2.060	-0.394
15	900	3.790	0.02742	1.310	-0.590
20	1200	4.250	0.03075	0.850	-0.778
25	1500	4.290	0.03104	0.810	-0.799
30	1800	4.300	0.03111	0.800	-0.804
45	2700	4.310	0.03118	0.790	-0.810
60	3600	4.330	0.03133	0.770	-0.821

$k_{mean} = 1.98E-06 \text{ ms}^{-1}$
 $k_H = k_V$





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Drilled By
KM

Logged By
N/A

Borehole No.

MW03

Sheet 1 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722655E - 724172N	Hole Type: CP
--	----------------------------	-----------------------------------	----------------------

Location: Carrickmines, Co. Dublin	Level: 68.99 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 02/02/2022 - 02/02/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					0.50	68.49		Open hole boring. Driller described: CLAY overburden.	
							+++++	Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	1
							+++++		2
							+++++		3
							+++++		4
							+++++		5
							+++++		6
							+++++		7
							+++++		8
							+++++		9

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
12.80	12.00	20		See shift data.	15.00	96	131				
					Equipment:						
					Deltabase 520						

Remarks: MW03 terminated at 15.00m bgl. 50mm dia. standpipe installed. Response zone from 11.00m - 15.00m. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:		GW (m bgl)	Shift	Depth (m bgl)	Remarks
			12.00	02/02/2022 08:00 02/02/2022 18:00	0.00 15.00	Start of shift. End of borehole.



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Drilled By

KM

Logged By

N/A

Borehole No.

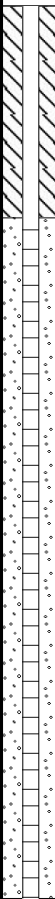
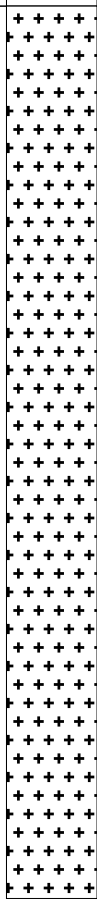
MW03

Sheet 2 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722655E - 724172N	Hole Type: CP
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Location: Carrickmines, Co. Dublin	Level: 68.99 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 02/02/2022 - 02/02/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
							Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.		
									
					15.00	53.99		End of Borehole at 15.000m	

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
12.80	12.00	20		See shift data.	15.00	96	131				
					Equipment:	Deltabase 520					

