

Site Specific Flood Risk Assessment



Project: Holy Cross College SHD 19.253

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1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION

This report has been prepared as part of a planning application for a proposed residential development at Clonliffe Road, Drumcondra, on behalf of the applicant, CWTC Multi Family ICAV acting on behalf of its sub-fund DBTR DR1 Fund. This report outlines the findings of the Site-Specific Flood Risk Assessment (SSFRA) carried out for the proposed development.

The project involves the development of lands at Holy Cross College, Clonliffe Road, Dublin 3 and Drumcondra Road Lower, Drumcondra, Dublin 9.

The overall lands encompass a site of 14.76ha, of which 7.74ha relates directly to the residential proposed development. The remaining 7.02ha (which is outside the scope of this application) is intended for use as a GAA sports facilities and, as well as a new hotel.

The lands are located within the grounds of the former Holy Cross College seminary. The site is bounded by Clonliffe Road to the south, the Archbishop of Dublin's residence and Lower Drumcondra Road to the West, residential and private lands to the east, and the Tolka River runs the full length of the northern boundary. The site is currently predominantly green space (with trees) with several existing structures which formed the seminary campus. Refer figure 1.1 and Site Plan Layout drawing in Appendix 1 for a satellite and plan view of the site.

The development will consist of the construction of a Build To Rent residential development set out in 12 no. blocks, ranging in height from 3 to 18 storeys, to accommodate 1614 no. apartments (comprising 540 studios, 602 no. 1 bed units, 419 no. 2 bed units and 53 no. 3 bed units) including a retail unit, a café unit, a crèche, and residential tenant amenity spaces. The development will include a single level basement under Blocks B2, B3 & C1, a single level basement under Block D2 and a podium level and single level basement under Block A1 to accommodate car parking spaces, bicycle parking, storage, services and plant areas. To facilitate the proposed development the scheme will involve the demolition of a number of existing structures on the site.

The proposed development sits as part of a wider Site Masterplan for the entire Holy Cross College lands which includes a permitted hotel development and future proposed GAA pitches and clubhouse.

The site contains a number of Protected Structures including The Seminary Building, Holy Cross Chapel, South Link Building, The Assembly Hall and The Ambulatory. The application proposes the renovation and extension of the Seminary Building to accommodate residential units and the renovation of the existing Holy Cross Chapel and Assembly Hall buildings for use as residential tenant amenity. The wider Holy Cross College lands also includes Protected Structures including The Red House and the Archbishop's House (no works are proposed to these Structures).

The residential buildings are arranged around a number of proposed public open spaces and routes throughout the site with extensive landscaping and tree planting proposed. Communal amenity spaces will be located adjacent to residential buildings and at roof level throughout the scheme. To facilitate the proposed development the scheme will involve the removal of some existing trees on the site.

The site is proposed to be accessed by vehicles, cyclists and pedestrians from a widened entrance on Clonliffe Road, at the junction with Jones's Road and through the opening up of an unused access point on Drumcondra Road Lower at the junction with Hollybank Rd. An additional cyclist and pedestrian access is proposed through an existing access point on Holy Cross Avenue. Access from the Clonliffe Road entrance will also facilitate vehicular access to future proposed GAA pitches and clubhouse to the north of the site and to a permitted hotel on Clonliffe Road.

The proposed application includes all site landscaping works, green roofs, boundary treatments, PV panels at roof level, ESB Substations, lighting, servicing and utilities, signage, and associated and ancillary works, including site development works above and below ground.



Figure 1.1 Site Location Map Data © 2020 Google

1.2 SCOPE OF THIS REPORT

This report outlines the findings of the SSFRA (site specific flood risk assessment) carried out for the proposed residential development on the subject site, and takes cognisance of the following relevant guidelines and policies:

- Department of the Environment Heritage and Local Government (DEHLG) and the Office of Public Works (OPW) Guidelines for Planning November 2009 on 'The Planning system and Flood Risk Management Guidelines for Planning Authorities'.
- The Planning and Development Act 2000.

The stages involved in the assessment of flood risk are listed in the guidelines as follows:

- Stage 1: Flood Risk Identification
- Stage 2: Initial Flood Risk Assessment
- Stage 3: Detailed Flood Risk Assessment

The OPW and DEHLG's publication also outline a Sequential Approach for determining whether a particular development is appropriate for a specified location in terms of flood risk. The categorisation of the subject site in terms of the OPW and DEHLG's sequential approach is further outlined in Section 2.0

This SSFRA addresses the flood risk on the subject site. Please refer to the separate document CLN-BMCE-ZZ-ZZ-RP-C-04 Masterplan Flood Risk Assessment for the flood risk assessment of the balance of the (GAA owned) masterplan lands.

2.0 STAGE 1: FLOOD RISK IDENTIFICATION

Stage 1 identifies whether there are any flooding or surface water management issues at the subject site location and whether a flood risk assessment is required. This involves review of desk study information available as outlined in the following headings.

| Source | Pathway | Receptor | Likelihood | Consequence | Risk |
|--------------------------|---------------------------------|----------|----------------|-------------|--------|
| Tidal Note | Overtop Breach | Property | Very remote | High | Low |
| Fluvial Note | Overtop Breach | Property | Remote | High | Medium |
| Groundwater | Rising groundwater levels | Property | Very remote | Medium | Low |
| Pluvial Surface water | Overflow / Blockage | Property | Possible | Medium | Medium |

Table 2.1 The possible sources of flood water

2.1 HISTORICAL FLOODING

The Tolka River runs the full length of the northern boundary of the subject site. The River Tolka has a history of flooding following heavy rainfall. A number of studies were commissioned including the Greater Dublin Strategic Drainage Study (GDSDS) in 2001-2005 and the Tolka Flood Study in 2002. At that time, the aim of the study was to identify works that could be undertaken straight away to reduce the risk of flooding in the worst affected areas. Works began in the Dublin City and County Meath areas in 2003 which was completed in 2011. Works adjacent to the subject site included the construction of a wall to the north and south east of the Sports Ground, a new bridge at Distillery Road, a low crest level weir and 20m of river channel widening. A statement from the Government website Gov.ie as quoted *'Since the Scheme was completed there have been no reports of flooding from the River Tolka in these areas.'*

A review of the OPW Historical Flood Maps online was carried out and indicates a number of past flooding events reported in the vicinity (within 2.5km) of the subject site.

