HYDROGEOLOGICAL IMPACT ASSESSMENT

for

A PROPOSED DEVELOPMENT SITE AT JUNCTION OF SANTRY AVENUE AND SWORDS ROAD, SANTRY, CO. DUBLIN

Technical Report Prepared For

Dwyer Nolan Developments Ltd

Technical Report Prepared By

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Our Reference

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1.0 INTRODUCTION

1.1 Background

AWN have been requested by Dwyer Nolan Developments Ltd to carry out a Hydrogeological Impact Assessment for a development of residential units located at the junction of Santry Avenue and Swords Road, Santry, Dublin 9.

Dwyer Nolan Developments Ltd. intend to apply to An Bord Pleanála for permission for a strategic housing development, on a site of c. 1.5 hectares, located at the junction of Santry Avenue and Swords Road, Santry, Dublin 9. The development site is bounded to the north by Santry Avenue, to the east by Swords Road, to the west by Santry Avenue Industrial Estate, and to the south by the permitted Santry Place development (granted under Dublin City Council Ref's. 2713/17 & 2737/19).

1.2 Hydrogeological Impact Assessment Objectives

A Hydrogeological Impact Assessment (HIA) was undertaken for the proposed new development on Santry, Dublin 9, following the methodology given in Basement Development Guidance (2019, now withdrawn) and Basement Development Policy documents published by the Dublin City Council.

The Basement Development Policy document explains the historical context which created the need for a new policy to be put in place. It also presents existing Planning and Legislative background relating to the matter and describes the implementation process of this new policy.

The Basement Development Guidance document presents a methodology where the impact of basement on the surrounding ground and groundwater is assessed on a site specific basis. This policy sets out the requirements to complete this risk-based impact assessment with regard to hydrology, hydrogeology and land stability.

The HIA was undertaken to assess the likely impact on the existing water regime during and post construction of a basement within the proposed development. The objective is to ensure that the basement development:

- Protects and enhances where possible the groundwater quality, quantity and classification;
- Provides evidence that the construction of the basement shall not place groundwater at undue risk;
- Provides evidence that the structural stability of adjoining or neighbouring buildings and land areas are not put at risk;
- Provides a management plan for any demolition works and for the construction of the basement;
- Does not have an adverse effect on existing patterns of surface water drainage;
- Shall not significantly impact on groundwater or surface water flows to the extent that this is likely to increase the risk of flooding;
- Ensures appropriate handling and dealing with waste removal;
- Conserves and where possible enhances the biodiversity value of the site;
- Generally complies with the relevant regulations such as the Basement Development Policy and the Basement Development Guidance.

1.3 General Qualifications and Conditions of Use

The subject report is intended to be an accurate and unbiased account of what the potential impacts of constructing a basement within the proposed residential development. It has been compiled based on information from the following sources:

- Ordnance Survey Ireland - aerial photographs and historical mapping;
- Geological Survey of Ireland (GSI) - on-line mapping, Geo-hazard Database, Geological Heritage Sites & Sites of Special Scientific Interest, Bedrock Memoirs and 1: 100,000 mapping;
- Teagasc soil and subsoil database;
- Environmental Protection Agency (EPA) – website mapping and database information;
- The Irish Meteorological Service –rainfall data and river/estuary levels;
- Strategic Flood Risk Assessment (SFRA) - Dublin City Development Plan, 2016–2022;
- Relevant Eastern Catchment Flood Risk Assessment and Management (CFRAM) Flood Reports;
- Requirements for the Protection of Fisheries Habitat During Construction and Development Works at River Sites, Eastern Regional Fisheries Board (ERFB);
- Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA 532, 2001);
- Water Framework Directive (2000/60/EC);
- The Construction Industry Research and Information Association (CIRIA) Environmental Good Practice on Site (C502);

The assessment also relies on information regarding design provided by Dwyer Nolan Developments as follows:

- Foundation Appraisal Report. Swords Road, Santry Phase 2 (DBFL, 2021);
- Ground Investigation Report. Development in Santry (GII, 2019);
- Construction and Environmental Management Plan (CEMP). Mixed Use Development at Heiton Buckley, Santry Avenue, Dublin 9 (DBFL, 2021);
- Engineering services Report. Mixed Use Development at Chadwicks, Santry Avenue, Dublin 9 (DBFL, 2021);
- Various plans of the project.

This report is based on the above information and prepared for the purpose of making a submission to the planning authority on this particular site only. The impacts categorised above are based on the judgement and experience of the Engineers & Hydrogeologist carrying out the assessment, and may be based on information or documentation supplied by others.

Moreover, the report is intended for the sole use of Dwyer Nolan Developments and their elected agents and advisors and, further, solely for the purpose for which it was originally commissioned. It may not be assigned or copied to third parties or relied upon by third parties.

This report was prepared by Marcelo Allende (BEng), and Teri Hayes (BSc MSc PGeol EurGeol). Marcelo is a Water Resources Engineer with over 15 years of experience in environmental consultancy and water resources studies. Marcelo is an

Environmental Consultant with AWN Consulting, a member of the International Association of Hydrogeologists (Irish Group) and a member of Engineers Ireland (MIEI). Teri is a hydrogeologist with over 25 years of experience in water resource management and impact assessment. She has a Masters in Hydrogeology and is a former President of the Irish Group of the Association of Hydrogeologists (IAH) and has provided advisory services on water related environmental and planning issues to both public and private sector bodies. She is qualified as a competent person as recognised by the EPA in relation to contaminated land assessment (IGI Register of competent persons www.igi.ie). Her specialist area of expertise is water resource management eco-hydrogeology, hydrological assessment and environmental impact assessment.

2.0 ASSESSMENT OF HYDROLOGICAL AND HYDROGEOLOGICAL BASELINE AND GROUNDWATER BODY STATUS

A reliable Conceptual Site Model (CSM) requires an understanding of the existing hydrological and hydrogeological setting. This is described below for the proposed development site and surrounding hydrological and hydrogeological environs.

