9.0 LAND, SOILS & GEOLOGY

9.1 Introduction

The following topics will be explored in this chapter of the EIAR:

- Subsoil and Bedrock

This Chapter assesses the likely and significant impacts associated with the proposed residential development on the geological environment. The site is located within the Sandyford Business Park near to the Stillorgan Luas stop. The site is bounded by Blackthorn Drive to the north and Carmanhall Road to the south. The Ordnance Survey of Ireland (OSI) grid reference for the centre of the site is 719207E, 726893N.

This chapter provides:

- A description of the project (in connection with soils and geology);
- The baseline soils and geology environments for the project site;
- A statement of the likely significant impacts associated with both the construction and operation phases of the development.
- A 'do nothing' scenario has also been considered.
- Mitigation measures are proposed in the form of avoidance, prevention, reduction, offsetting, and reinstatement or remedial measures and recommendations for monitoring are included where appropriate.
- Predicted residual effects are described.

Assessments for the site are detailed in this Chapter with relevant technical information included in:

- Appendices 9.1 and 9.2 Ground Investigation Reports
    - Appendix 9.1: Ground Investigation Ireland's (GII) Ground Investigation Report, Sandyford Central (Ref No 8408-01-19). Dated 07/08/2019.
    - Appendix 9.2: Ground Investigation Ireland's (GII) Waste Classification Report, Sandyford Central (Ref No 8408-01-19). Dated 30/08/2019.

The assessment of this Land and Soils chapter of the EIAR for the proposed development hereby referred as 'Sandyford Central' has been prepared by O'Connor Sutton Cronin and Associates Multi-Disciplinary Consulting Engineers (OCSC) for, and on behalf of, Sandyford GP Limited (acting in its capacity as general partner for the Sandyford Central Partnership). The Chapter was authored by Eleanor Burke (BSc, MSc, DAS, MIEnvSc), OCSC Environmental Division Manager and Technical Principal and has prepared multiple EIS and EIAR documents throughout her 17No. years post qualification experience.

9.1.1 Guidelines

The Assessment has been carried out generally in accordance with but not limited to the following guidelines:

- Environmental Protection Agency (**EPA**) *Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports* (August 2017) (EPA Guidelines);
- EPA *Draft Advice Notes for preparing Environmental Impact Statements (September 2015*);
- EPA *Guidelines on Information to be contained in Environmental Impact Statements (2002);*
- EPA *Advice Notes on Current Practice in the preparation of Environmental Impact Statements* (2003);
- Institute of Geologists of Ireland (**IGI**) *Guidelines for the preparation of Soils Geology and Hydrogeology Chapters of Environmental Impact Statements by the Institute of Geologists of Ireland* (2013) (IGI Guidelines);
- IGI *Geology in Environmental Impact Statements, A Guide* (2002);
- National Roads Authority (**NRA**) *Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes* (2009);
- Construction Industry Research and Information Association (**CIRIA**) *Control of Water Pollution from Construction Sites* (2001); and
- CIRIA *Environmental Handbook for Building and Civil Engineering Projects* (2000).

9.1.2 Approach

The assessment followed a phased approach as outlined in Chapter 4.4 of the EPA Draft *Advice Note for Preparing Environmental Impact Statements* (EPA, 2015) and the IGI Guidelines (IGI, 2013). A Conceptual Site Model (**CSM**) was developed in order to identify any likely Source-Pathway-Receptor (**SPR**) linkages relating to the site of the Proposed Development. The phases of assessment are outlined below.

- **Phase 1:** Initial Assessment
- **Phase 2:** Direct and Indirect Site Investigations and Studies, Refinement of the Conceptual Site Model and Detailed Assessment and Impact Determination
- **Phase 3:** Mitigation, Residual and Final Impact Assessment
- **Phase 4:** Completion of the EIAR Chapter.

Phase 1: Initial Assessment
An initial assessment was carried out which; defined the project in terms of location, type and scale; established the baseline conditions for the Site including identifying the type of soil / geological environment; and established the activities associated with the Proposed Development.

These objectives were achieved by way of a geological desk study and baseline data collection. A list of sources for the desk study together with relevant legislation are included in the Section 9.9.

Additional information has been compiled through consultation and feedback from the project/EIA Team.

Sources including the EPA and Geological Survey Ireland (GSI) were utilised to establish the baseline conditions for the Site and all available information was compiled into a preliminary CSM. The CSM is based on the accepted SPR model for assessing environmental impacts. The CSM went through iterative reviews and was updated with Site specific data obtained through site investigations and studies.

Phase 2: Direct and Indirect Site Investigations and Studies, Refinement of the Conceptual Site Model and Detailed Assessment and Impact Determination

Direct and Indirect Site Investigations and Studies

Ground Investigations Ireland (GII) undertook a site investigation between February and June 2019. Reports based on the site investigation and sampling exercise including Waste Soil Classification Report are contained in Appendix 9.2. The intrusive investigation completed included the following:

1. Excavation of eight (8 No.) trial pits;
2. Excavation of two (2 No.) infiltration test trial pits;
3. Excavation of two (2 No.) foundation pis;
4. Drilling of ten (10 No.) rotary core boreholes; and
5. Collection of subsoil samples for chemical analysis.
6. Logging and sampling of borehole arising's;
7. Analysis of a selection of samples for geotechnical and chemical properties;

The soil analysis laboratory certificates and site investigation logs are also included within the GII Report in Appendix 9.1.

Refinement of the Conceptual Site Model

Throughout the desk-based study the CSM was continually updated, tested and refined. The outcome is presented in this Chapter, associated figures and technical reports.

Detailed Assessment and Impact Determination

A Detailed Assessment and Impact Determination was carried out which incorporates the full range of site investigations and studies, the refined CSM and a full assessment of any potential impacts.

The approach adopted is as per the IGI Guidelines (IGI, 2013) and each potential effect of the Sandyford Central Development has been described in terms of Quality, Significance, Extent, Probability and Duration. The classification of impacts/effects in this chapter follows the definitions provided in the Draft Guidelines (EPA, 2017).

Additional guidance and EIA definitions are contained in NRA Guidelines (NRA, 2009). These guidelines provide useful matrices outlining how additional assessment criteria based on the Importance of a feature to be protected and the magnitude of the potential impact. This approach has been adopted where appropriate.

Where the Initial Impact Determination concluded that the level of potential impact is capable of measurable and noticeable consequences it is carried into the next assessment phase.

Phase 3: Mitigation, Residual and Final Impact Assessment
Phase 3 builds on the outcome of the initial assessment and detailed site assessments, by identifying mitigation measures to address the identified impacts, where such impacts were capable of measurable and noticeable consequences. This process also considered how the Proposed Development was amended through the EIAR process to incorporate mitigation measures.

The Proposed Development, including all identified mitigation measures (assumed implemented), is then subject to impact assessment, to identify any residual impacts.

The Final Impact Assessment presented in this Chapter incorporates the outputs from the Detailed Assessment and Impact Determination, Mitigation Measures and Residual Impact Assessment.

Phase 4: Completion of the EIAR Section
The final phase of work was the completion of this EIAR Section with associated Figures and Appendices. The format used in this EIAR Chapter follows the EPA Guidelines.

9.1.3 Assumptions & Limitations

The description of existing conditions is based on the available desk study and information supplied by the design team as outlined in Section 9.2. Geological conditions have been inferred from the GII Reports (2019). In addition, geological conditions have been inferred in areas were investigation was not possible and the geology is considered typical and uniform across the development site.