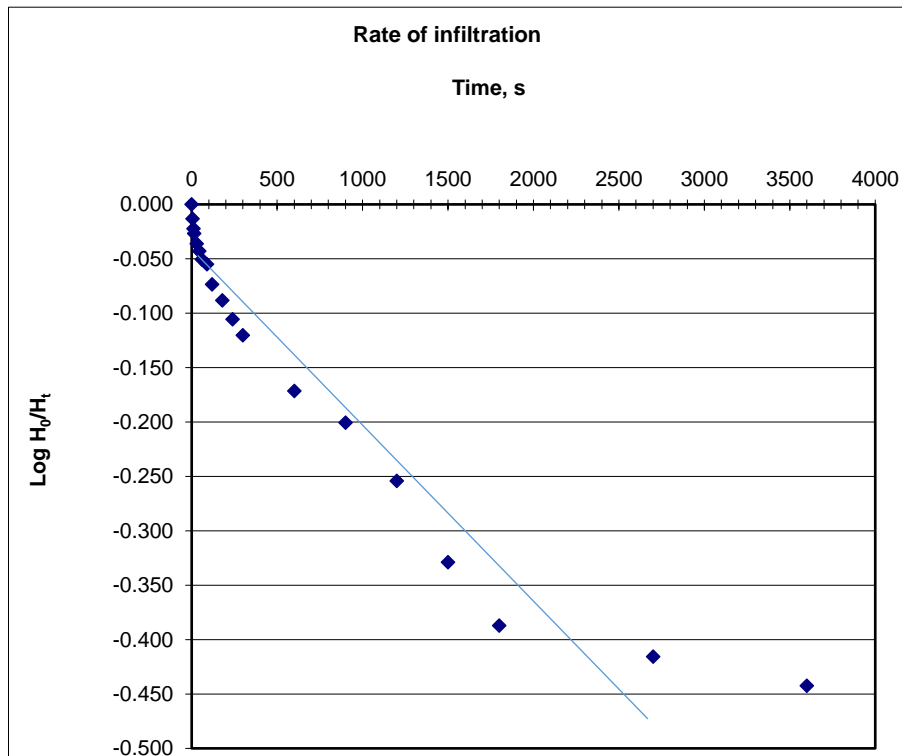
Remarks: MW03 terminated at 15.00m bgl. 50mm dia. standpipe installed. Response zone from 11.00m - 15.00m. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:	GW (m bgl)	Shift	Depth (m bgl)	Remarks
			02/02/2022 08:00	0.00	Start of shift.
		12.00	02/02/2022 18:00	15.00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW03** H_w/H_o **10.00**
 Test **1**
 Casing diameter **96** mm
 Casing depth **0.5** m
 Borehole depth **15** m
 Groundwater level **10.00** m bgl
 Date **03/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_o/H_t$
0	0	0.000	0.00000	10.000	0.000
0.083	5	0.300	0.00217	9.700	-0.013
0.17	10	0.500	0.00362	9.500	-0.022
0.25	15	0.600	0.00434	9.400	-0.027
0.5	30	0.800	0.00579	9.200	-0.036
0.75	45	0.940	0.00680	9.060	-0.043
1	60	1.100	0.00796	8.900	-0.051
1.5	90	1.190	0.00861	8.810	-0.055
2	120	1.560	0.01129	8.440	-0.074
3	180	1.840	0.01331	8.160	-0.088
4	240	2.160	0.01563	7.840	-0.106
5	300	2.420	0.01751	7.580	-0.120
10	600	3.260	0.02358	6.740	-0.171
15	900	3.700	0.02677	6.300	-0.201
20	1200	4.430	0.03205	5.570	-0.254
25	1500	5.310	0.03842	4.690	-0.329
30	1800	5.900	0.04268	4.100	-0.387
45	2700	6.160	0.04456	3.840	-0.416
60	3600	6.390	0.04623	3.610	-0.442

k_{mean} **1.07E-06 ms⁻¹**
 $k_H = k_V$





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Drilled By
KM

Logged By
N/A

Borehole No.

MW04

Sheet 1 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722558E - 724248N	Hole Type: CP
--	----------------------------	-----------------------------------	----------------------

Location: Carrickmines, Co. Dublin	Level: 75.61 m OD	Scale: 1:50
---	--------------------------	--------------------

Client: Cairn Homes Properties Limited	Date: 02/02/2022 - 02/02/2022
---	--------------------------------------

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					1.10	74.51		Open hole boring. Driller described: clayey GRAVEL overburden. Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	1 2 3 4 5 6 7 8 9

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
14.90				See shift data.	16.00	96	131				
					Equipment: Deltabase 520						

Remarks: MW04 terminated at 16.00m bgl. 50mm dia. standpipe installed. Response zone from 11.00m - 16.00m. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:		GW (m bgl)	Shift	Depth (m bgl)	Remarks
	15.90	02/02/2022 18:00	0.00	02/02/2022 08:00	16.00	Start of shift. End of borehole.



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Drilled By

KM

Logged By

N/A

Borehole No.

MW04

Sheet 2 of 2

Project Name: Barrington Site Investigation

Project No.
P22023

Co-ords: 722558E - 724248N

Hole Type
CP

Location: Carrickmines, Co. Dublin

Level: 75.61 m OD

Scale
1:50

Client: Cairn Homes Properties Limited

Date: 02/02/2022 - 02/02/2022

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
						+++++	Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.		
						+++++		10	
						+++++		11	
						+++++		12	
						+++++		13	
						+++++		14	
						+++++		15	
				16.00	59.61	+++++	End of Borehole at 16.000m	16	
								17	
								18	