2.1 Existing Site Conditions

The proposed development is located on lands at the junction of Santry Avenue and Swords Road, Santry, Dublin 9 on a site area of 1.5ha (refer to Insert 2.1 below). The site is bounded to the north by Santry Avenue, to the east by Swords Road, to the south by the permitted Santry Place development (Ref.s 2713/17 & 2737/19) and to the west by the Santry Avenue Industrial Estate. The brownfield site is currently Heiton Buckly Building Suppliers. The site is relatively flat.

Insert 2.1 *Development Site Location*

2.1.1 Existing Ground Conditions

A ground investigation was carried out for the adjoining development at Santry Place by GII, in January 2019 and was included as reference for the Foundation Assessment undertaken by DBFL. This investigation included the following:

- 3 no. trial pit to a maximum depth of 3.1 mbgl;
- 3 no. cable percussion boreholes to a maximum depth of 1o mbgl;
- 1 no. rotary core boreholes to a maximum of 9.7 mbgl;
- Geotechnical and environmental laboratory testing.

This report is included as part of the present application. Given the homogeneity of the area in terms of geology and the absence of structural geological elements (such as faults, as can be seen in sections below) this investigation is considered to be representative of the subject site.

Location of site investigations is presented in the Insert 2.2 below.

Insert 2.2 *Location of Site Investigations (in blue) (Source: DBFL, 2021)*

The stratification encountered at the adjacent site is as follows:

- Surfacing: Reinforce concrete up to 0.3 mbgl;
- Fill: Granular fill were encountered beneath the concrete to a depth of 0.4-1.0 mbgl;
- Made Ground: Made ground deposits (described as sandy gravelly Clay with occasional cobbles and contained rare fragments of plastic and plywood) were encountered beneath the Fill material to a variable depths between 0.7-3.4 mbgl;
- Cohesive Deposits: Deposits described as low permeability stiff sandy gravelly Clay were encountered beneath the Made Ground up to depths of 10 mbgl.
- The depth of bedrock head was not proven during the site investigation, with the maximum exploration to 10 mbgl.

This stratification is consistent with the groundwater vulnerability considered by the GSI at the site (refer to section 2.1.2 below).

Groundwater strikes associated with perched water within the overburden was encountered in only 1 no. of the exploratory boreholes at 5.5 mbgl (measured in February 2019, i.e., during wet and winter/ spring conditions).

Soil samples were selected from the exploratory holes for a range of environmental testing, including Waste Acceptance Criteria (WAC), pH and sulphate. Results show no evidence of contamination, as samples meet all WAC criteria for inert soils.

2.1.2 Geological and Hydrogeological Setting

Mapping from the Geological Society of Ireland (GSI maps, http://www.gsi.ie accessed on 16-06-2022) indicates the bedrock underlying the site is part of the Lucan Formation (code CDLUCN) and made up of dark limestone and shale (Calp). The lithological description comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are rare dark coarser grained calcarenitic limestones, sometimes graded, and interbedded dark-grey calcar. The beds are predominantly fine-grained distal turbidites in the north Dublin Basin. The formation is intermittently exposed on the coast between Rush and Drumanagh Head. The formation ranges from 300m to 800m in thickness.

The GSI also classifies the principal aquifer types in Ireland as:

- Lk - Locally Important Aquifer - Karstified
- Ll - Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive
- Pl - Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Pu - Poor Aquifer - Bedrock which is Generally Unproductive
- Rkd - Regionally Important Aquifer (karstified diffuse)

Presently, from the GSI (2022) National Bedrock Aquifer Map, the GSI classifies the bedrock aquifer beneath the subject site as a ‘Locally Important Aquifer – Bedrock which is Moderately Productive only in Local Zones’. The proposed development is within the ‘Dublin’ groundwater body and is classified as ‘Poorly productive bedrock’. The most recent WFD groundwater status for this water body (2013-2018) is ‘Good’ with a current WFD risk score ‘Under Review’.

Aquifer vulnerability is a term used to represent the intrinsic geological and hydrological characteristics that determine the ease with which groundwater may be contaminated generally by human activities. The GSI (2022) guidance presently classifies the bedrock aquifer vulnerability in the region of the subject site as ‘Low’ which indicates a general thick overburden depth potential of >10m, indicating good protection of the underlying aquifer by low permeability subsoil. This desk study data was confirmed by the site investigations undertaken at the adjacent site which shows the overburden has depths greater than 10.0mbgl before reaching the bedrock. The aquifer vulnerability class in the region of the site is presented as Insert 2.2 below.

Insert 2.2 *Groundwater Vulnerability Map (source: GSI, 2021)*

The GSI/ Teagasc (2021) mapping database of the quaternary sediments in the area of the subject site indicates the principal subsoil type in the residential area comprises Till derived from limestones (TLs), which is also consistent with the adjacent site investigations undertaken.

With regard to static groundwater level, there is no current available information. However, the GII site investigation at the adjacent site encountered groundwater strike at 5.5 mbgl in 1 no. borehole (winter measurement). It is noted this is a perched water level within made ground. No dewatering of the water table within bedrock is required for the proposed development.