9.2 Proposed Development

The description of the proposed development and the consideration of alternatives is detailed in Chapter 4. The study area for this assessment chapter includes the site and a 2km radius from the site.

The site is located within the Sandyford Business Park near to the Stillorgan Luas stop. The site is bounded by Blackthorn Drive to the north and Carmanhall Road to the south. Sandyford GP Limited (acting in its capacity as general partner for the Sandyford Central Partnership) intend to apply to An Bord Pleanála for permission for a strategic housing development at a 1.54 ha site at the former Aldi Site, Carmanhall Road, Sandyford Business District, Dublin 18.

The development, which will have a Gross Floor Area of 49,342 sq m will principally consist of: the demolition of the existing structures on site and the provision of a Build-to-Rent residential development comprising 564 No. apartments (46 No. studio apartments, 205 No. one bed apartments, 295 No. two bed apartments and 18 No. three bed apartments) in 6 No. blocks as follows: Block A (144 No. apartments) is part 10 to part 11 No. storeys over basement; Block B (68 No. apartments) is 8 No. storeys over basement; Block C (33 No. apartments) is 5 No. storeys over lower ground; Block D (103 No. apartments) is part 16 to part 17 No. storeys over lower ground; Block E (48 No. apartments) is 10 No. storeys over semi-basement; and Block F (168 No.

apartments) is 14 No. storeys over semi basement.

The development provides resident amenity spaces (1,095 sq m) in Blocks A, C and D including concierge, gymnasium, lounges, games room and a panoramic function room at Roof Level of Block D; a creche (354 sq m); café (141 sq m); a pedestrian thoroughfare from Carmanhall Road to Blackthorn Drive also connecting into the boulevard at Rockbrook to the west; principal vehicular access off Carmanhall Road with servicing and bicycle access also provided off Blackthorn Drive; 285 No. car parking spaces (254 No. at basement level and 31 No. at ground level); 21 No. motorcycle spaces; set-down areas; bicycle parking; bin storage; boundary treatments; hard and soft landscaping; lighting; plant; ESB substations and switchrooms; sedum roofs; and all other associated site works above and below ground.

The site is currently an open yard in the northern and central section with an industrial/commercial building located in the southern section. The southern section is more elevated than the central and northern sections with a ramp located along the eastern boundary linking the areas.

The site has a shallow fall from Carmanhall Road to Blackthorn Drive of approximately 4m. The proposed ground floor level (lowest level), across the site is approx. +77mOD. There is an existing concrete slab from a previous warehouse building at a level of approximately 81.3m therefore the total amount of excavation for the site is expected to be moderate with fill required in areas.

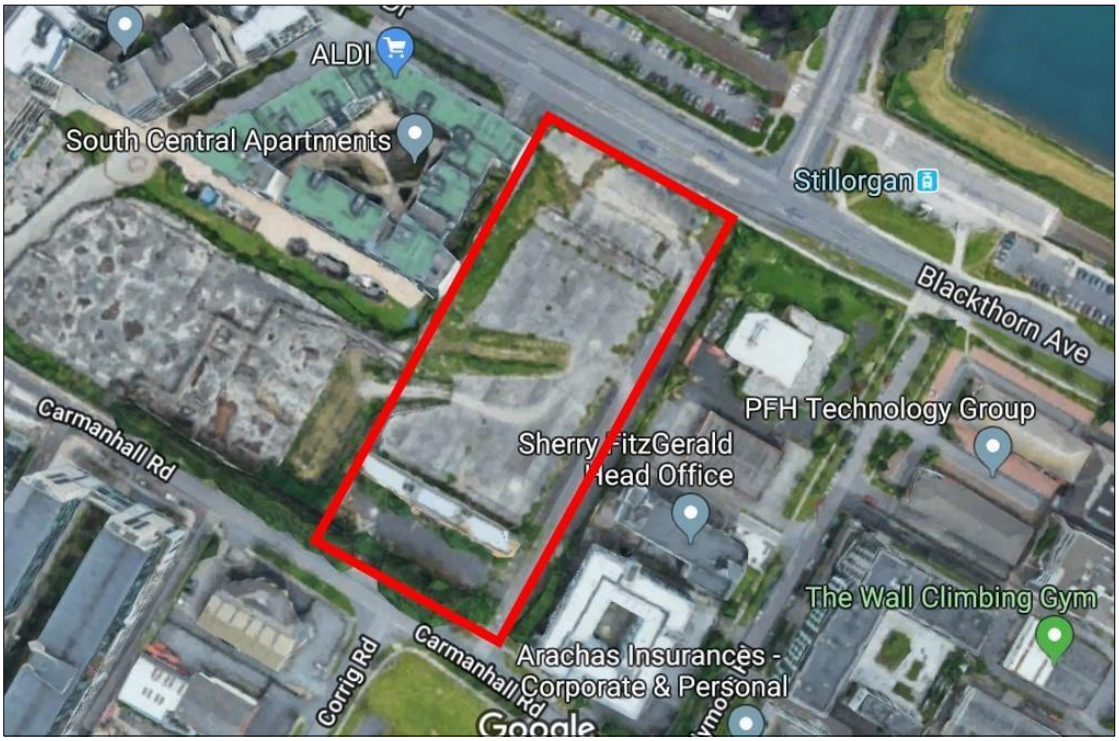

Figure 9.1: Site Location.

Source: Google Maps.

The activities associated with the project which have the potential for impact are detailed in Table 9.1.

Phase	Activity	Description
Construction	Discharge to Ground	Surface water runoff percolating to ground could result in contamination of the ground in the event of incident rainfall on a spill.
	Earthworks: Excavation of Superficial Deposits	Removal of material due to design requirements for two full basements, two semi basements and two Lower Ground. In addition, some imported fill will be required.
	Storage of hazardous Material	Fuel for re-fuelling on-site machines and chemical storage (such as for concrete curing) during the construction phase.
	Demolition	The development will include demolition of the existing structures on site. The principle of demolishing the remaining structures on site was established under the previous permissions at the subject site - DLR. Reg. Ref.: D07A/0619 and more recently the SHD permission under ABP Ref.PL06.301428 (extant).
	Import/Export of Materials	All suitable surplus subsoil, if any exists, will be exported for reuse off site where a suitable reuse site can be identified. Soil reuse will be subject to the requirements under the Waste Management Act (e.g. Article 27 or 28). Where material cannot be reused it will be recovered or disposed of in accordance with the Waste Hierarchy and Waste Management Act. Aggregates will be required for sub-base under roads and buildings. All sub-base materials must meet the relevant engineering specification. The use of recycled or secondary aggregates should be considered as a replacement for primary aggregates.
Construction and operation	Construction of sub-surface structures	Two full basements and two semi basements are proposed as part of the design. This will result in the removal of both made ground and native material from the site.
	Infilling	A degree of fill will be required during the works which will include the importation of concrete and stone. Construction materials which contain recycled/recovered content should be considered as part of the procurement stage.
Operation /unplanned events	Storage of hazardous Material	No fuel oil storage required for operational phase. All heating will be provided by natural gas systems.

Table 9.1: Site Activities Summary.

As outlined in Table 9.1, the Construction Phase holds the highest number of activities which could potentially impact on the geological environment. These activities primarily pertain to the excavation and infilling activities required to construct the basements. The operational

phase of the project has very few if no activities which would constitute a risk to the soil and geological environment.

9.2.1 Project Phases/Lifecycle

This residential application will be submitted to An Bord Pleanála in November 2019 as a Strategic Housing Development (SHD) and will be determined in Quarter 1 2020.