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
14.90				See shift data.	16.00	96	131				
					Equipment:						
					Deltabase 520						

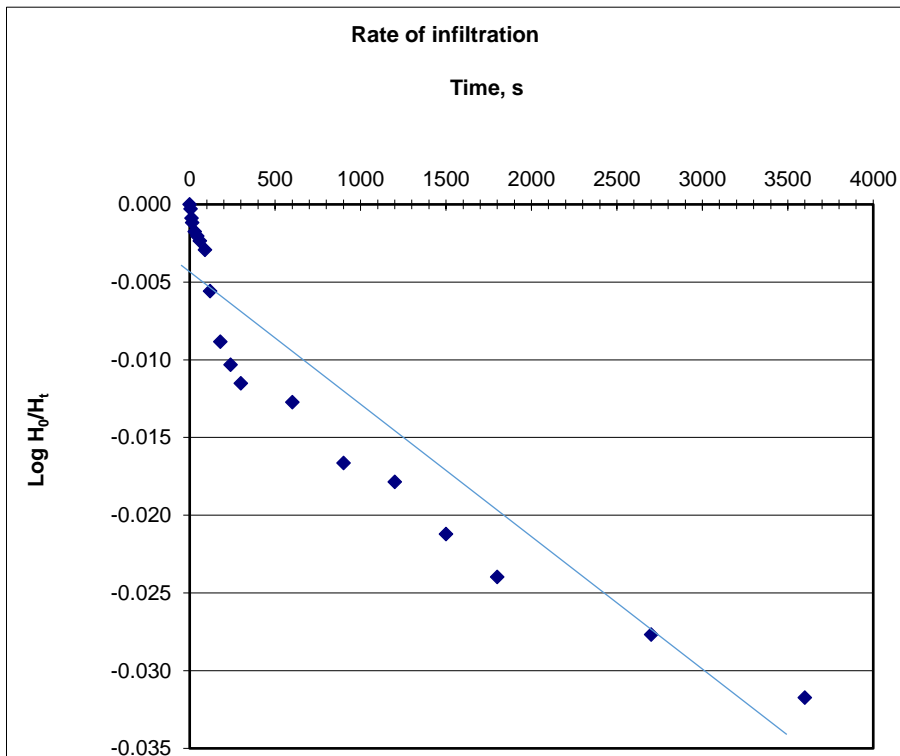
Remarks: MW04 terminated at 16.00m bgl. 50mm dia. standpipe installed. Response zone from 11.00m - 16.00m. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:			
	GW (m bgl)	Shift	Depth (m bgl)	Remarks
	15.90	02/02/2022 08:00	0.00	Start of shift.
		02/02/2022 18:00	16.00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW04** H_w/H_o **14.90**
 Test **1**
 Casing diameter **96 mm**
 Casing depth **1.1 m**
 Borehole depth **16 m**
 Groundwater level **14.90 m bgl**
 Date **04/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_0/H_t$
0	0	0.000	0.00000	14.900	0.000
0.083	5	0.010	0.00007	14.890	0.000
0.17	10	0.030	0.00022	14.870	-0.001
0.25	15	0.040	0.00029	14.860	-0.001
0.5	30	0.060	0.00043	14.840	-0.002
0.75	45	0.070	0.00051	14.830	-0.002
1	60	0.080	0.00058	14.820	-0.002
1.5	90	0.100	0.00072	14.800	-0.003
2	120	0.190	0.00137	14.710	-0.006
3	180	0.300	0.00217	14.600	-0.009
4	240	0.350	0.00253	14.550	-0.010
5	300	0.390	0.00282	14.510	-0.012
10	600	0.430	0.00311	14.470	-0.013
15	900	0.560	0.00405	14.340	-0.017
20	1200	0.600	0.00434	14.300	-0.018
25	1500	0.710	0.00514	14.190	-0.021
30	1800	0.800	0.00579	14.100	-0.024
45	2700	0.920	0.00666	13.980	-0.028
60	3600	1.050	0.00760	13.850	-0.032

k_{mean} **7.65E-08 ms⁻¹**
 $k_H = k_V$





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Drilled By
KM

Logged By
N/A

Borehole No.