2.1.2 Hydrological Setting

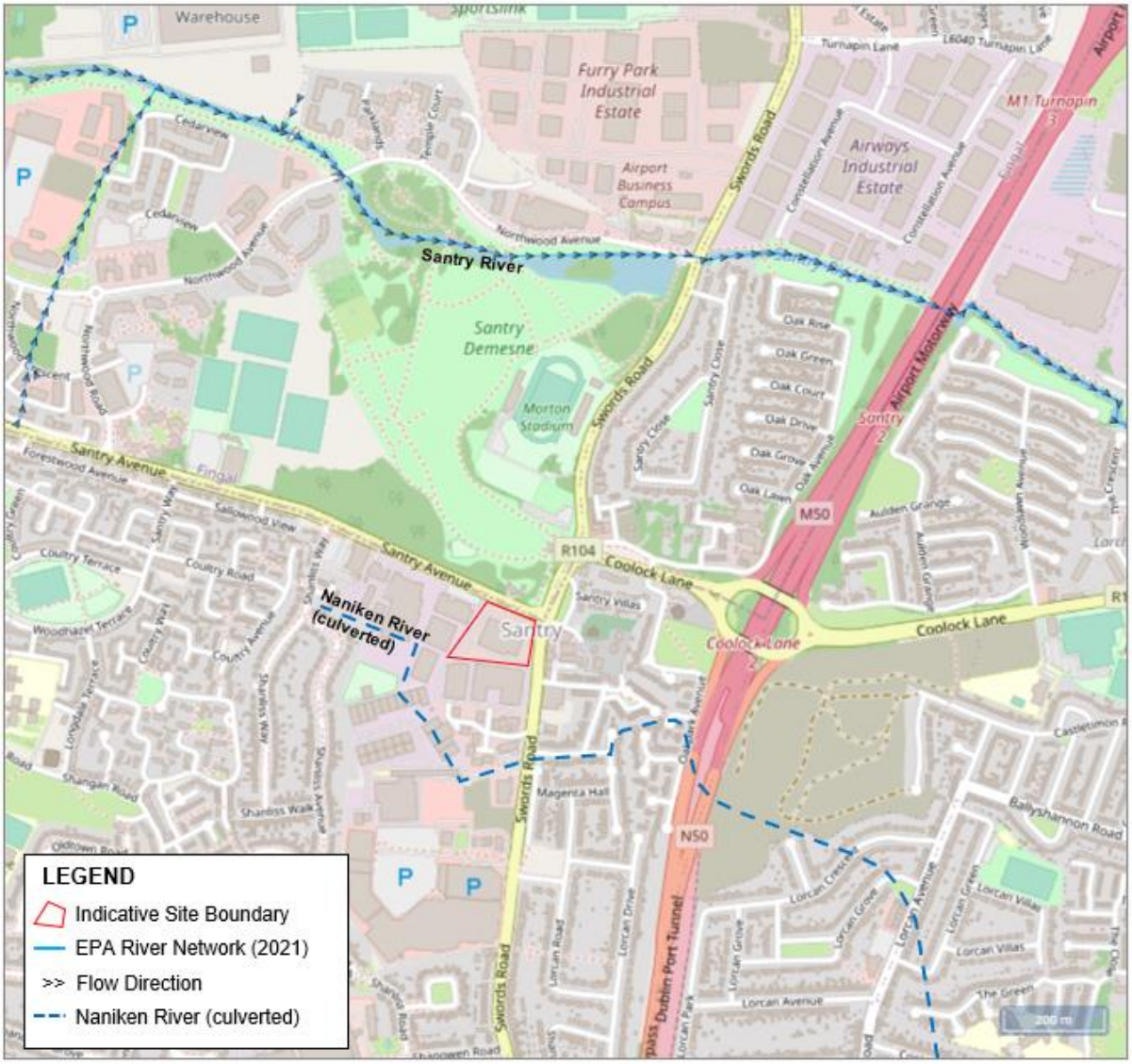
The proposed development site lies within the Liffey and Dublin Bay Catchment (Hydrometric Area 09) and Mayne River sub-catchment (WFD name: Mayne_SC_010, Id 09_17; EPA, 2021).

There are no watercourses at the site or in the immediate vicinity of the site. According to the EPA river network (EPA maps, https://gis.epa.ie/EPAMaps/ accessed on 16-06-2021), the nearest watercourse to the site is the Santry River which resides c. 680 m to the north of the site (refer to insert 2.3 below). The Dublin Bay coastal waterbody is the nearest water receptor and is located c. 7.4 Km southeast of the proposed development.

The Environmental Protection Agency (EPA, 2022) on-line mapping presents the available water quality status information for water bodies in Ireland. The Santry

River belongs to the Santry_010 WFD surface waterbody which has a '*Poor*' Status (EPA, 2022) and its WFD risk score is '*At risk of not achieving good status*'. This '*Poor*' status is related to its '*Poor*' biological conditions (Invertebrate or Potential), oxygenation and phosphorous conditions which have been recorded as 'Moderate'. This status is related to data from 1 no. EPA active water quality station in Clonshaugh Road, located 2 km to the east of the proposed development site

The Coastal Waterbody Dublin Bay has a WFD status (2013 – 2018) of 'Good' and a WFD risk score of 'Not at risk'. The ecological status (which comprises biological and chemical status) of transitional and coastal water bodies during 2013-2018 for Dublin Bay is classed as 'Good'. The most recent surface water quality data for the Dublin Bay on trophic status of estuarine and coastal waters indicate that they are 'Unpolluted' (based on *Water Quality in 2020*, EPA, 2021)'. Under the 2015 'Trophic Status Assessment Scheme' classification of the EPA, 'Unpolluted' means there have been no breaches of the EPA's threshold values for nutrient enrichment, accelerated plant growth, or disturbance of the level of dissolved oxygen normally present.



Insert 2.3 *Hydrological Map (source: EPA, 2022. The Rivers of Dublin, Sweeney, 2017)*

According to the OSi maps (https://www.floodinfo.ie/map/floodmaps/ accessed on 16-06-2022), the site is located within Flood Zone C (i.e., where the probability of flooding from rivers is less than 0.1% or 1 in 1000 years – probability of fluvial flooding is low risk). No historic flooding was identified at the site or surrounding area with the exception of a single event in 1965 recorded c.250m to the south of the site. This event is associated with the Naniken River system which currently flows culverted in this area.

The proposed development will not have direct hydrological linkage with the Santry or Naniken River.

3.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

Dwyer Nolan Developments Ltd. intend to apply to An Bord Pleanála for permission for a strategic housing development, on a site of c. 1.5 hectares, located at the junction of Santry Avenue and Swords Road, Santry, Dublin 9. The development site is bounded to the north by Santry Avenue, to the east by Swords Road, to the west by Santry Avenue Industrial Estate, and to the south by the permitted Santry Place development (granted under Dublin City Council Ref's. 2713/17 & 2737/19).