9.3 Baseline Scenario

The receiving environment is discussed in terms of; geomorphology; and the superficial and solid geology. This Section and the accompanying Figures can be considered as the geo-environmental CSM for the project site.

9.3.1 Sourcing Baseline Information

The site is within the Sandyford Industrial Estate which has been well studied with regards to geology, including the properties and characteristics of the soil, subsoil and bedrock, and there are a number of case histories available for subsurface development/structures in the general area. See Figure 9.2 for geo-environmental site investigation locations within area.

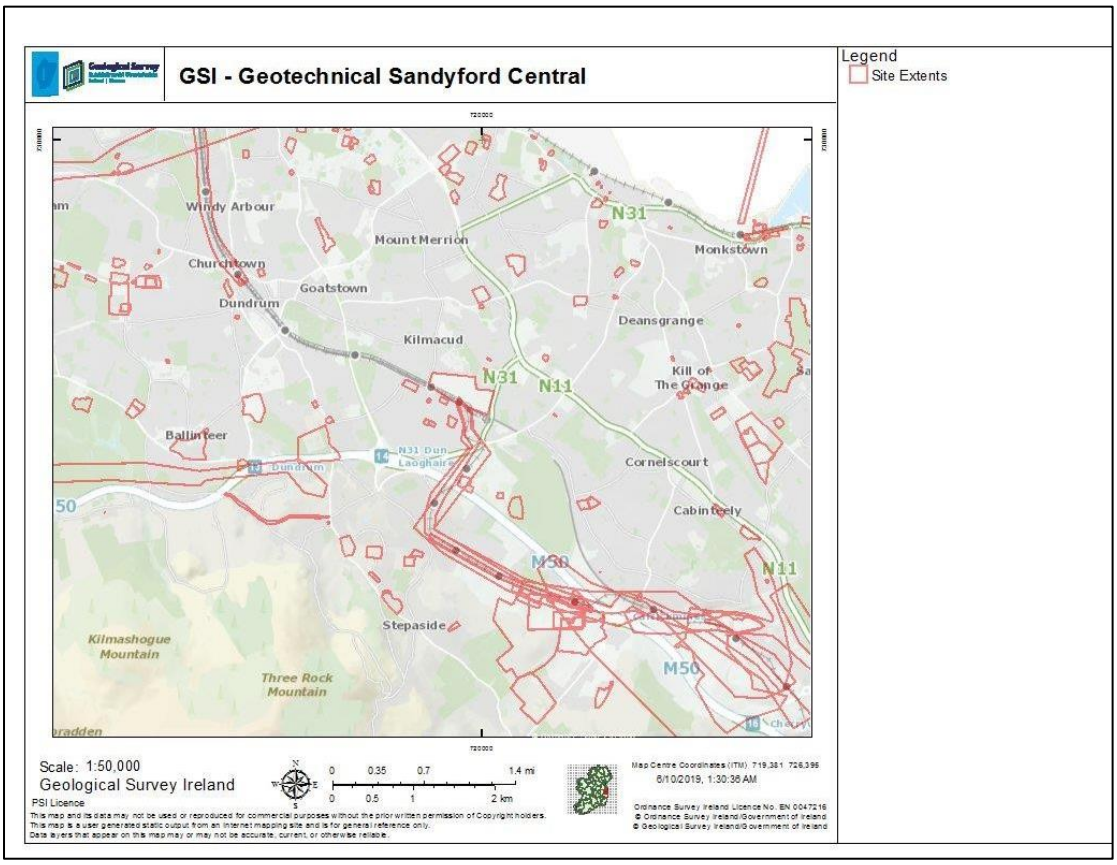

Figure 9.2: Site Investigation Locations, Dublin.

Source: GSI Database.

Additional sources of information include databases held by the Geological Survey of Ireland (GSI), Environmental Protection Agency (EPA), Ordnance Survey of Ireland (OSI) and National Parks and Wildlife Service (NPWS).

A full list of references is included in Section 9.9.

9.3.2 Topography & Setting

The site has a shallow fall from Carmanhall Road to Blackthorn Drive of approximately 4m. The proposed ground floor level (lowest level), across the site is +81.3mOD. There is an existing concrete slab from a previous warehouse building at a level of approx 81.3m therefore the total amount of excavation for the site is expected to be low with fill required in areas.

The regional site location is illustrated on Figure 9.3.

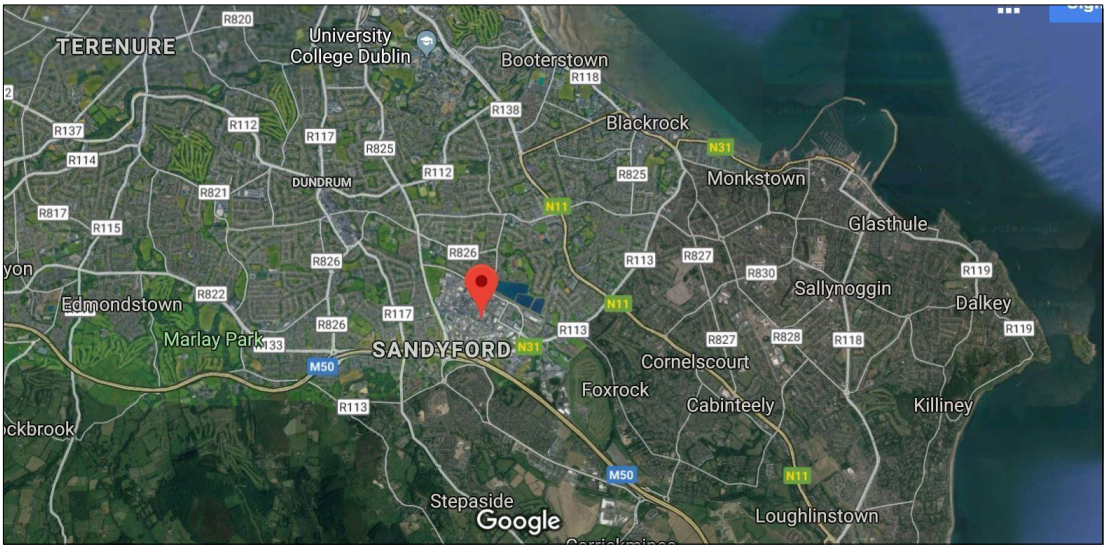

Figure 9.3: Regional Site Location.

Source: Google Maps.

As shown on Figure 9.1, the site's immediate surrounding area is mixed use in nature. The site is located on the junction of Saint Raphaela's Road and Blackthorn Drive in Sandyford, Dublin 18 (Figure 9.1). The site is bounded to the west, south and east by mixed use, commercial and residential buildings, which form part of the Business Park. The site is bounded to the north by Blackthorn Drive and the Luas Green Line and residential properties beyond. The Stillorgan Reservoir is located to the north east of the site beyond Blackthorn Drive. Refer to Figure 9.1 for an aerial photograph of the site. The adjacent land uses are listed in Table 9.2 below.

Boundary	Land use
North	Blackthorn Drive, Luas Green Line and Residential properties.
South	Carmanhall Road, mixed use developments including a mix of office-blocks and residential developments.
East	Mixed use developments including a mix of office-blocks and temporary school (DLRCC Reg. Ref. D18A/1210)
West	Mixed use developments including a mix of office-blocks and residential developments. A retail unit, Aldi, is also present. On a site immediately to the west a Strategic Housing Development (SHD) application has recently been granted by An Bord Pleanála (Reg. Ref. ABP-304405-19)

Table 9.2: Adjacent Land Uses.