MW05

Sheet 1 of 1

Project Name: Barrington Site Investigation

Project No.
P22023

Co-ords: 722688E - 724321N

Hole Type
CP

Location: Carrickmines, Co. Dublin

Level: 73.49 m OD

Scale
1:50

Client: Cairn Homes Properties Limited

Date: 03/02/2022 - 03/02/2022

Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					1.50	71.99		Open hole boring. Driller described: Clayey GRAVEL with bolder conten.	1
					2.90	70.59		Open hole boring. Driller described: CLAY with boulder content.	2
					5.50	67.99		Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	3
								End of Borehole at 5.500m	4
									5
									6
									7
									8
									9

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
4.90	4.00	20		See shift data.	5.50	96	131				
					Equipment:						
					Deltabase 520						

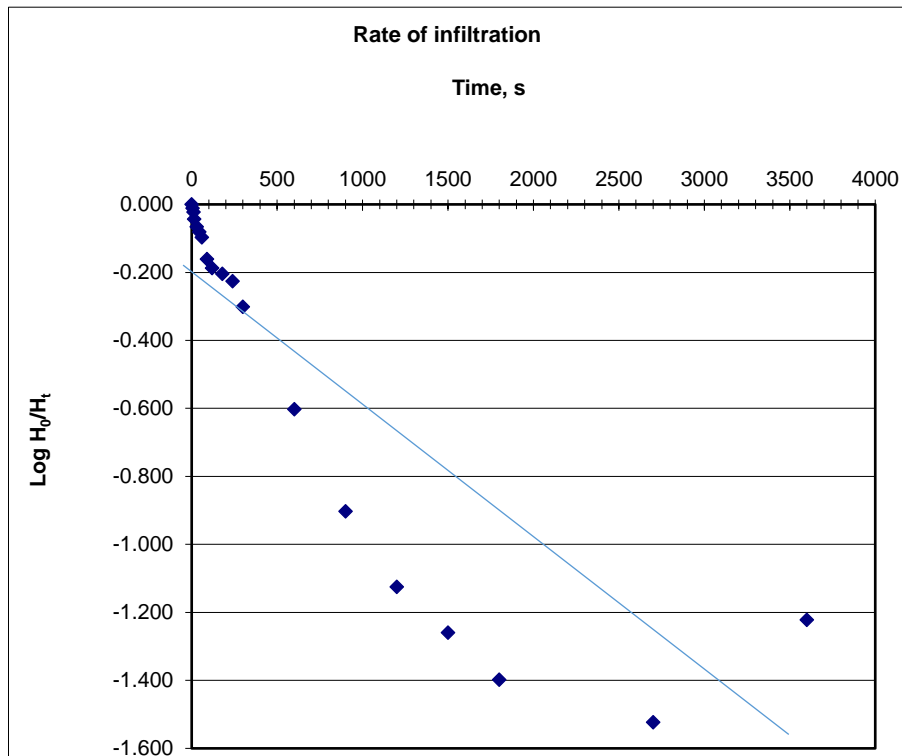
Remarks: MW05 terminated at 5.50m bgl. 50mm dia. standpipe installed. Response zone from 2.50m - 5.50m. Watera tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:			
	GW (m bgl)	Shift	Depth (m bgl)	Remarks
	5.00	03/02/2022 08:00	0.00	Start of shift.
		5.00	03/02/2022 18:00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW05** H_w/H_o **2.00**
 Test **1**
 Casing diameter **96 mm**
 Casing depth **2.9 m**
 Borehole depth **5.5 m**
 Groundwater level **2.00 m bgl**
 Date **04/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_0/H_t$
0	0	0.000	0.00000	2.000	0.000
0.083	5	0.050	0.00036	1.950	-0.011
0.17	10	0.100	0.00072	1.900	-0.022
0.25	15	0.190	0.00137	1.810	-0.043
0.5	30	0.280	0.00203	1.720	-0.066
0.75	45	0.340	0.00246	1.660	-0.081
1	60	0.400	0.00289	1.600	-0.097
1.5	90	0.620	0.00449	1.380	-0.161
2	120	0.700	0.00506	1.300	-0.187
3	180	0.750	0.00543	1.250	-0.204
4	240	0.810	0.00586	1.190	-0.225
5	300	1.000	0.00723	1.000	-0.301
10	600	1.500	0.01085	0.500	-0.602
15	900	1.750	0.01266	0.250	-0.903
20	1200	1.850	0.01338	0.150	-1.125
25	1500	1.890	0.01367	0.110	-1.260
30	1800	1.920	0.01389	0.080	-1.398
45	2700	2.060	0.01490	0.060	-1.523
60	3600	2.120	0.01534	0.120	-1.222