The proposed development provides for 350 no. apartments, comprised of 113 no. 1 bed, 218 no. 2 bed, & 19 no. 3 bed dwellings, in 4 no. seven to fourteen storey buildings, over basement level, with 4 no. retail / commercial units, a medical suite / GP Practice units and a community use unit located at ground floor level facing onto Santry Avenue and Swords Road. A one storey residential amenity unit, facing onto Santry Avenue, is also provided for between Blocks A & D.

The development consists of the following:

- Demolition of the existing building on site i.e. the existing Chadwicks Builders Merchants (c. 4,196.8m2).
- Construction of 350 no. 1, 2, & 3 bed apartments, retail / commercial and community uses in 4 no. buildings that are subdivided into Blocks A-G as follows:
    - Block A is a 7 to 14 storey block consisting of 59 no. apartments comprised of 26 no. 1 bed, 27 no. 2 beds & 6 no. 3 bed dwellings, with 2 no. commercial/retail units located on the ground floor (c. 132.4m2 & 173m2 respectively). Adjoining same is Block B, which is a 7 storey block consisting of 38 no. apartments comprised of 6 no. 1 bed, 26 no. 2 bed, & 6 no. 3 bed dwellings, with 1 no. commercial/retail units and 1 no. medical suite / GP Practice unit located on the ground floor (c. 162.3m2 & 130.4m2 respectively). Refuse storage areas are also provided for at ground floor level.
    - Block C is a 7 storey block consisting of 55 no. apartments comprised of 13 no. 1 bed & 42 no. 2 bed dwellings. Refuse storage areas are provided for at ground floor level. Adjoining same is Block D which is a 7 to 10 storey block consisting of 51 no. apartments comprised of 25 no. 1 bed, 19 no. 2 bed, & 7 no. 3 bed dwellings, with 1 no. commercial unit / café located on the ground floor (c. 163.3m2). A refuse storage area is also provided for at ground floor level.
    - Block E is a 7 to 10 storey block consisting of 58 no. apartments comprised of 10 no. 1 bed & 48 no. 2 bed dwellings, with 1 no. community use unit located on the ground floor (c. 188.1m2). A refuse

storage area, substation, & switchroom are also provided for at ground floor level. Adjoining same is Block F which is a 7 storey block consisting of 55 no. apartments comprised of 13 no. 1 bed & 42 no. 2 bed dwellings. A refuse storage area & bicycle storage area are also provided for at ground floor level.
    - Block G is a 7 storey block consisting of 34 no. apartments comprised of 20 no. 1 bed & 14 no. 2 bed dwellings. A refuse storage area & bicycle storage area are also provided for at ground floor level.
- Construction of a 1 storey residential amenity unit (c. 187.9m2) located between Blocks A & D.
- Construction of basement level car parking (c.5,470.8m2) accommodating 173 no. car parking spaces & 719 no. bicycle parking spaces. Internal access to the basement level is provided from the cores of Blocks A, B, C, D, E, & F. External vehicular access to the basement level is from the south, between Blocks B & C. 36 no. car parking spaces & 58 no. bicycle parking spaces are also provided for within the site at surface level.
- Public open space of c. 1,915m2 is provided for between Blocks C, D, E, & F. Communal open space of c. 3,122m2 provided for between (i) Blocks E, F, & G, (ii) Blocks A, B, C, & D, and (iii) in the form of roof gardens located on Blocks A, C, & F and the proposed residential amenity use unit. The development includes for hard and soft landscaping & boundary treatments. Private open spaces are provided as terraces at ground floor level of each block and balconies at all upper levels.
- Vehicular access to the development will be via 2 no. existing / permitted access points: (i) on Santry Avenue in the north-west of the site (ii) off Swords Road in the south-east of the site, as permitted under the adjoining Santry Place development (Ref. 2713/17).
- The development includes for all associated site development works above and below ground, bin & bicycle storage, plant (M&E), sub-stations, public lighting, servicing, signage, surface water attenuation facilities etc.

According to the Engineering Services Report (DBFL, 2021), surface water drainage will be attenuated on site in discharge into the public sewer network. Foul water will be discharged separately into the public foul sewer network. There will be no direct discharges to ground required for construction/ operation of the development.

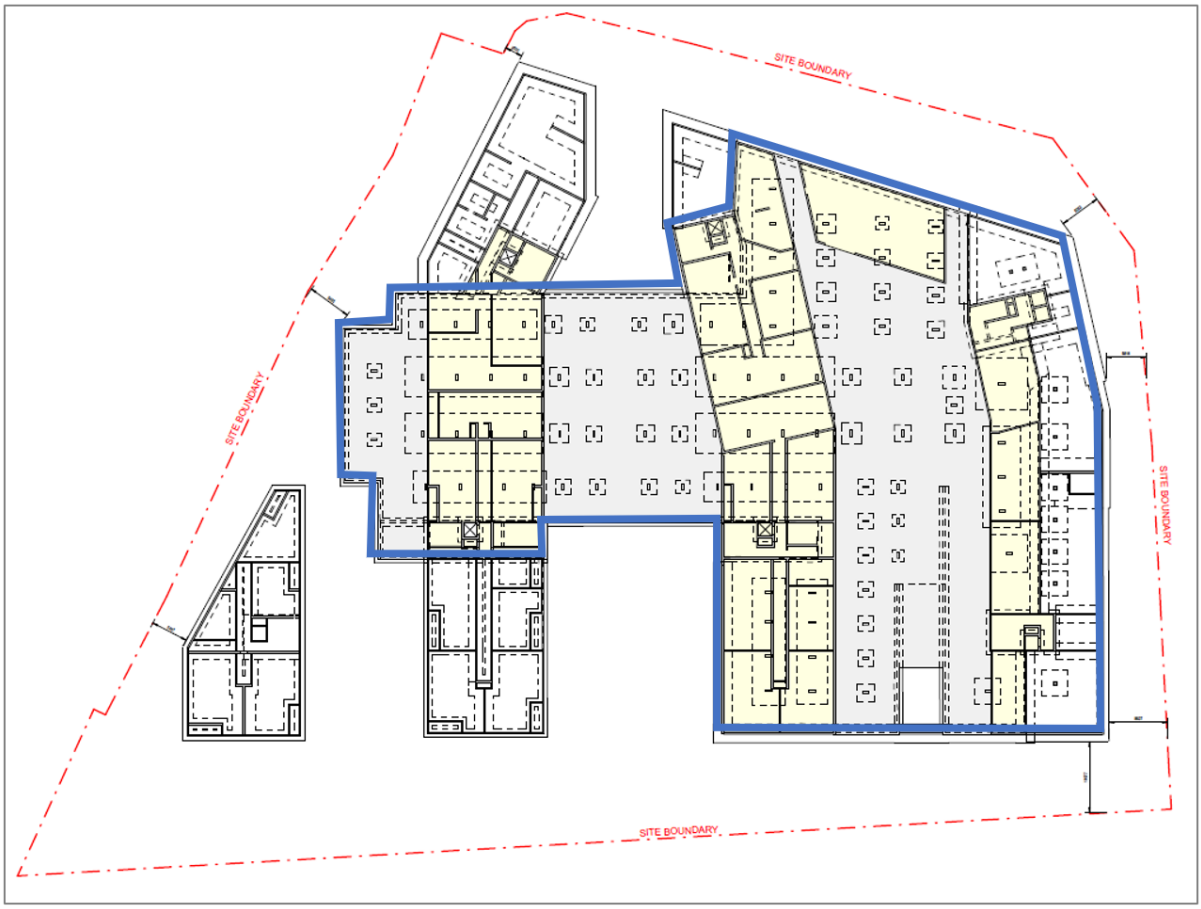
The basement for the proposed development will be founded at a formation level of approx. 4.5 mbgl.