9.3.3 Areas of Geological Interest

The Geological Survey of Ireland (GSI) online mapping service was consulted regarding areas of geological interest in the area of the site. The nearest area of geological heritage is the Murphystone Quarry (Site Code DLR009) located approximately 5km south of the site. It is a large working quarry where granite is extracted from the northernmost pluton of the Leinster granite. It is designated as a County Geological Site (CGS) and is under the control of Dún Laoghaire-Rathdown County Council. It is located at X: 317923 and Y: 224198 ITM. Given the distance to the site and its nature it is considered to be outside of the zone of influence of the proposed development.

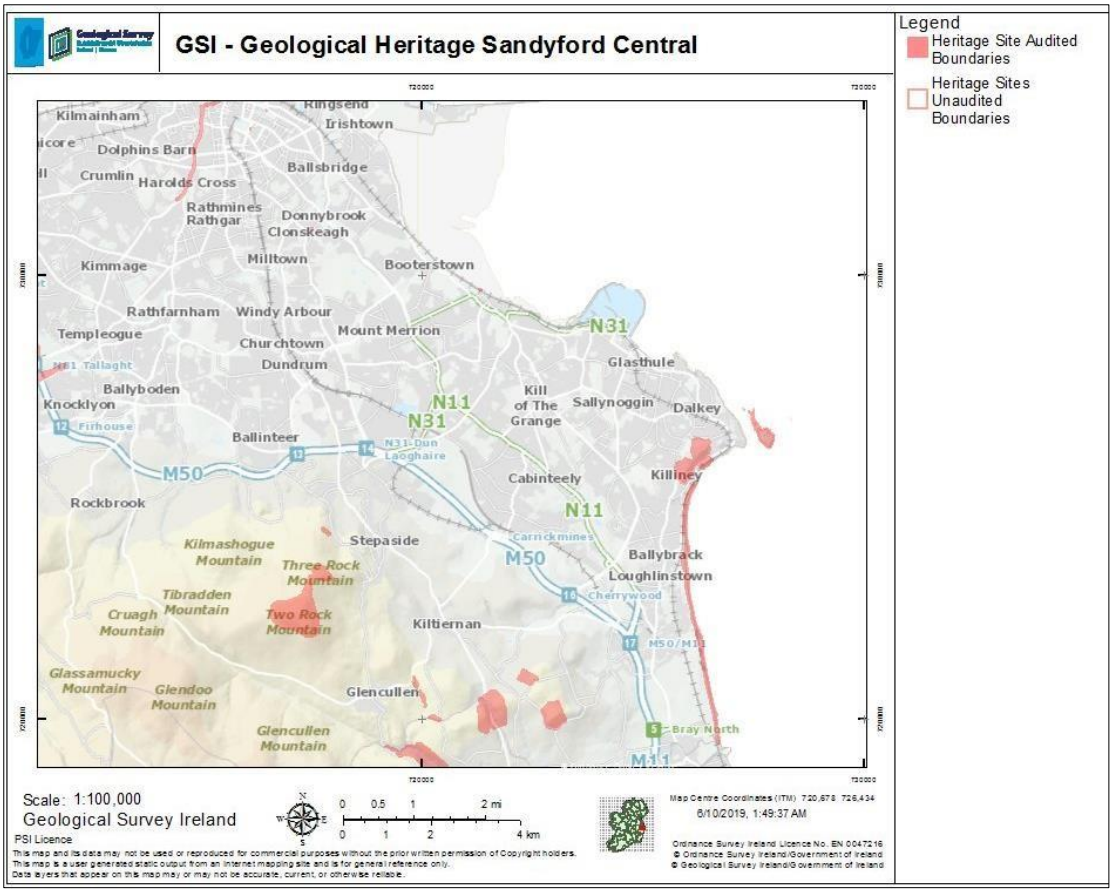

Figure 9.4: County Geological Site.

Source: OSI, 2019.

9.3.4 Historic Land-Use

Aerial images of the site from 1995, 2000 and 2005 show the site layout with the former warehouse. This was demolished by the time the 2011-2013 aerial photograph was taken. Currently the site consists of a concrete slab associated with the former buildings. There was no evidence of hydrocarbon storage during previous site use.

There are a number of historical maps available for the area including:

- 6" historical map (1837-1842)
- 25" OSI maps (1888-1913)
- Cassini Map (1830s to 1930s) – refer Figure 9.5.

All of the maps show the area as agricultural/ pasture.

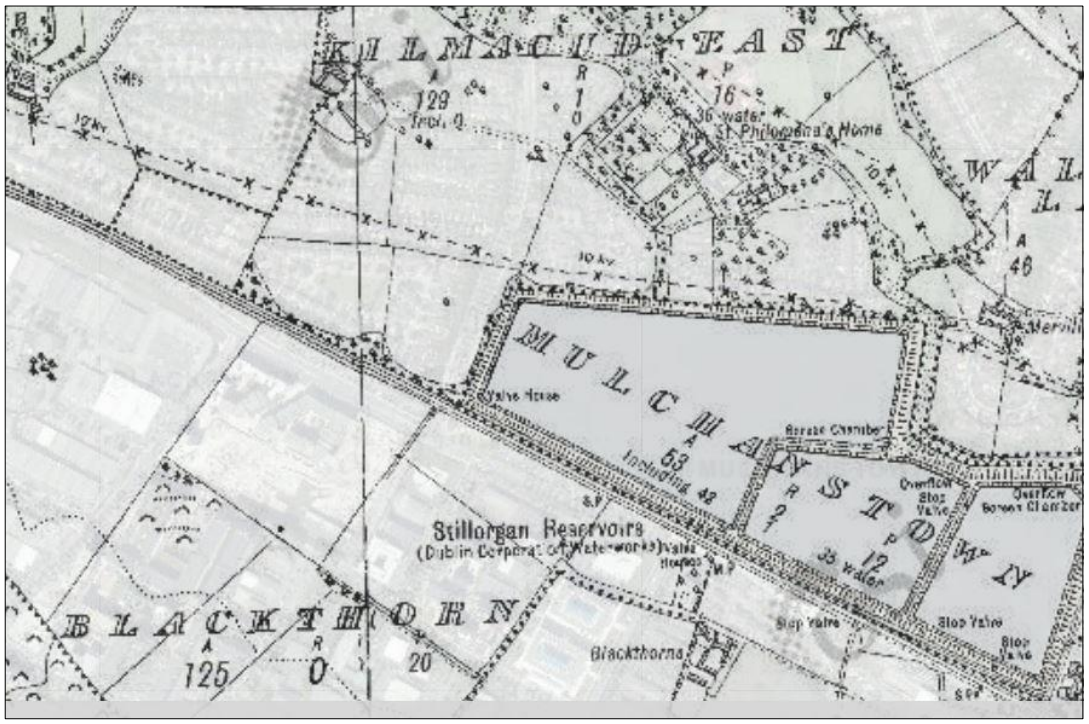

Figure 9.5: Approximate Location of the Proposed Development on the Cassini Map with the Adjacent Reservoir.

Source: Ordnance Survey Ireland.

9.3.5 Regional Soils

Made ground, concrete and tarmac covers the majority of the Dublin area as a result of development through the years. The majority of central Dublin has had some anthropogenic influence with made ground covering almost all of the central city and stretching out to the suburbs.