k_{mean} **4.89E-06 ms⁻¹**
 $k_H = k_V$



Groundwater level rose during test period. Infiltration rate determined over 45mins.



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Drilled By

KM

Logged By

N/A

Borehole No.

MW06

Sheet 1 of 2

Project Name: Barrington Site Investigation	Project No.: P22023	Co-ords: 722676E - 724318N	Hole Type: CP
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Location: Carrickmines, Co. Dublin	Level: 73.44 m OD	Scale: 1:50
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Client: Cairn Homes Properties Limited	Date: 04/02/2022 - 04/02/2022
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Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
					1.50	71.94		Open hole boring. Driller described: Clayey GRAVEL.	1
					2.50	70.94		Open hole boring. Driller described: Sandy GRAVEL. Possible weathered bedrock.	2
								Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.	3
									4
									5
									6
									7
									8
									9

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
11.70	11.40	20		See shift data.	13.00	96	131				
					Equipment:						
					Deltabase 520						

Remarks: MW06 terminated at 13.00m bgl. 50mm dia. standpipe installed. Response zone from 7.00m bgl to 13.00m bgl. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:		GW (m bgl)	Shift	Depth (m bgl)	Remarks
				04/02/2022 08:00	0.00	Start of shift.
				12.00	04/02/2022 18:00	13.00



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Drilled By

KM

Logged By

N/A

Borehole No.

MW06

Sheet 2 of 2

Project Name: Barrington Site Investigation	Project No. P22023	Co-ords: 722676E - 724318N	Hole Type CP
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Location: Carrickmines, Co. Dublin	Level: 73.44 m OD	Scale 1:50
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Client: Cairn Homes Properties Limited	Date: 04/02/2022 - 04/02/2022
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Well Backfill	Water Strike (m bgl)	Sample and In Situ Testing			Depth (m bgl)	Level (mOD)	Legend	Stratum Description	
		Depth (m bgl)	Type	Results					
							Down The Hole Hammer. Driller described: Weathered GRANITE bedrock.		
								10	
								11	
								12	
								13	
					13.00	60.44		13	
							End of Borehole at 13.000m	14	
								15	
								16	
								17	
								18	

Groundwater:					Hole Information:			Chiselling Details:			
Struck (m bgl)	Rose to (m bgl)	After (mins)	Sealed (m bgl)	Comment	Depth (m bgl)	Hole Dia (mm)	Casing Dia (mm)	Top (m)	Base (m)	Duration (hh:mm)	Tool
11.70	11.40	20		See shift data.	13.00	96	131				
					Equipment:						
					Deltabase 520						