Given the geotechnical characteristics of the cohesive deposits at the subject site (refer to DBFL, 2021) conventional strip and pad foundations are considered suitable for walls and columns for all blocks up to 14 storeys in height. Circulation cores are proposed to be founded on raft foundations as these cores provide stability to the overall scheme and as a result will attract higher load.

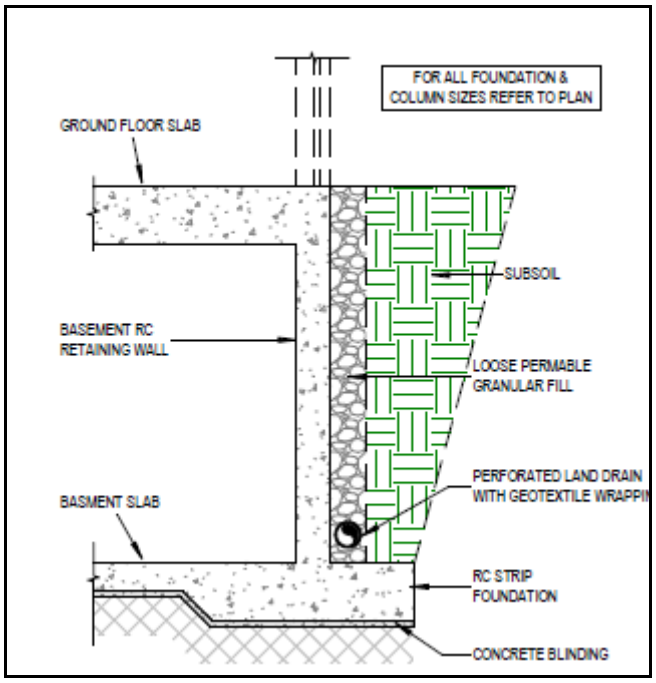
The ground conditions and allowable bearing capacity was verified using the ground investigation report carried out by IGSL on the nearby Coolock lane development (refer to DBFL, 2021). A piling solution was not considered due to the relatively shallow depth of the stiff cohesive deposits.

Given the location of the basement within the site and the space between the basement perimeter and the site boundary, a 45 degree batter is achievable to form the basement excavation.

It is also recommended that extensive ground investigations are carried out on the proposed site (including a combination of trial pits, boreholes and dynamic probes), before more detailed project design takes place. Refer to Insert 3.1 below for the basement plan and Insert 3.2 for a projected basement section.



Insert 3.1 *Outlined Basement Plan (blue polygon) (source: DBFL, 2021)*



Insert 3.2 *Typical Basement Section (source: DBFL, 2021)*

3.1 CONSTRUCTION WORK PROGRAMME

The approximate basement Construction Sequence is outlines below:

i. Demolition Works

The existing buildings on the site will be demolished as part of the planning application. Demolition will be completed by the appointed contractor in accordance with the relevant standards and guidelines. Contaminated materials used in the existing buildings will be identified and disposed of by a specialised contractor. Demolition will be carried out as described below to permit basement construction without undermining or causing loss of support to adjacent structures.

ii. Basement Construction

A full site investigation will be carried out prior to construction commencing. A specialist ground works contractor will be appointed to carry out the excavation and any rock breaking works that may be required. The appointed specialist contractor will carry out a full risk assessment prior to the commencement of work.

A ground works operation will be carried out in order to ensure that material removed from the ground is taken away at regular intervals in order to reduce the amount of material that will be stored on site. Excavated material will be reused on site where possible subject to the WAC analysis.