According to the National Soils Map also known as the Teagasc Soil Information System, the topsoil and subsoil beneath the site has been classified into one main category, made ground. This is expected given the site was previously developed. The topsoil of the surrounding area is also made ground. Refer to Figure 9.6 from the GSI online mapping for further information. GII's Ground Investigation Report noted Tarmac and/or Reinforced Concrete surfacing was noted throughout the entire site area.

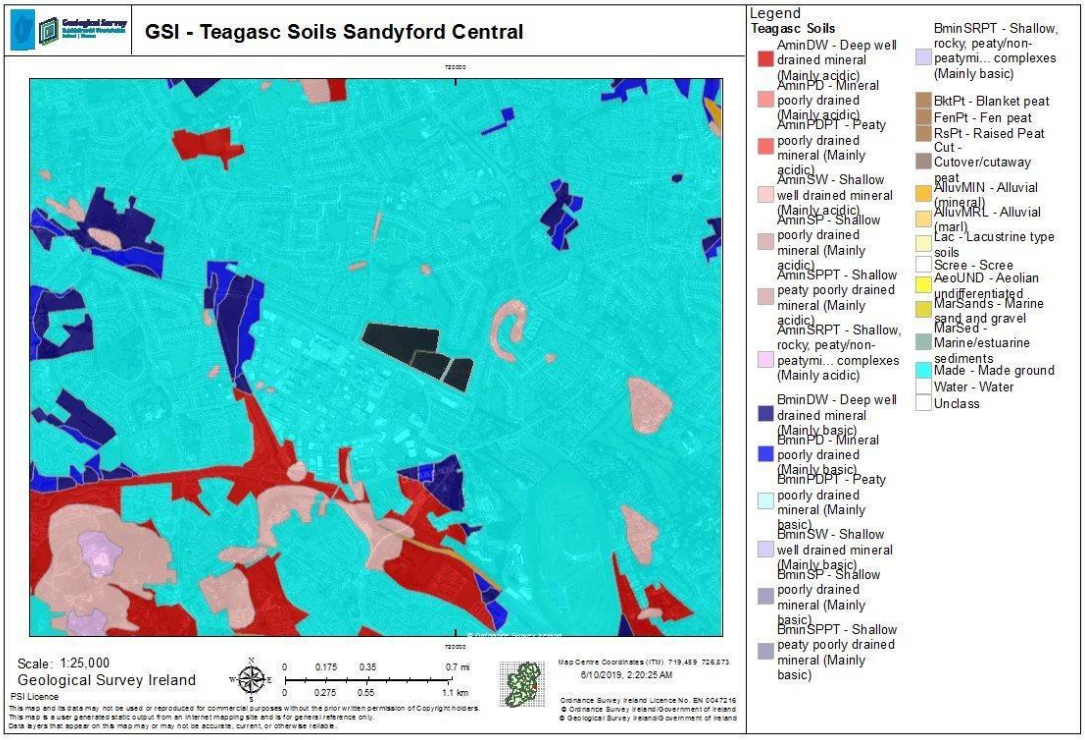

Figure 9.6: Teagasc Topsoils.

Quaternary sediments have been classified by the Geological Survey Ireland and are identified in Figure 9.7 below. The site is located overlying Limestone Till. However, further to the south lies Till derived from Granite.

Limestone Till is the dominant subsoil type in the region and is a glacial deposit which is known as Dublin Boulder Clay. This till resulted from glaciations which covered the region during the Pleistocene and Quaternary periods. It is known that the ice thickness in Dublin was c. 1km. The grinding action of this ice sheet as it eroded the underlying limestone and shale, together with the loading effect, resulted in the formation of a very dense low-permeability deposit with pockets of coarse gravel (Long et al, 2012). The lenses are generally less than 2m wide and less than 0.5m thick. They are generally self-draining within 24hrs and have poor interconnectivity.

Local withdrawal and recedence of the ice sheet led to the formation of fluvioglacial sediments (gravel and sand lenses) and glaciomarine sediments (stiff/firm laminated clays, silts and sands). The glacial deposits can exhibit significant lateral and vertical variations in grain size distribution over short distances.

Dublin Boulder Clay has been extensively studied and there are many publications describing its properties. Additionally, there are numerous examples of deep excavations (up to 25m) and constructions within Dublin Boulder Clay (e.g. Dublin Port Tunnel, Trinity College Library and Leinster House). Data and case history from these sites have shown that the walls in Dublin Boulder Clay are very rigid due to the inherent natural strength and stiffness of the material and the slow dissipation of excavation-induced depressed pore pressure or suctions (Long et al, 2012).

The recent construction of the Dublin Port Tunnel has allowed extensive study of Dublin Boulder Clay and four distinct formations within the clay have been identified namely; the upper brown boulder clay (UBrBC), the upper black boulder clay (UBkBC), the lower brown boulder clay (LBrBC) and the lower black boulder clay (LBkBC) (Skipper at al. 2005). The 2No. upper units are the most commonly encountered in excavations and hence are the most important from the point of view of retaining structures and basements.

Boulder clays generally exhibit very low permeability in the order of $1x10^{-7}$ to $1x10^{-9}$ m/s or lower. The glacial boulder clay will tend to act as an aquitard between the other more permeable formations namely the overlying made ground and the sands and gravels.

Immediately to the south of the site lies an area of Granite Till with an area of outcrop.