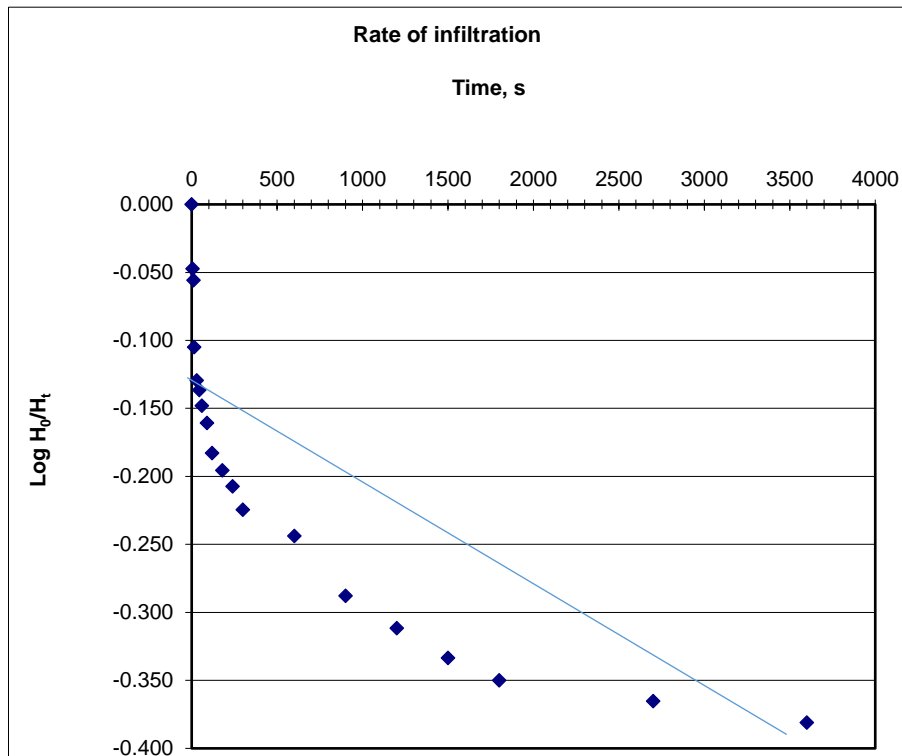
Remarks: MW06 terminated at 13.00m bgl. 50mm dia. standpipe installed. Response zone from 7.00m bgl to 13.00m bgl. Water tubing installed to borehole. Falling head test carried out in borehole.	Shift Data:	GW (m bgl)	Shift	Depth (m bgl)	Remarks
			04/02/2022 08:00	0.00	Start of shift.
		12.00	04/02/2022 18:00	13.00	End of borehole.

P22023 Falling head permeability test

Project **Barrington**
 BH ID **MW06** H_w/H_o **5.82**
 Test **1**
 Casing diameter **96 mm**
 Casing depth **2.5 m**
 Borehole depth **13 m**
 Groundwater level **5.82 m bgl**
 Date **04/02/2022**
 Strata **Granite bedrock**

Min	Sec	depth, m bgl	vol, cu.m	H_t	$\log H_0/H_t$
0	0	0.000	0.00000	5.820	0.000
0.083	5	0.600	0.00434	5.220	-0.047
0.17	10	0.700	0.00506	5.120	-0.056
0.25	15	1.250	0.00904	4.570	-0.105
0.5	30	1.500	0.01085	4.320	-0.129
0.75	45	1.570	0.01136	4.250	-0.137
1	60	1.680	0.01215	4.140	-0.148
1.5	90	1.800	0.01302	4.020	-0.161
2	120	2.000	0.01447	3.820	-0.183
3	180	2.110	0.01526	3.710	-0.196
4	240	2.210	0.01599	3.610	-0.207
5	300	2.350	0.01700	3.470	-0.225
10	600	2.500	0.01809	3.320	-0.244
15	900	2.820	0.02040	3.000	-0.288
20	1200	2.980	0.02156	2.840	-0.312
25	1500	3.120	0.02257	2.700	-0.334
30	1800	3.220	0.02330	2.600	-0.350
45	2700	3.310	0.02395	2.510	-0.365
60	3600	3.400	0.02460	2.420	-0.381