Localised sump pumps will be installed to remove the water through settlement tanks and after appropriate treatment into the local drainage network infrastructure for discharge. On completion of the excavation works to the formation level of the basement slab, this will be blinded to the final design levels. Any below ground services will be installed and tested below the basement slab. Prior to construction of

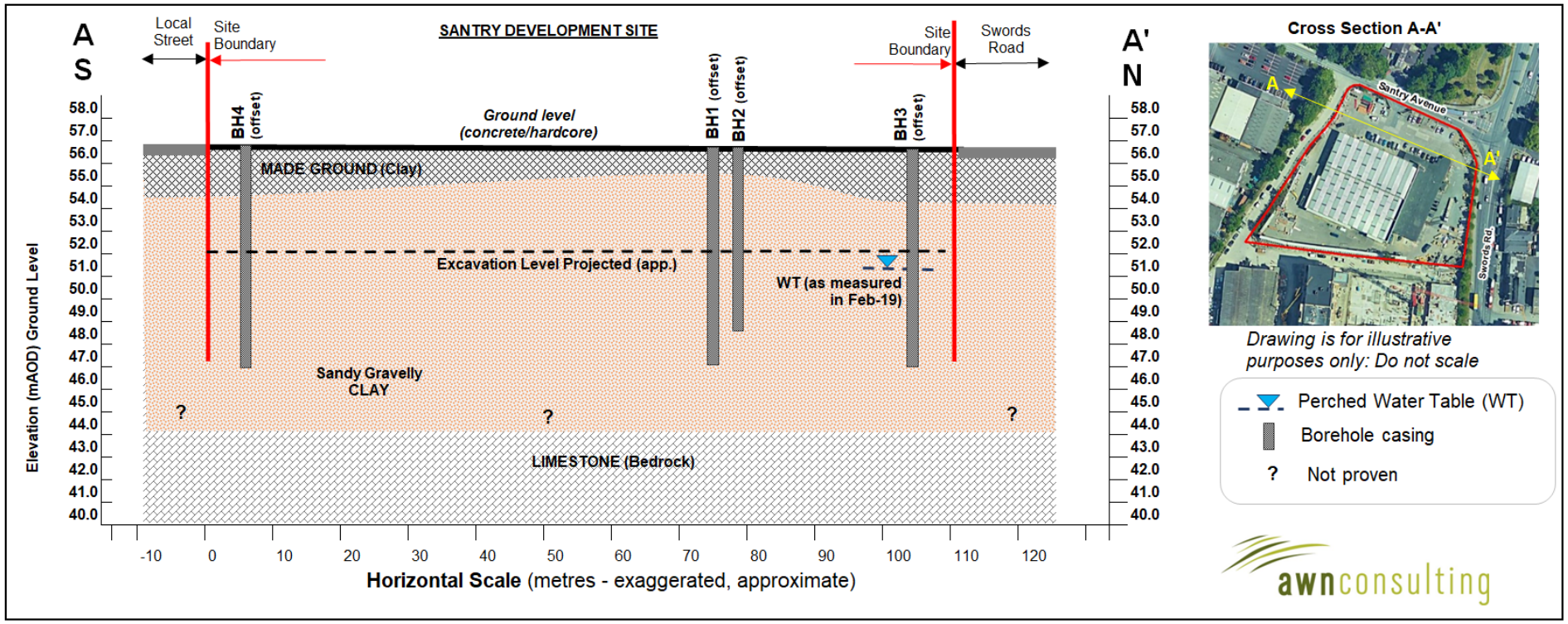
the foundations and suspended slab at the lower basement level, a proprietary basement tanking system and water bar will be installed at all construction joints. A typical basement slab construction is as follows:

- Trim & grade to slab formation with suitable well compacted capping material.
- Cast mass concrete blinding to form a surface for applying waterproof membrane and tanking.
- Apply continuous waterproof tanking material and seal all laps (and along perimeter of secant wall/slab junction).
- Install slab reinforcement to slab area (including any columns and wall starters) Formwork to perimeter and any box-outs necessary (around raking props).
- Clean & inspect slab pour prior to concrete operations.
- *Note: The placement of large volumes of concrete such as the deep foundations will be carried out by a mobile or static concrete pump. The above process will repeat until the foundation raft is constructed.*

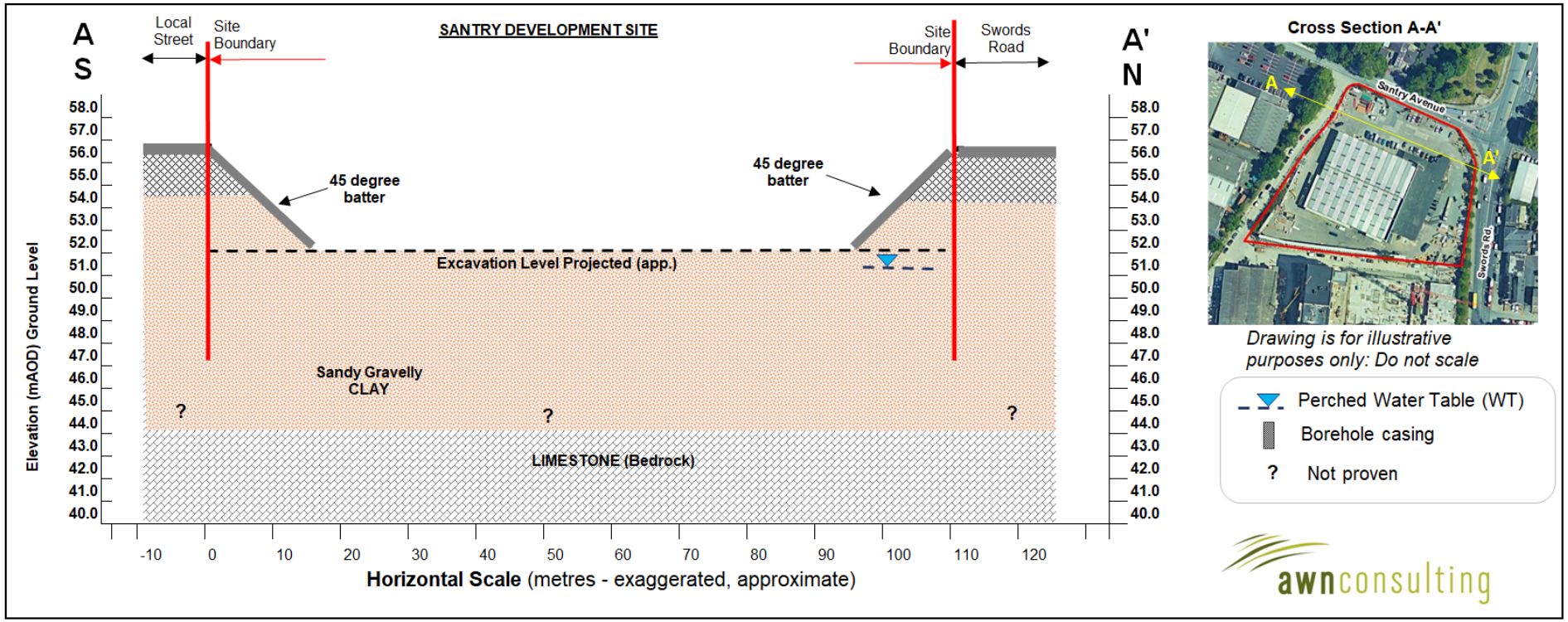
When a sufficient area of basement slab is constructed the vertical elements will be constructed to allow the upper level; basement slabs to be constructed.