The first report dates back to November 1901 and the source of flooding was the River Tolka. The site which was flooded is located approximately 500m north west of the proposed development.

The second flooding event was in November 1965 and the source of flooding was the River Tolka. The site which was flooded is located approximately 300m east of the subject site.

The third flooding incident in the vicinity was in August 1986 and the source of flooding was the River Tolka during hurricane Charley. A number of sites in the vicinity were flooded including a site north west and another north east of the proposed development.

There is a report of a flooding event on Jones Road in July 2013 with very little information on the source of flooding. The single event is shown south east of the proposed development.

There are no records of past flooding at the subject site location in recent history.

Based on available and recorded information as outlined above, the subject site is considered not to have been subject to flooding in recent history.



Figure 2.1 Recorded Past Flood Events (Source: OPW – www.floodinfo.ie)

2.2 COASTAL FLOODING

Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels or overcome coastal defences where these exist. A review of the OPW Tidal Flood Extents Mapping was carried out and indicates no coastal flooding at the subject site for the following flood event probabilities:

- 10% Tidal AEP (Annual Exceedance Probabilities) or 1 in 10 year return period.
- 0.5% Tidal AEP or 1 in 200 year return period.
- 0.1% Tidal AEP or 1 in 1000 year return period.

Therefore, the risk of tidal flooding is considered low as the subject site lies outside the 0.1% AEP. The OPW tidal flood extents map near the subject site area is included in Appendix 2 for further information.



Figure 2.2 Clontarf Tidal Flood Extents (Source: OPW Eastern CFRAM Study)

2.3 FLUVIAL FLOODING

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas. The River Tolka runs the full length of the northern boundary of the subject site. The river flows in a south easterly direction before entering the sea at Clontarf. A review of the OPW fluvial flood extents maps of the River Tolka was carried out and unfortunately the area is currently under review. Older information including the Tolka Flood Study in September 2010 carried out by RPS for DCC and OPW was reviewed and it shows that the proposed site development lies outside the 1 in 1000 year fluvial combined with the 1 in 2 year tidal. The study concluded as quoted *'Further to the review of the flood mapping in September 2010 by DCC and OPW, it was concluded that the 0.1% AEP fluvial coupled with the 50% AEP tidal event was the most appropriate to apply to Tolka River for the Dublin City area.'* Refer to Figure 2.3 which shows the proposed

development located outside the 0.1% AEP flood extent. Figure taken from the River Tolka Flood Study.

Notwithstanding the above, the existing riverbank's levels adjacent to the subject site varies from 5.70 - 4.30m. The lowest proposed building's finished floor level (Block D2) is at 7.50m or 1.8 - 3.2 m above the riverbank's levels. In addition, the proposed development does not remove any flood storage volume from the lower level flood plain, as it can be seen in Figure 2.3 & Figure 3.2 taken from DCC Development plan 2016-2022. Appendix 11 of the DCC development plan states as quoted *'Retaining wall north side protects this stretch from hundred-year flow. Parkland on south side allowed to flood and will do so at fifty-year flood level'*. This parkland area referred to in the plan, lies outside the subject site location and is earmarked for future Sports Grounds.

Other surface water bodies in the vicinity is the Royal Canal located approximately 460m south of the subject site. The Royal Canal flows in a south easterly direction and into the River Liffey. The Royal Canal is a manmade waterway channel and water levels in the canal is regulated via series of locks. Therefore, the risk of flooding may arise when locks malfunction or from vandalism.

However, in such event, the canal will drain towards the River Liffey and away from the subject site. Therefore, the risk of flooding from the Royal Canal is considered low.

In summary, the risk of fluvial flooding is currently being assessed by the OPW. The River Tolka Catchment Flood Risk Assessment and Management (CFRAM) is under review following an objection, submission and/or further information received. However, this risk is considered low due the site located outside the 0.1% AEP fluvial coupled with the 50% AEP tidal flood extent. In addition, the considerable level difference between the proposed finished levels and the riverbank levels in the vicinity.



Figure 2.3 Tolka River Flood Extents for 0.1% AEP - Source Dublin City Council

2.4 GROUND WATER

Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall, to meet the ground surface and flows out over. A review of site investigations undertaken recently as part of this project was carried out to identify ground water levels in a number of trial pits. Trial pits at the subject site location confirm ground water levels at an average of 1.30m below ground levels.

The scheme comprises of three number of basements including one in the centre of site under Blocks B's and Block C one under Blocks A's and one under Block D2. Waterproof construction methods and measures will be employed to seal and prevent ingress of ground water into the basement.

A review of the groundwater vulnerability data from the Geological Survey Ireland (GSI) website was also carried out and the model indicates low risk of groundwater contamination. The map identifies how susceptible areas are to groundwater contamination.

Therefore, the risk of flooding due to ground water ingress to the proposed development is considered low. The proposed basement will be waterproofed.



Figure 2.4 Groundwater Vulnerability (Source: GSI Data Viewer Map)

2.5 PLUVIAL FLOODING

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban surface water drainage systems or the ground to absorb it. A review of the available literature including the DCC Flood Resilient City (FRC) project was carried out, and indicates some pluvial flooding south east of at the subject site boundary. Note, these maps are 'predictive' flood maps showing areas predicted to be inundated during a theoretical or 'design' flood event with an estimated probability of occurrence, rather than information for actual floods that have occurred in the past, which is presented on 'historic' flood maps.