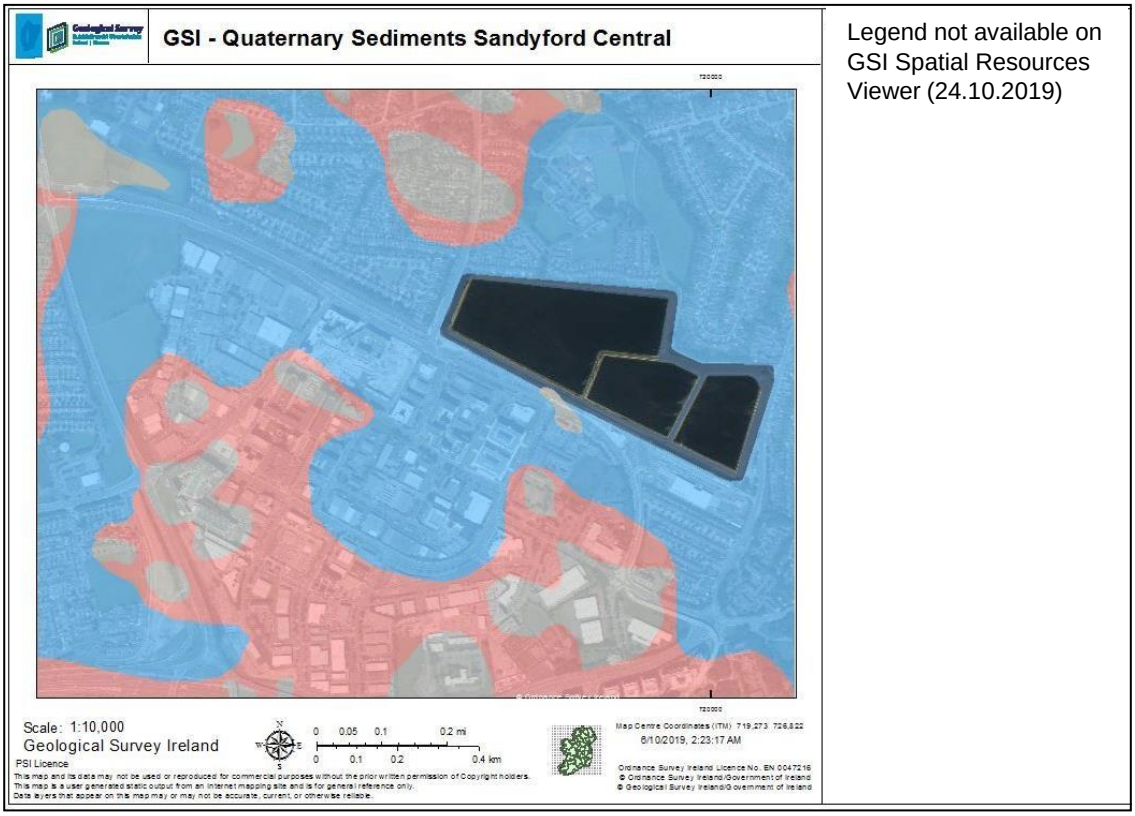

Figure 9.7: Teagasc Topsoils

9.3.6 Regional Geology

The bedrock of the Sandyford area consists of Caledonian (Silurian - Devonian) of the Type 2e equigranular (Northern and Upper Liffey Valley Plutons) Formation. It comprises pale grey fine to coarse-grained granite. The local bedrock geology mapped by the GSI is illustrated on Figure 9.8. The presence of granite bedrock was confirmed during the site investigation.

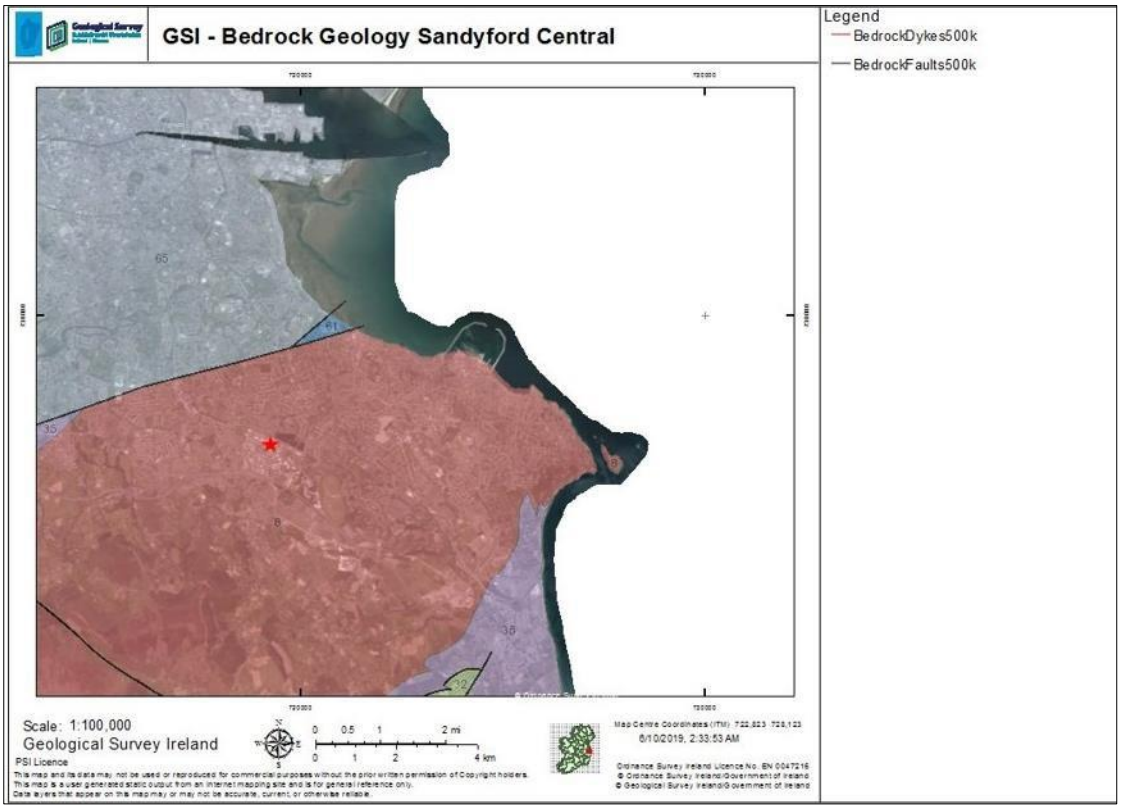

Figure 9.8: Local Bedrock Geology.

9.3.7 Local Soils & Geology

The site-specific site investigations have proven the topsoil and subsoil formations. The site investigation and the associated sampling completed by Ground Investigations Ireland (GII) took place during February to June 2019 and comprised the following:

1. Excavation of eight (8 No.) trial pits;
2. Excavation of two (2 No.) infiltration test trial pits;
3. Excavation of two (2 No.) Foundation Pits;
4. Drilling of ten (10 No.) rotary core boreholes;
5. Collection of subsoil samples for chemical analysis;
6. Logging and sampling of borehole arisings; and
7. Analysis of a selection of samples for geotechnical and chemical properties.

The GII site investigation records for the site, also indicate that the natural soils on site are generally cohesive deposits (clay), described as firm to stiff brown, grey or dark grey sandy gravelly CLAY with occasional cobbles and boulders. Gravel lenses were occasionally present in the glacial till throughout the site.

The geology of the site from the intrusive investigation can be summarised to be as follows:

- **SURFACING:** Tarmac or Reinforced Concrete was encountered in all the exploratory holes and was present to a maximum depth of 0.15 to 0.3m BGL. Tarmac surfacing was present typically to a depth of 0.05m to 0.24m BGL.
- **FILL/MADE GROUND:** Fill deposits were encountered beneath the Surfacing and was present to a relatively consistent depth of between 0.6m and 0.9m BGL and was typically described as Brown or Grey sandy clayey angular to sub angular Gravel (Crushed Rock Fill). Made Ground Deposits were encountered in TP3 and TP5 to a depth of 3.1m and 0.9m BGL respectively. These deposits were described generally as *brown or grey slightly sandy very gravelly CLAY with some cobbles and boulders and contained occasional fragments of plastic, concrete, red brick, metal glass and plastic.*
- **COHESIVE DEPOSITS:** Cohesive deposits were encountered beneath the Fill or Made Ground and were described typically as *firm or stiff brown, grey or dark grey sandy gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. The strength of the cohesive deposits typically increased with depth and was firm to stiff or stiff below 1.5m BGL in the majority of the exploratory holes with the exception of TP5 where it was noted as Firm to a depth of 3.1m BGL above rock. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.
- **GRANITE BEDROCK**: In trial pits TP1 and TP2 weathered rock was encountered which was excavatable with the JCB 3CX excavator to a depth of up to 0.8m below the top of the stratum. The trial pits were terminated upon encountering the more competent bedrock, in which further excavation became more difficult. This material was recovered typically as angular gravel and cobbles of Granite however there was some variability in the fracture spacing and the ease at which the excavator could progress. Some clay and sand were also present with the rock mass either from weathering or as infilling to fractures which were opened upon excavation.

  The rotary core boreholes recovered Granite Bedrock in each of the boreholes at depths of 1.5m to 5.5m BGL. The depth to rock varies from 1.5m BGL (79.8m OD) in BH04 and BH06 in the central portion of the site and is deeper towards the north eastern portion of the site to a maximum depth of 4.7m BGL (75.6m OD) in BH10. The total core recovery is good in the granite bedrock, typically 100% with some of the uppermost runs dropping to 80 or 90%. The SCR and RQD both are relatively poor in the upper weathered zone, often recovered as non-intact, however both indices show an increase with depth in each of the boreholes. The strength of the stratum varies from Extremely weak to Very Strong as noted on the logs with some portions of the core recovered as non-intact. The weathering is noted on the core logs and is typically distinctly weathered to partially weathered with occasional zones of where the granite was unweathered.