4.0 CONCEPTUAL GROUND MODEL

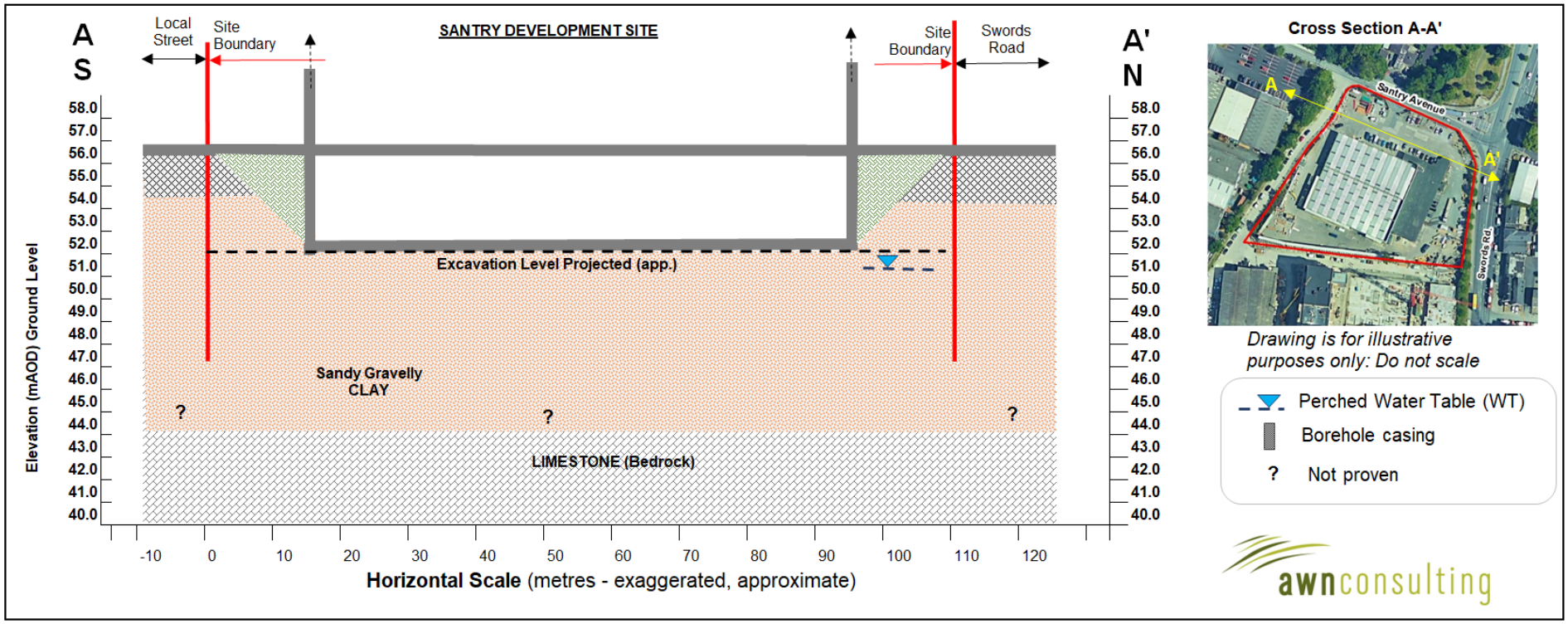
Based on the existing site conditions and the description of the proposed development, conceptual cross sections for the current situation, the construction phase and operation phase are shown in Inserts 4.1 to 4.3 below.



Insert 4.1 *Conceptual Cross Section A-A' for current situation*



Insert 4.2 *Conceptual Cross Section A-A' during Construction Phase*



Insert 4.3 *Conceptual Cross Section A-A' during Operation Phase*

5.0 POTENTIAL IMPACTS

There is no expected long term impact on groundwater levels surrounding the proposed site due to the nature of the hydrogeological environment and the shallow depth of the basement. Local shallow groundwater within overburden (Made ground and cohesive deposits – low permeability sandy gravelly Clay) will be intercepted (refer to Conceptual Ground Model above) by the basement retaining wall but following basement construction groundwater will migrate around the structure with no overall change in the groundwater and surface water regime.

During construction, a very localised impact may occur during early stages of excavation until the 45 degree batters are in place. Once these are installed into the low permeability clay (made ground and cohesive deposits), any horizontal flow from the water bearing gravel layer will be cut off and minimal inflows from the base of construction (along with any collected rainwater) will occur until the floor is constructed. Considering a water table at 5.5mbgl interpreted from ground investigations at the adjacent site, no drawdown of perched water would be required at the site as the level for foundations is projected at a depth of c. 4.5mbgl. However, in the event that perched water is encountered during excavation works, based on the construction design and average hydraulic conductivity for this type of overburden, the zone of influence would be expected to be within or close to the 45 degree batters and the basement retaining walls i.e. close to the site boundary during construction with full recovery post construction.

The regional water table within bedrock will not be affected by the planned basement construction. The effect on the shallow water table will at most be temporary. The basement is estimated to be completed within approximately 12-16 weeks.

Since the site is currently hardstand (Heiton Buckly Building Suppliers), the proposed development will not result in the increase in hardstanding area. Therefore, groundwater recharge and groundwater regime will not be affected.