The FRC project and pluvial model prediction was examined further and it highlights a number of anomalies including:

- The area south east of the site boundary shown as flooded is modelled as hardstanding although it is currently greenfield.
- The drainage system is simulated as gravity network to discharge into the River Tolka and Dublin Bay; this is incorrect as we know that the network is pumped at the Poplar Row pumping station to the Ringsend Treatment Works.

Notwithstanding the above, the FRC project considers the subject site to be low risk of pluvial flooding as it is not located in low laying areas. The FRC project identifies the main source of flooding to be surface water run-off conveyed by road networks into low lying areas such as Fairview Strand and Marino Crescent.

Runoff from the proposed development, internal access roads and car parks will be attenuated prior to discharge into the River Tolka. Discharge rates will be restricted to Dublin City Council (DCC) Drainage Division's requirements. The proposed SuDS measures will reduce the risk of flooding downstream of the subject site. The proposed surface system will be designed for the 1 in 100 year plus 20% for climate change, in line with DCC Drainage Division guidelines. During storm events it is expected that sections of the River Tolka will flow at full capacity and therefore restricting discharge from the development. The proposed outfall will be fitted with a non-return valve at the headwall to prevent backflow into the site. The proposed surface water system on site is designed to cater for 5-hour surcharged outfall for resilience for storms up to and including the 1 in 100 year return period plus 20% for climate change. Therefore, the risk of flooding due to the River Tolka reaching flow capacity is considered low due to the proposed resilient measures in place.

During extreme rainfall events and in the event of the drainage system is blocked due to lack of maintenance, there is potential for localised ponding to occur. However, no habitable floors of buildings will be at risk of flooding by any surface water ponding. Internal finished floor levels are set at a minimum of 150mm above highest external surface levels in the vicinity. Residual risk of flooding are addressed under Section 4.0.

Therefore, the risk of pluvial flooding is considered low, due to existing and proposed measures in place. The existing drainage on site will be improved as a result of the proposed works including the removal of the surface drainage system from the combined network on Clonliffe Road to substantially reduce both the peak and volume of runoff into the network. The proposed storm attenuation facilities will restrict flows to 2.0 l/s/ha into the River Tolka which will further reduce the risk of pluvial flooding on site and downstream.



Figure 2.5 DCC Flood Resilient City Project 2% AEP Event - 3hr Duration Map

2.6 CLIMATE CHANGE

All new developments are required to take climate change into consideration when assessing the flood risk of a site. When designing for extreme rainfall events an allowance of 20% additional flow should be taken. The system is designed for storms up to and including the 1 in 100 year storm and 20% extra for climate change. Hence the development can be considered to be climate change resilient. Refer to the Infrastructure report for further details on hydraulic analysis for the proposed development.

3.0 STAGE 2: INITIAL FLOOD RISK ASSESSMENT

The purpose of an initial flood risk assessment is to examine flood risk issues highlighted as part of Stage 1 Flood Risk Identification.

Based on available recorded information as outlined in Stage 1, the site is considered not been subject to flooding in recent history.

The risk of tidal flooding is considered low as the subject site lies outside the 0.1% AEP.

The risk of fluvial flooding is considered low due the site located outside the 0.1% AEP fluvial coupled with the 50% AEP tidal flood extent. In addition, the considerable level difference between the proposed finished levels and the riverbank levels in the vicinity.

The risk of flooding due to ground water ingress to the proposed development is considered low. Waterproofing construction methods and measures will be employed to seal and prevent ingress of ground water into the basements, in the normal

The risk of pluvial flooding is considered low, due to the site location and proposed measures for the development.

3.1 SEQUENTIAL APPROACH

The sequential approach used in this assessment follows the guidelines from The Planning System and Flood Risk Management Guidelines for Planning Authorities, 2009, see Figure 3.1 for a graphical representation.

As outlined in the OPW and DEHLG publication, new developments are divided into three categories which are as follows:

- Highly Vulnerable Development (i.e. power stations, residential)
- Less Vulnerable Development (i.e. retail, leisure)
- Water-compatible Development (i.e. car parking, recreational space)

The proposed residential development comes under the heading of Highly Vulnerable Development.



Figure 3.1 Sequential Approach (Source: Guidelines for Planning Authorities, 2009)

| | 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 | | |

 Table 3.1 Matrix of vulnerability versus flood zone (Source: Guidelines for Planning Authorities, 2009)

Geographical areas are similarly divided into three categories, based on their risk of river and tidal flooding. The three categories are as follows:

- Flood Zone A where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding).
- Flood Zone B where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding).
- Flood Zone C where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding i.e. all areas which are not within zone A or B).

Based on the flood risk identification in Stage 1, the proposed development falls in Flood Zone C. Hence, the proposed development is deemed 'Appropriate' in accordance with the guidelines of the OPW's publication. Therefore, no 'Justification Test' and / or Stage 3 Detailed Flood Risk Assessment is required. The sequential approach shown in recommends mitigation measures for residual risks. In addition, extract from DCC Development Plan 2016-2022 in Figure 3.2 shows the proposed development in Flood Zone C in agreement with this SSFRA.



Figure 3.2 Flood Zone Mapping - Source DCC Development Plan 2016-2022

4.0 RESIDUAL FLOOD RISK MANAGEMENT

As highlighted in Section 2.5, During extreme rainfall events and where the proposed drainage system is blocked, there is a chance that localised ponding will occur. However, as internal finished floor levels are set at a minimum of 150mm above highest external surface levels in the vicinity, any runoff or ponding will be retained on access road and car park surfaces. This measure during the unlikely event is considered appropriate for the nature of the development.