9.3.8 Soils Contamination Assessment

Demolition

The development will include demolition of the existing structures on site. The principle of demolishing the remaining structures on site was established under the previous permissions at the subject site - DLR. Reg. Ref.: D07A/0619 and more recently the SHD permission under ABP Ref.PL06.301428 (extant). An asbestos survey was undertaken by

Phoenix Environmental report dated 19th October 2019 which did not identify any asbestos containing materials.

A carefully planned approach to waste management and adherence to the site-specific Construction and Demolition Waste Management Plan (Appendix 15.1) during the construction phase will ensure that the effect on the environment will be short-term, neutral and imperceptible.

Therefore, demolition is not anticipated to have any significant impact on Land, Soils and Geology.

Waste Soil Classification

An assessment of soil contamination in the context of waste acceptance was carried out in the event that any surplus soil from the Site requires disposal off site during the Construction Phase. Samples of the soil have been analysed by GII for the presence of possible contaminants in order to check if historical pollution of the soil has occurred at the proposed development site and the associated impact on waste soil disposal, if required. In total 21No soil samples were assessed by GII using the HazWasteOnLine Tool. All samples were classified as non-hazardous.

Waste Acceptance Criteria (WAC) have been agreed by the EC (Council Decision 2003/33/EC) and are only applicable to material if it is to be disposed as a waste at a landfill facility. Each individual member state and licensed operators of a licence landfill may apply more stringent WAC. WAC limits and the associated laboratory analysis are not suitable for use in the determination of whether a waste is hazardous or non-hazardous. The level of selenium detected at TP-05 between 2m and 3.1m and TP-06 between 1m and 2.4m exceeded the inert WAC. The level of Selenium detected at TP-04 between 0.9m and 2m exceeded the stable non-reactive WAC.

Therefore in summary two number samples exceeded the inert WAC limits with the one sample exceeding the non-hazardous limits and is therefore hazardous. All other samples were within the inert WAC limits. GII have produced dig plans with levels indicating the type of soil sample taken in their Waste Classification Report (Appendix 9.2).

TPH was detected in the samples collected from TP-03 between ground level and 3.1m. The levels detected ranged for 130mg/kg between surface and 1m, 244mg/kg between 1m and 2m and 108m/kg between 2m and 3m. The levels of TPH are not significant enough to classify the waste as hazardous nor are the levels of mineral oil detected enough to exceed the inert criteria. The laboratory interpretation of the source of the TP is degrade diesel and lubricating oil. There was no identifiable source of diesel on site during the investigation and as such the diesel may be related to previous site activities.

All of the samples collected were screened for asbestos and no asbestos identified.

If any material is removed, it should be managed and undertaken by a competent contractor according to best practice and disposed of accordingly by a licensed waste disposal contractor. The information referenced above is to be used to assist the contractor.

WASTE CATEGORY	TITLE	CLASSIFICATION CATEGORY	POTENTIAL OUTLET
Category A	Inert Waste Criteria	Reported concentrations less than inert waste guidelines, which are based on waste acceptance criteria set out by the adopted EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002). Results found to be non-hazardous using the HazWasteOnline application.	Potentially suitable for reuse or recovery subject to Planning and/or Waste Permissions and acceptance criteria.
Category B1	Inert Waste Criteria	Reported concentrations less than inert waste guidelines, which are based on waste acceptance criteria set out by the adopted EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002). Results found to be non-hazardous using the HazWasteOnline application.	Disposal at Integrated Material Solutions (formerly Murphy's Hollywood Landfill) or Walshestown Restoration
Category B2	Inert (with elevated PAHs)	Acceptance Criteria as laid out in Waste Licence W0129-02 and W0254-01. Reported concentrations less than inert waste guidelines, which are based on waste acceptance criteria set out by the adopted EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002) with the exception of PAHs (Total 17 <100mg/kg). Results found to be non-hazardous using the HazWasteOnline application.	Disposal at Integrated Material Solutions (formerly Murphy's Hollywood Landfill) or Walshestown Restoration
Category C1	Non-Haz Criteria	Analytical results greater than Category A criteria but less than non- hazardous waste guidelines, which are based on waste acceptance criteria set out by the adopted EU Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 and Annex II of Directive 1999/31/EC (2002) no limit for TOC. Results found to be non-hazardous using the HazWasteOnline application.	Disposal/Recovery at licensed Landfill (Ballynagran, Corranure). Material can be sent for recovery as engineering material rather than disposed of (no landfill tax)

WASTE CATEGORY	TITLE	CLASSIFICATION CATEGORY	POTENTIAL OUTLET
Category C2	Non-Haz Criteria but with trace asbestos	Results as per C1 but with trace asbestos	Material will need to be disposed of at a licensed landfill if trace asbestos confirmed. If asbestos level is quantifiable then it may have to be disposed in N. Ireland or further abroad.
Category D	Hazardous	Analytical results found to be hazardous using the HazWasteOnline application.	None in Ireland (export) with the exception of Enva in Portlaoise.

Table 9.3: Soil Waste Categories.

In total 21 No. samples were collected during site investigation works. The results of the Waste Acceptance Criteria testing confirmed material complied with inert limits with the exception of 4No. samples of which 1 No. were classified as Non-Hazardous and 1No. as hazardous due to the presence of elevated Selenium.

	A Inert	B1 Inert (PAHs)	B2 Inert (PAHs)	C1 Non-Haz	C2 Non-Haz w/ trace asbestos	D Hazardous
No. of samples	17	0	0	3	0	1

Table 9.4: Soil Classification Results.

9.3.9 Radon

According to the EPA (now incorporating the Radiological Protection Institute of Ireland) between five and ten per cent of the homes in this 10km grid square are estimated to be above the Reference Level of 200 Bq/m^3. A High Radon Area is any area where it is predicted that 10% or more of homes will exceed the Reference Level.

9.3.10 Summary & Type of Geological/Hydrogeological Environment

Based on the regional and site-specific information included within this Chapter and

Chapter 10 (Water and Hydrology), the type of Geological Environment as per the IGI Guidelines is **Type A – Passive geological / hydrogeological environment**. A Type A – Passive geological

environment is one where typically there are areas of thick low permeability subsoil, and areas underlain by poor aquifers and recharge areas. On this site, while the thickness of subsoil is thin, the site is underlain by a poor aquifer. Type A environments are considered to be historically stable geological environments.

A summary of the site geology is outlined thus:

- The site is essentially a brownfield site with previous light industrial site use and current vacant status.
- The only known potential contamination sources on site include previous land use and made ground discussed in section 9.3.7;
- There are no expected potential pollutant linkages associated with the construction or operation phases of the site provided the mitigation measured in Table 9.6 are implemented;
- The subsoils predominantly comprise glacial till which comprises of a layer of fine to coarse sandy Gravel embedded among or between layers of Sandy Gravelly Clay (Dublin Boulder Clay);
- Depth to bedrock varied between 1.5 to 5.5 mbGL and the bedrock comprises Granite.
- There are two full basements, two semi- basements and two Lower Ground Basements proposed. The two Lower Ground and two semi-basements will reduce the requirement for significant soil removal, see section 9.2 for the proposed development description.

Accordingly, it is not considered that the Site is particularly sensitive from a geological perspective.

9.4 Potential Impact of the Proposed Development

The EPA Guidelines identify the terminology used for the Significance of Effects and have been summarised in Table 9-5 below.