k_{mean} **9.18E-07 ms⁻¹**
 $k_H = k_V$



KEY TO SYMBOLS - LABORATORY TEST RESULT

U	Undisturbed Sample	
P	Piston Sample	
TWS	Thin Wall Sample	
B	Bulk Sample - Disturbed	
D	Jar Sample - Disturbed	
W	Water Sample	
pH	Acidity/Alkalinity Index	
SO ₃	% - Total Sulphate Content (acid soluble)	
SO ₃	g/ltr - Water Soluble Sulphate (Water or 2:1 Aqueous Soil Extract)	
+	Calcareous Reaction	
Cl	Chloride Content	
PI	Plasticity Index	
<425	% of material in sample passing 425 micron sieve	
LL	Liquid Limit	
PL	Plastic Limit	
MC	Water Content	
NP	Non Plastic	
Y _b	Bulk Density	
Y _d	Dry Density	
Ps	Particle Density	
U/D	Undrained/Drained Triaxial	
U/C	Unconsolidated/Consolidated Triaxial	
T/M	Single Stage/Multistage Triaxial	
100/38	Sample Diameter (mm)	
REM	Remoulded Triaxial Test Specimen	
TST	Triaxial Suction Test	
V	Vane Test	
DSB	Drained Shear Box	
RSB	Residual Shear Box	
RS	Ring Shear	
σ ₃	Cell Pressure	
σ ₁ -σ ₃	Deviator Stress	
c	Cohesion	
c _e	Effective Cohesion Intercept	
φ	Angle of Shearing Resistance - Degrees	
φ _e	Effective Angle of Shearing Resistance	
ε _f	Strain at Failure	
*	Failed under 1 st Load	
**	Failed under 2 nd Load	
#	Unstable	
##	Excessive Strain	
p _o	Effective Overburden Pressure	
m _v	Coefficient of Volume Decrease	
c _v	Coefficient of Consolidation	
Opt	Optimum	
Nat	Natural	
Std	Standard Compaction - 2.5kg Rammer	(¶ CBR)
Hvy	Heavy Compaction - 4.5kg Rammer	(§ CBR)
Vib	Vibratory Compaction	
CBR	California Bearing Ratio	
Sat m.c.	Saturation Moisture Content	
MCV	Moisture Condition Value	



Amended Report

Report No.: 22-04914-2

Initial Date of Issue: 14-Feb-2022 **Date of Re-Issue:** 17-Feb-2022

Client: Priority Geotechnical Ltd

Client Address: Unit 12
Owenacurra Business Park
Midleton
County Cork
Ireland

Contact(s): Colette Kelly

Project: P22023 Barrington Carrickmines

Quotation No.: **Date Received:** 10-Feb-2022

Order No.: 14407 **Date Instructed:** 10-Feb-2022

No. of Samples: 2

Turnaround (Wkdays): 5 **Results Due:** 16-Feb-2022

Date Approved: 14-Feb-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Water

Project: P22023 Barrington Carrickmines

Client: Priority Geotechnical Ltd		Chemtest Job No.:		22-04914	22-04914	
Quotation No.:		Chemtest Sample ID.:		1369405	1369406	
		Sample Location:		MW6	MW2	
		Sample Type:		WATER	WATER	
		Date Sampled:		04-Feb-2022	04-Feb-2022	
Determinand	Accred.	SOP	Units	LOD		
pH	U	1010		N/A	8.4	8.3
Electrical Conductivity	U	1020	µS/cm	1.0	240	210
Alkalinity (Bicarbonate)	U	1220	mg CaCO3/l	10	54	55
Alkalinity (Carbonate)	U	1220	mg CaCO3/l	10	< 10	< 10
Chloride	U	1220	mg/l	1.0	18	16
Sulphate	U	1220	mg/l	1.0	26	25
Calcium	U	1455	mg/l	2.00	17	17
Potassium	U	1455	mg/l	0.50	1.5	1.2
Magnesium	U	1455	mg/l	0.20	3.2	3.0
Sodium	U	1455	mg/l	1.50	13	11
Total TPH >C6-C40	U	1670	µg/l	10	< 10	< 10

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1670	Total Petroleum Hydrocarbons (TPH) in Waters by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO	Pentane extraction / GC FID detection

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

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

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

All Asbestos testing is performed at the indicated laboratory

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

Sample Deviation Codes

A - Date of sampling not supplied

B - Sample age exceeds stability time (sampling to extraction)

C - Sample not received in appropriate containers

D - Broken Container

E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

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

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

Charges may apply to extended sample storage

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

customerservices@chemtest.com