5.0 CONCLUSION

This report outlines the findings of the SSFRA carried out for the proposed residential development at Clonliffe Road, Drumcondra. This SSFRA was carried out in accordance with the DEHLG guidelines for Planning 2009 and The Planning and Development Act 2000.

Based on available and recorded information, the site has not been subject to flooding in recent history.

The risk of tidal flooding is considered very low as the subject site lies outside the 0.1% AEP.

The risk of fluvial flooding in the area is currently under review by the OPW. However, this risk is considered low due the site located outside the 0.1% AEP fluvial coupled with the 50% AEP tidal flood extent. In addition, the considerable level difference between the proposed finished levels and the riverbank levels in the vicinity.

The risk of flooding due to ground water ingress to the proposed development is considered low. Waterproofing construction methods and measures will be employed to prevent ingress of ground water into the basements, in the normal manner.

The risk of pluvial flooding is considered low, due to the site location and proposed measures for the development.

Based on the flood risk identification in Stage 1, the proposed development falls in Flood Zone C. Hence, the proposed development is deemed 'Appropriate' in accordance with the guidelines of the OPW's publication.

Site Plan Layout



OPW Flood Maps



Overland Flow Path Routes



Trial Pit Logs

Site Location Plan





Trial Pit Records



| S | Grou | nd Inv | estigatio | ons Irel | Site Project Calvary | | | rial Pit lumber TR1 | | |
|----------------------------|---------------------------------------|-----------------------|----------------------|----------|---|--------------------------|---|---|---------------------|---------------------------|
| Machine:5 E Method:T | Tonne Tracked xcavator rial Pit | Dimensio 3.00m X | ons 0.40m X 2.40m | | Ground Level (mOD) 7.89 | | Client Virtus Project Managemer | ıt | J N 93 | lob lumber 63-01-20 |
| | | Location 716 | 216.7 E 736595 | .2 N | Dates 12/02/2020 | | Engineer Barrett Mahony Consulting Engineers | | S | Sheet 1/1 |
| Depth (m) | Sample / Tests | Water Depth (m) | Field Re | cords | Level Depth (mOD) (m) (Thickness) | |) Description | | Le | ater State |
| 0.00-1.00 | ES | | | | 7.59 | (0.30) 0.30 (0.60) | MADE GROUND: Dark br gravelly Topsoil with occas ceramic Soft brown slightly sandy s occasional subangular to s | own slightly sandy slightly sional fragments of bricks an slightly gravelly CLAY with subrounded cobbles and bot | ulders | |
| 1.00 1.00-2.40 | B ES | | | | 6.99 | 0.90 | Brown/grey clayey sandy s coarse GRAVEL with some cobbles and occasional bo | subangular to subrounded fi e subangular to subrounded ulders | ne to | |
| 2.00 | В | | | | 6.39 | (0.90) | Grey slightly clayey sandy coarse GRAVEL with som cobbles and occasional bo | subangular to subrounded f e subangular to subrounded pulders | ine to | |
| | | | | | 5.49 | 2.40 | Complete at 2.40m | | | |
| Plan | | | · · | | | . 1 | Remarks | d . | | |
| | | | · · | | | | Trial pit unstable; side walls Trial pit backfilled on comple | conapsed etion | | |
| | | | · · | | | | | | | |
| · · | · · | | · · | | | | | | | |
| | | | | | | . 5 | Scale (approx) 1:25 | Logged By JC | Figure No. 9363-01- | o. -20.TR1 |

| S | Grou | ind In | vestigatio www.gii | ons Irela .ie | Site Project Calvary | | | Trial Pit Number TR2 | | | |
|-------------------|---------------------------------------|-----------------------|----------------------------------|------------------|-------------------------|---|--|---|------------------------|-----------------------------|------------|
| Machine:5 E | Tonne Tracked xcavator rial Pit | Dimens 3.00m | t ions X 0.40m X 2.40m | G | Found | Level (mOD) 7.15 | Client Virtus Project Managemer | nt | | Job Number 9363-01-20 | |
| | | Locatio | n 6193.2 E 736525. | 1 N | Dates 12/02/2020 | | Engineer Barrett Mahony Consulting | Engineer Barrett Mahony Consulting Engineers | | Sheet 1/1 | |
| Depth (m) | Sample / Tests | Water Depth (m) | Field Records | | Level mOD) | evel Depth nOD) (m) Description (Thickness) | | escription | | | Water |
| 0.00-1.00 | ES | | | | 6.95 | (0.20) 0.20 (1.00) (1.00) | MADE GROUND: Dark br gravelly Topsoil with occas ceramic Soft brown slightly sandy s occasional subangular to s | own slightly sandy slightly sional fragments of bricks a slightly gravelly CLAY with subrounded cobbles | nd | | |
| 1.00 1.00-2.40 | B ES | | seepage(1) at 1. | 60m. | 5.95 | - 1.20 - (0.40) - 1.60 | Firm brown slightly sandy subangular to subrounded Brown clayey sandy subar coarse GRAVEL with som cobbles and occasional br | gravelly CLAY with some cobbles ngular to subrounded fine to e subangular to subrounded pulders (view obstructed by | | | ∇ 1 |
| 2.00 | В | | fast ingress(2) at 2.00m. | | 4.75 | | Groundwater) | plete at 2.40m | | | |
| | | | | | | | | | | | |
| Plan . | | | | | | . F | Remarks Groundwater seepage at 1.0 | 60m BGL | | | |
| | | | | | | | Trial pit unstable; side walls Terminated at 2.40m BGL du Trial pit backfilled on comple | at 2.00111 bGL; Tast Ingress spalling ue to groundwater ingress etion | | | |
| | | | | | | | | | | | |
| · · | · · | | · · | · · | • | • | | | | | |
| | | | | | | . s | scale (approx) 1:25 | Logged By JC | Figure 9363- | No. 01-20.TR | |