The proposed basement construction, which would involve c. 4.5 m deep excavations has the potential to cause minor ground movements inside and outside the excavated area as a result of changes in vertical load on the ground. The construction sequence outlined in Section 3.1 of this report was developed to control any potential movement to within acceptable limits.

The potential for impact on the aquifer is low based on there will be no direct discharges to ground required for construction/ operation of the development and the absence of any bulk chemical storage on site and direct water discharges into the ground/ subsoil. The overburden thickness, low permeability nature of till and a lack of fracture connectivity within the granite/ limestone will minimise the rate of off-site migration for any indirect discharges to ground at the site. As such there is no potential for a change in the groundwater body status or significant source pathway linkage through the aquifer to any Natura 2000 site in Dublin Bay.

During both construction and operational phases, there is no source-pathway-receptor hydrogeological connection between the subject site and Dublin Bay through the Dublin aquifer as vertical migration to the underlying limestone bedrock is minimised due to the thickness of overburden (‘Low’ vulnerability) present at the site providing a high level of aquifer protection from any potential source. There is low risk

of migration through poorly connected fracturing within the limestone (Locally Important Aquifer) rock mass.

Therefore, no likely impact on the status of the aquifer is expected due to low potential loading, natural attenuation within overburden and discrete nature of fracturing reducing off site migration.

6.0 POTENTIAL MITIGATION MEASURES

The following mitigation measures will be included in the design to protect water quality:

Any minor ingress of groundwater and collected rainfall in the excavation will be pumped out during construction. It is proposed that the water be discharged via the existing stormwater sewer network. The use of slit traps and an oil interceptor (if required) will be adopted if monitoring indicates the requirements for the same with no silt or contaminated water permitted to discharge to the sewer.

Site investigation has not identified any significant water bearing gravels within the basement footprint. However, if water bearing gravels encountered then the design should facilitate discharge around the basement structure.

To minimise any impact on the underlying subsurface strata from material spillages, all oils, solvents and paints used during construction will be stored within temporary bunded areas; these areas shall be bunded to a volume of 110% of the capacity of the largest tank/container.

Where feasible all ready-mixed concrete will be brought to site by truck. A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated storm water to the underlying subsoil. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility offsite.

In addition, monitoring of groundwater levels pre, during and post construction of basement works and monitoring of vibration and noise during the installation of 45 degree batters will complement the measures described above. Where groundwater is encountered, a minimum of 3 no. boreholes with standpipes it is suggested to install in order to measure these levels and their seasonal fluctuation.

A Construction and Environmental Management Plan (CEMP) undertaken by DBFL is included as part of the planning application. A more detailed plan will be provided after the contractor is appointed. At that stage the contractors' detailed strategy during construction, including management of any collected water will be provided.

7.0 CONTINUOUS SITE INVESTIGATION

The site investigation comprises several stages. This included the pre-construction phase, during construction and post construction investigation.

7.1 Pre-Construction Stage

A desk study was carried out on the basis of a review of existing data sources such as the Geological Survey Ireland (GSI) and Environmental Protection Agency (EPA) websites. Results of this investigation were showed in the previous Section 2.0.

On the basis of this investigation, an interpretation is provided of the detailed site soil and geology and hydrogeology, of the geotechnical properties of the ground and an engineering and hydrogeological interpretation of the implications of the ground conditions in the previous Section 2.0. This interpretation was based on ground investigations for the adjacent site undertaken in 2019.

As such, it is necessary to install at least 3 no. boreholes with standpipes to carry out groundwater monitoring prior to commencing construction works.

6.2 Construction Stage

Due to the potential for minor ground movements during excavation works, at locations where movements are of critical importance, appropriate instrumentation will be installed and the wall and ground movements monitored accordingly. The predictions of ground movement based on the ground movement analysis should be checked by monitoring the basement wall. The monitoring will include the installation of inclinometers in the basement retaining wall elements so the pattern of wall behaviour can be reviewed with predicted values. From this understanding, the designer will carry out back analysis of the observed (monitored) wall behaviour and recalibrate the analytical model in terms of the excavation geometry and the behaviour of the ground and the structural elements with appropriate modifications or contingencies applied as required.

It is recommended that movement monitoring should be undertaken with surveying points set up prior to commencement of the works and readings be undertaken at weekly intervals. It is recommended that trigger values for monitoring are based on the predicted ground movements to ensure conservatism and that they are agreed under the Party Wall Act. In cases where vibration from construction methods could potentially damage sensitive neighbouring buildings and structures vibration monitors are to be installed. The precise monitoring strategy will be developed at a later stage and it will be subject to discussions and agreements with the owners of the adjacent properties and structures. Contingency measures will be implemented if movements of the adjacent structures exceed predefined trigger levels. Both contingency measures and trigger levels will need to be developed within a future monitoring specification for the works.

Based on ground water monitoring on the adjacent site, it is considered that there is a low risk of inflow during construction works. However, three groundwater monitoring wells are proposed outside of the basement footprint. Water level data collection will be undertaken before during and after construction.

8.0 CONCLUSIONS

The proposed basement will have no long term impact on water levels in the overburden or underlying aquifer and no impact on the current water body status. The bedrock water table will not be affected by the excavation works. Temporary dewatering of the perched water table within the clayey deposits to facilitate excavation works is expected to be minor and it will have a temporary local impact only.

The basement will need to be fully waterproofed to ensure no groundwater enters the finished basement. Site investigation has not identified any significant water bearing gravels within the basement footprint. However, if water bearing gravels encountered then the design should facilitate discharge around the basement structure.

Management of any collected rainwater and any groundwater seepage during basement excavations will be pumped to existing sewers (following appropriate treatment) in agreement with the regulatory authority.

By providing a 45 degree batter system there are no concerns regarding slope stability and horizontal movement can be easily limited to industry acceptable limited by careful detailed design.

Overall, the impact on the environment as a result of the proposed basement development in the area is predicted to be **long term-imperceptible and neutral**, provided mitigation measures above described are implemented.