| S | Gro | und In | vestigat www.g | ions Ire _{ii.ie} | Site Project Calvary | Site Project Calvary | | Trial Pit Number TR3 | | | |
|-------------------|----------------------------|-----------------|-------------------------|------------------------------|-------------------------|-------------------------------------|---|--|-------------------|---------------------|--|
| Machine : 5 E | Tonne Tracked Excavator | Dimens 3.00m | sions X 0.40m X 3.00 | m | Ground | Level (mOE |) Client | | Job Number | r | |
| Method :⊤ | rial Pit | | | | | 9.71 | Virtus Project Managemer | 11 | 9363-01-2 | 20 | |
| | | Locatio 71 | on 6184.1 E 73647 | '8.5 N | Dates 12 | 2/02/2020 | Engineer Barrett Mahony Consulting | Engineer Barrett Mahony Consulting Engineers | | Sheet 1/1 | |
| Depth (m) | Sample / Test | s Depth (m) | er h Field Records | | Level (mOD) | Depth (m) (Thickness | ;) Description | | | Water | |
| 0.00-1.00 | ES | | | | 9.46 | (0.25 - 0.25 - 0.55 - 0.55 | MADE GROUND: Dark br gravelly Topsoil with occas ceramic Soft to firm brown slightly occasional subangular to | own slightly sandy slightly sional fragments of bricks ar sandy slightly gravelly CLAY subrounded cobbles | nd | | |
| 1.00 1.00-3.00 | BES | | seepage(1) at | 1.20m. | 0.01 | | Firm brown slightly sandy subangular to subrounded | gravelly CLAY with some cobbles | | ⊽ 1 | |
| 2.00 | в | | | | 7.91 | - 1.80 - 1.80 - (0.70 | Firm to stiff brown slightly subangular to subrounded | sandy gravelly CLAY with so I cobbles | | | |
| | | | | | 6.71 | 2.50 (0.50 | Stiff brown slightly sandy g subangular to subrounded | gravelly CLAY with some I cobbles | | | |
| 3.00 | B | | | | | | Complete at 3.00m | | | | |
| Plan | | • | | | • | | Remarks | | · · · | | |
| | | | | | . . | | Groundwater seepage at 1. Trial pit unstable; side walls Trial pit backfilled on comple | 20m BGL spalling ttion | | | |
| | | | | | - | | | | | | |
| | · · | | | | • | | | | | | |
| | | | | | | | Deele (e e e e è | Lengel D | F igure 11 | | |
| | | | | | | | 1:25 | JC | 9363-01-20.TR | 3 | |

| Ground Investigations Ireland Ltd | | | | | | | | Site Trial Pit Project Calvary TR4 | | | Trial Pit Number TR4 | |
|-----------------------------------|----------------|-----------------------|--------------------|---------|----------------|---|---------|---|---|--------------|---|--|
| Machine : 5 | Tonne Tracked | Dimens | ions | | Ground | Level (mC | D) | Client | | | Job Number | |
| Method : T | rial Pit | 2.50m | X 0.40m X 3.0 | UM | | 9.34 | | Virtus Project Managemer | ht | | 9363-01-20 | |
| | | Locatio 71 | n 6282.3 E 7364 | 21.6 N | Dates 12 | Dates 12/02/2020 | | Engineer Barrett Mahony Consulting Engineers | | Sheet 1/1 | | |
| Depth (m) | Sample / Tests | Water Depth (m) | Field | Records | Level (mOD) | Depth (m) (Thickne | ss) | Description | | | Kater Kater | |
| 0.00-2.00 | ES | | | | 9.24 | - (0.1 0. | ၇) ၂ | MADE GROUND: Dark bro gravelly Topsoil with occas ceramic | own slightly sandy slightly sional fragments of bricks ar | nd | | |
| 1.00 | в | | | | | - - - - - - - - - - - - - - - - - - - | 0) | MADE GROUND: Brown/c gravelly Clay with occasio fragments of bricks, morta | dark grey slightly sandy sligh nal cobbles and boulders, a r, ceramic pipe and shells | ntly nd | | |
| | | | | | | | | | | | | |
| 2.00 2.00-3.00 | BES | | | | 7.34 | 2.(| 0) | Soft to firm brown slightly occasional subangular to s | sandy slightly gravelly CLAY subrounded cobbles | ? with | الله المراجع ا المراجع المراجع المراجع مراجع المراجع ا مراجع المراجع الم مراجع المراجع ا مراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراجع المراحمع المراجع المراجع المراجع المراحم م مراجع مراجع المراجع المراجع المراجع المراجع المراجع الممر ممراحع المراجع المراجع المراجع المراحع المراحع المراحع م مراجع | |
| 3.00 | В | | | | 6.34 | | .00 | Complete at 3.00m | | | <u>., 7, 87, 19</u> , | |
| Plan | | • | | | | | R | Remarks | | | | |
| | | | | | | | | No groundwater encountere Trial pit unstable; side walls Trial pit backfilled on comple | d spalling tíion | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | • | | s | cale (approx) | Logged By | Figure | e No. | |
| | | | | | | | | 1:25 | JC | 9363- | -01-20.TR4 | |

| | Grou | nd In | vestigati www.gi | ons Ire i.ie | Site Trial Pin Project Calvary TR5 | | | Trial Pit Number TR5 | • | | | |
|----------------------------------|---------------------------------------|-----------------------|--------------------------------|-----------------|---------------------------------------|----------------------------|-----------|---|---|--------------|---|---------|
| Machine : 5 E: Method : Tr | Tonne Tracked xcavator rial Pit | Dimens 2.50m | ions X 0.40m X 3.00m | 1 | Ground | Ground Level (mOD) 8.68 | | Client Virtus Project Management | | | Job Number 9363-01-2 | r 20 |
| | | Locatio | n 6399.6 E 736348 | 3.2 N | Dates 12 | Dates 12/02/2020 | | Engineer Barrett Mahony Consulting Engineers | | | Sheet 1/1 | |
| Depth (m) | Sample / Tests | Water Depth (m) | Field Re | cords | Level (mOD) | Depti (m) (Thickne | ı ess) | D | escription | | Legend | Water |
| 0.00-1.10 | ES | | | | 8.58 | - (0. - 0. | 10) 10 | MADE GROUND: Dark br gravelly Topsoil with occas ceramic | own slightly sandy slightly sional fragments of bricks ar | nd | | |
| | | | | | | (1.' | 00) | MADE GROUND: Brown/o gravelly Clay with some bi bone | lark brown slightly sandy sli icks, mortar, timber and ani | ghtly mal | | |
| | | | | | 7.50 | | 10 | | | | | |
| 1.10 1.10-3.00 | B ES | | | | 7.58 | 1. (0 | 40) | Firm brown slightly sandy occasional subangular to | slightly gravelly CLAY with subrounded cobbles | | 0 <u>0</u> 00 0000 0000 0000 0000 0000 0000 00 | |
| | | | seepage(1) at 1 | .50m. | 7.18 | - - 1. - | 50 | Firm brown slightly sandy subangular to subrounded | gravelly CLAY with some cobbles and granular lense | es | <u>, , , , , , , , , , , , , , , , , , , </u> | Z1 |
| 2.00 | В | | | | | | 10) | | | | <u>6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</u> | |
| | | | | | | | - , | | | | 0 <u>0</u> 0 000 000 000 000 000 000 | |
| | | | | | 6.08 | 2. | 60 | Firm to stiff brown slightly subangular to subrounded | sandy gravelly CLAY with so | ome | <u>, , , , , , , , , , , , , , , , , , , </u> | |
| | | | | | 5.00 | (0 - | 40) | | | | 0 <u>.0</u> 0 0 <u>.0</u> 0 | |
| 3.00 | В | | | | 5.68 | 3. | 00 | Complete at 3.00m | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Plan . | | | | | | <u> </u> | F | Remarks | | | | |
| | | | | | | | | Groundwater seepage at 1. Trial pit unstable; side walls Trial pit backfilled on comple | 50m BGL spalling stion | | | |
| | | | | | · · | | | | | | | |
| | | | | | . . | · • | | | | | | |
| | | • | | | | | | | | | | |
| | | • | | | | | S | cale (approx) | Logged By JC | Figure | 9 No. 01-20.TR | 5 |

| | Grou | nd In | vestigatic www.gii. | ons Irela .ie | Site Project Calvary | | | Trial Pit Number TR6 | | |
|---------------|----------------|-----------------------|------------------------|------------------|-------------------------|--|---|--|--|-------------|
| Machine : 5 | Tonne Tracked | Dimens | sions | | Ground | Level (mOD) | Client | Client | | |
| Method :⊺ | rial Pit | 2.80m | X 0.40m X 3.00m | | | 8.65 | Virtus Project Managemer | ht | 9363-01 | - 20 |
| | | Locatio | n 6377.3 E 736275. | 7 N | Dates 11 | /02/2020 | Engineer Barrett Mahony Consulting Engineers | | Sheet 1/1 | |
| Depth (m) | Sample / Tests | Water Depth (m) | Field Rec | cords | Level (mOD) | Depth (m) (Thickness) | D | escription | Legend | Water |
| 0.00-1.10 | ES | | | | 8.45 | (0.20) 0.20 (0.20) (0.20) (0.20) (0.90) | MADE GROUND: Dark br gravelly Topsoil with occas ceramic MADE GROUND: Dark br gravelly Clay with some br timber | own slightly sandy slightly sional fragments of bricks ar wwn/grey slightly sandy slig icks, mortar, scrap metal ar | nd ntly Id | ∇ 1 |
| 1.10-3.00 | ES | | seepage(1) at 0.8 | 30m. | 7.55 | 1.10 (0.70) | Firm light brown mottled g CLAY with occasional sub | rey slightly sandy slightly gr angular to subrounded cobt | avelly 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| | | | fast ingress(2) at | 2.30m. | 6.85 | - 1.80 - 1.80 | Firm brown slightly sandy subangular to subrounded | gravelly CLAY with some cobbles and granular lense | 25 25 25 25 25 25 25 25 25 25 | √2 |
| 2.50 | В | | | | 5.65 | 3.00 | Complete at 3.00m | | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| | | | | | | - - - | | | | |
| Plan | · · | • | | | | • • | Remarks | R0m BGI | | |
| | | • | | | | | Second groundwater stelpage at 0.1 Second groundwater strike a Trial pit unstable; side walls Trial pit backfilled on comple | at 2.30m BGL; fast ingress spalling tion | | |
| | | • | | | | | | | | |
| | | • | | | | | | | | |
| | · · | • | | | | | | | | |
| | | | | | | 5 | Scale (approx) 1:25 | Logged By JC | Figure No. 9363-01-20.TF | २6 |

| | Grou | ind In | vestigat www.g | ions Ire jii.ie | Site Project Calvary | | | | |
|-------------------|---------------------------|-----------------------|--------------------------------|--------------------|-------------------------|------------------------------------|---|--|---|
| Machine : 5 E | Tonne Tracked xcavator | Dimens 2.50m | i ons X 0.40m X 3.20 | m | Ground | Level (mOD) 10.14 | Client Virtus Project Managemer | Client Virtus Project Management | |
| Method : I | rial Pit | Locatio | n 6315.8 E 73620 | 68.6 N | Dates 11 | /02/2020 | Engineer Barrett Mahony Consulting Engineers | | Sheet 1/1 |
| Depth (m) | Sample / Tests | Water Depth (m) | Field F | lecords | Level (mOD) | Depth (m) (Thickness | D | escription | Legend S |
| 0.00-1.00 | ES | | | | 9.84 | (0.30) 0.30 (0.70) (0.70) | MADE GROUND: Dark br gravelly Topsoil with occas ceramic Soft to firm brown slightly occasional subangular to | own slightly sandy slightly sional fragments of bricks ar sandy slightly gravelly CLAY subrounded cobbles | nd with $\frac{10}{6} \frac{10}{7} \frac{10}{7} \frac{10}{7}$ $\frac{10}{6} \frac{10}{7} \frac{10}{7} \frac{10}{7}$ $\frac{10}{6} \frac{10}{7} \frac{10}{7} \frac{10}{7}$ $\frac{10}{6} \frac{10}{7} \frac{10}{7} \frac{10}{7} \frac{10}{7}$ $\frac{10}{7} \frac{10}{7} \frac{10}{7$ |
| 1.00 1.00-2.00 | B ES | | seepage(1) at | 1.40m. | 9.14 | - 1.00 - 1.00 - (0.90) | Soft to firm brown slightly some subangular to subro granular lenses | sandy slightly gravelly CLAY unded cobbles and occasio | (vith <u>0, 0, 0</u>) (vith <u>0, 0</u>) (v |
| 2.00 | В | | | | 8.24 | 1.90 (0.30) 2.20 | Firm brown slightly sandy subangular to subrounded Firm to stiff brown slightly some subangular to subro | slightly gravelly CLAY with s I cobbles sandy slightly gravelly CLAY unded cobbles | some 6 0 0 0 (1) |
| 3.00 | в | | seepage(2) at | 2.50m. | 7.24 | (0.70) 2.90 (0.30) | Stiff dark grey slightly san subangular to subrounded | dy gravelly CLAY with some I cobbles and occasional bo | |
| | | | | | 6.94 | 3.20 | Complete at 3.20m | | <u> </u> |
| Plan . | | | | | | | Remarks | 10m BCI | |
| | | | | | | | Second groundwater strike Trial pit unstable; side walls Trial pit backfilled on comple | at 2:50m BGL; seepage spalling stion | |
| | | | | | | | | | |
| · · | | | · · | | | | | | |
| | | | | | | | Scale (approx) 1:25 | Logged By JC | Figure No. 9363-01-20.TR7 |

| S | Gro | und In | vestiga www.g | tions Ire gii.ie | Site Project Calvary | | | Trial Pit Number TR8 | | | | |
|------------------|---------------------------|-------------------------|-------------------------|---------------------|-------------------------|--------------------------|-------------------------------------|---|--|----------------|---------------------------------------|-------|
| Machine : 5 E | Tonne Tracked xcavator | Dimens 2.80m | sions X 0.40m X 3.00 | Ground | Level (m | OD) | Client Virtus Project Management | | | Job Number | | |
| Method : T | rial Pit | Locatio | 'n | Dates | | | | | | 9363-01-2 | 0 | |
| | | 71 | 716438.3 E 736277.7 N | | | 1/02/2020 | | Barrett Mahony Consulting Engineers | | | 1/1 | |
| Depth (m) | Sample / Test | s Water Depth (m) | Field | Records | Level (mOD) | Depti (m) (Thickne | h ess) | D | escription | | Legend | AVALO |
| 0.00-0.70 | ES | | | | | (0.' | 70) | MADE GROUND: Dark br gravelly Topsoil with occas pottery and ceramic | own slightly sandy slightly sional fragments of bricks, s | hells, | | |
| 0.70-3.00 | ES | | | | 6.11 | 0. (0. | .70 50) | Soft light brown mottled gr CLAY with occasional sub | ey slightly sandy slightly gra angular to subrounded cobb | avelly bles | <u> </u> | |
| 1.00 | B | | seepage(1) a | t 1.20m. | 5.61 | | .20 | Soft brown slightly sandy subangular to subrounded | gravelly CLAY with some cobbles and granular lense | es | | 1 |
| 2.00 | в | | fast ingress(2 | ?) at 2.00m. | 4.81 | 2. | .00 | Firm brown slightly sandy subangular to subrounded | gravelly CLAY with some cobbles and granular lense | es | | 2 |
| | | | | | | - (1. - (1. | 00) | | | | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| 3.00 | В | | | | 3.81 | 3. | .00 | Complete at 3.00m | | | , , a , ² , | |
| Plan . | · . | | | | | <u> </u> | F | Remarks | | | | |
| | | | | | | | | Groundwater seepage at 1.3 Second groundwater strike Trial pit unstable; side walls Trial pit backfilled on comple | 20m BGL at 2.00m BGL; fast ingress spalling ttion | | | |
| | | | | | | | | | | | | |
| | | | | • | • | | | | | | | |
| | | | | | | | s | cale (approx) | Logged By | Figure | • No. | |

| S | Gro | ound In | vestigat www.g | ions Ire ii.ie | Site Project Calvary | | | Trial Pit Number TR9 | | | | |
|------------------|---------------------------|--------------------------|--------------------------------|-------------------|-------------------------|----------------------------|-------------------------------------|--|---|-----------------|--|----------------------------|
| Machine : 5 E | Tonne Tracked xcavator | Dimens 2.80m | ions X 0.40m X 3.00r | Ground | Level (r | nOD) | Client | | | Job Number | | |
| Method :⊺ | rial Pit | | | | 7.51 | | | | | 9363-01 | -20 | |
| | | 71 | n 6426.1 E 73623 | 11/02/2020 | | | Barrett Mahony Consulting Engineers | | | 1/1 | | |
| Depth (m) | Sample / Tes | ts Water Depth (m) | Field R | ecords | Level (mOD) | Dep (m (Thick | oth I) ness) | D | escription | | Legend | Water |
| 0.00-0.55 | ES | | | | 7.41 | - ((| 0.10) 0.10 | MADE GROUND: Dark bro gravelly Topsoil with occas ceramic | nd | | | |
| | | | | | | - ((| 0.45) | MADE GROUND: Brown/o gravelly Clay with fragmen and mortar | lark brown slightly sandy sli ts of brick, ceramic, plastic, | ghtly glass | | |
| 0.55-3.00 | .55-3.00 ES | | | | 6.96 | - | 0.55 | Soft to firm brown slightly | sandy slightly gravelly CLAY | ' with | 0 <u>.0-</u> 0 | |
| | | | | | | - (| 0.35) | | | | 0 <u>.0</u> 0.0 | |
| 1.00 | В | | seepage(1) at | 0.90m. | 6.61 | - - - - - - | 0.90 | Soft brown slightly sandy o subangular to subrounded | pravelly CLAY with some cobbles and granular lense | es | <u>6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</u> | 1⊠1 |
| | | | | | | | 1.40) | | | | | - - - - - |
| 2.00 | В | | | | | - | | | | | <u>6 0 0 0</u> 0 0 0 0 0 <u>0 0</u> 0 | • |
| | | | | | 5.21 | | 2.30 | Soft brown slightly sandy o subangular to subrounded fine to coarse Sand | pravelly CLAY with some cobbles and lenses of dark | grey | | - - - - - - |
| 3.00 | В | | | | 4.51 | | 3.00 | Complete at 3.00m | | | | |
| Plan . | | • | | | | | . R | Remarks | | | | |
| | | | | | | | | Groundwater seepage at 0.5 Trial pit unstable; side walls Trial pit backfilled on comple | 00m BGL collapsed tion | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | - | | | | | | | |
| | | | | | | | . | | | | | |
| | | | | | | | S | cale (approx) 1:25 | Logged By JC | Figure 9363- | e No. 01-20.Tl | R9 |

| | Gro | und In | vestig | jations l w.gii.ie | Ireland | Site Project Calvary | | | Trial Pit Number TR10 | | | |
|-------------------|----------------------------|-----------------------|-----------------------------------|-----------------------|----------------|-------------------------------------|--------------------------|--|--|----------------|---|------------|
| Machine : 5 E | Tonne Tracked Excavator | Dimens 2.80m | sions X 0.40m X | Ground | Level (m | DD) | Client | | | Job Number | | |
| Method :⊤ | rial Pit | | | | 1.01 | | Virtus Project Managemer | IL | | 9363-01-2 | !0 | |
| | | Locatio 71 | Location 716414.4 E 736204.3 N | | | 1/02/2020 | | Engineer Barrett Mahony Consulting Engineers | | | Sheet 1/1 | |
| Depth (m) | Sample / Tests | Water Depth (m) | Fie | eld Records | Level (mOD) | evel Depth OD) (m) (Thickness | | Description | | | Legend | Water |
| 0.00-0.60 | ES | | | | 7.72 | (0.7 0. | 5) 15 | MADE GROUND: Dark br gravelly Topsoil with occas ceramic | own slightly sandy slightly sional fragments of bricks ar | nd | | |
| | | | | | | (0.4 | 5) | MADE GROUND: Brown/o gravelly Clay with fragmer and mortar | dark brown slightly sandy sli hts of brick, ceramic, plastic, | ghtly glass | | |
| 0.60-2.00 | ES | | | | 7.27 | 0. | 50 0) | Soft to firm brown slightly occasional subangular to | sandy gravelly CLAY with subrounded cobbles | | 0 <u>-0</u> -0 0-0-0-0 0-0-0-0-0-0-0-0-0-0-0-0-0- | |
| | | | | | | - (0.2 | .0) | | | | 0 <u>.0</u> 0 0 <u>.0</u> 0 | |
| 1.00 | В | | | | 6.87 | 1. | 00 | Firm brown slightly sandy subangular to subrounded | gravelly CLAY with some I cobbles | | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | |
| | | | seepage(* | 1) at 1.40m. | | | 80) | | | | | <u>'</u> 1 |
| | | | | | | | | | | | 0.0 | |
| | | | | | 6.07 | - 1. | 30 | Firm to stiff brown slightly subangular to subrounded | sandy gravelly CLAY with so cobbles | ome | | |
| 2.00 2.00-3.00 | ES | | | | | | 80) | | | | | |
| | | | | | 5.07 | | | | | | <u>, , , , , , , , , , , , , , , , , , , </u> | 70 |
| | | | fast ingres | ss(2) at 2.60m. | 5.27 | - 2. | 50 | Firm to stiff brown slightly subangular to subroundec obstructing view and wasł | sandy gravelly CLAY with so I cobbles (groundwater ning away clay content) | ome | | ~ |
| 3.00 | B | | | | | Ē | Í | | | | | |
| 3.00 | | | | | 4.77 | - 3. - | 10 | Complete at 3.10m | | | <u> </u> | |
| | | | | | | | | | | | | |
| | | | | | | - | | | | | | |
| | | | | | | E F | | | | | | |
| | | | | | | - | | | | | | |
| Plan . | | | | | | <u>⊢</u> | F | Remarks | | | | _ |
| | | | | | | | | Groundwater seepage at 1. Second groundwater strike Trial pit unstable; side walls | 40m BGL at 2.60m BGL; fast ingress collapsed | | | |
| | | | | | | | | i rial pit backfilled on comple | 21101 | | | |
| | | · | • | | • | | | | | | | |
| | | • | • | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | • | cale (annroy) | Logged By | Figure | No | |
| | | | | | | | | 1:25 | JC | 9363-0 | 01-20.TR10 | 0 |

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