Significance	Description
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends

Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive impact of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.

Table 9.5: Description of Effects.

9.4.1 Construction Phase

In line with EIA guidance, each potential impact for the Proposed Development should be described in terms of its Quality, Significance and Duration. The potential impacts, mitigation measures and resulting residual impacts have been combined in a Detailed Assessment Table presented in Section 9.6 (Table 9.6).

The potential geological impacts during the Construction Phase are presented in detail in Table 9.6 below and are outlined below.

Soil excavation
The primary impact on the geological environment that will occur due to the Proposed Development is soil excavation, as the Proposed Development will require removal of soil for basement construction. This is a certain and definite impact and will happen as a result of the Proposed Development. This is a moderate negative impact, as a result of excavation of boulder clay and bedrock i.e. change in the natural geological features.

Accidental spills / contaminated runoff
The Proposed Development also creates potential for accidental spills or contaminated run-off during the Construction Phase. It is considered unlikely that any spills would be sufficiently large to impact the geological environment regardless this potential has been assessed.

There is the potential for water (rainfall) to become contaminated with pollutants associated with construction activity. Contaminated water arising from construction sites can pose a significant risk to the geological environment if allowed to percolate into the soil matrix. The potential main contaminants include:

- Cement / concrete (pH) – arising from construction materials;
- Hydrocarbons – accidental spillages from construction plant or onsite storage; and
- Wastewater (nutrient and microbial rich) – arising from poor welfare facilities.

Imported fill and aggregates
The Proposed Development will require imported fill and aggregates to facilitate the construction works. There is a risk that contaminated / unsuitable fill material could be brought to the Site, and then the associated risk it would bring i.e. contaminating the existing uncontaminated material. This is an unlikely impact as only engineering quality material will be brought onto the Site.

Export of material from the Site
Site investigations have established that there is no significant contamination present on site. Nonetheless material, which is exported from the Site, if not correctly managed or handled

could impact negatively on human beings, both at and near the receiving site, as well as water and soil environments. The risk is very unlikely because all material will be removed and either disposed of or recovered in accordance with the Waste Management Act and in that regard deposited at appropriate facilities.

Potential Pollution Linkages

A critical element of the risk assessment process is the establishment of a Conceptual Site Model (CSM) for the site. A CSM describes the potential sources of contamination at a site, the migration pathways it may follow and the receptors it could impact. If complete source-pathway-receptor scenarios exist then there is a potential pollutant linkage that needs to be characterised and assessed (via formal risk assessment). All three elements need to be present for a viable risk to exist (e.g. if a source and receptor exist but no pathway is present then there is no pollutant linkage and hence no risk).

Sources

- The potential contamination sources identified on site are historical uses of the site which may have included fuel storage tanks, imported made ground, chemical use on site, and historic car parking on-site;
- There will be a source of potential contamination present on site during the construction phase (e.g. machinery oils, fuel, cement etc.);
- Run-off from construction sites can contain minor levels of pollutants (e.g. mineral oils) with high concentrations of suspended solids;
- Hydrogeology has been addressed in Chapter 9. If it is required to lower the water table it could have a negative impact on nearby buildings, as the water table is lowered as the absence of water will crated a void space and the soil particles will compress against each other to fill the void and hence settlement occurs; and
- There will be no significant sources of potential contamination present on site during the operational phase of the development.

Receptors

- The surrounding land (buildings), soils and geology constitute a receptor.

Pathways

- Migration of contaminants from surface spills to land, soils and geology constitutes a potential pathway;
- Migration of contaminated run-off (e.g. during construction phase or operational phase) to surrounding geology constitutes a potential pathway.

Potential Pollutant Linkages

An environmental risk is only present when a pathway links a source with a receptor. The potential pollutant linkage CSM for the Sandyford Central development is summarised in Table 9.6:

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Effective Mitigation

Deleterious materials stored on site during the Construction Phase	Migration of surface spills / contaminated run-off	Surrounding Land / Soils	Y	All materials stored on site will be subject to strict control measures and local containment measures (e.g. bunded tanks and pallets).

Source	Pathway	Receptor	Potential Pollutant Linkage (Y/N)	Effective Mitigation
Contaminated run-off from construction activities			Y	Generation of contaminated run-off will be reduced through the Construction Management Plan (discussed later in this Chapter under Mitigation) and control measures implemented during the Construction Phase.

Table 9.6: Conceptual Site Model (CSM) Pollutant Linkages Geology and Groundwater.

The mitigation measures set out in Table 9.6 above are discussed in further detail in later sections.

Effects assessed elsewhere in this EIAR

The impacts of the Proposed Development on soil and geology during the Construction Phase also relate to and interact with other Chapters within the EIAR specifically:

- Chapter 5, Population & Human Health
- Chapter 6, Archaeology & Cultural Heritage
- Chapter 7, Biodiversity
- Chapter 10, Water – Water-Hydrology
- Chapter 11, Air Quality & Climate
- Chapter 12, Noise and Vibration
- Chapter 14, Material Assets: Traffic and Transportation
- Chapter 16, Material Assets: Site Services (Civils)
- Chapter 17, Material Assets: Site Services (Utilities)

Although we acknowledge that interactions occur between the aforementioned chapters, the significant interactions are discussed below and within Chapter 18 – Interactions and Cumulative Impacts.

- Excavated and stripped soil can be disturbed and eroded by site vehicles during the

construction phase. Rainfall and wind can also impact on non-vegetated/uncovered areas within the excavation or where soil is stockpiled. This can lead to run-off with high suspended solid content which can impact on water bodies. The potential risk from this indirect impact to water bodies and/or habitats from contaminated water would depend on the magnitude and duration of any water quality impact.

- There is a potential for dust from excavations or stockpiles to impact on air quality. This is discussed further in Chapter 11 Air Quality and Climate.
- Construction phase dewatering may be required to excavate the basements and associated infrastructure and to maintain dry working conditions in the excavation (for rainfall). Pumped water will require discharge offsite (discharge to sewer). Potential for dewatering addressed in Chapter 10.
- Noise and vibration will be generated through the construction phase particularly during excavation work. It is anticipated that conventional excavation techniques (i.e. hard digging) will suffice. Noise and vibration impacts are considered in detail in Chapter 12, Noise and Vibration.
- The construction phase and any import or export of material to the site (as part of excavation or infilling works) will have implications for traffic in the surrounding road network. These impacts are considered further in Chapter 14 Material Assets: Traffic.
- As with all construction projects there is potential for water (rainfall and/or groundwater) to become contaminated with pollutants associated with construction activity. Contaminated water which arises from construction sites can pose a significant short-term risk to groundwater quality for the duration of the construction if contaminated water is allowed to percolate to the aquifer. This is discussed further in Chapter 10. The potential main contaminants include:
    - Suspended solids (muddy water with increase turbidity) – arising from excavation and ground disturbance;
    - Cement/concrete (increase turbidity and pH) – arising from construction materials;
    - Hydrocarbons (ecotoxic) – accidental spillages from construction plant or onsite storage; and contaminated groundwater within the site from previous site activities;
    - Wastewater (nutrient and microbial rich) – arising from poor on-site toilet and washrooms
- The interaction between Land, Soils and Geology and Waste is discussed in Section 15.12 of the Waste Chapter.

9.4.2 Operational Phase

During the Operational Phase of the Proposed Development there will be an imperceptible impact on the geological environment. There is no requirement for any fuel oil stores as all heating will the fuelled by mains gas therefore not potential source of contamination from fuel stores.

9.4.3 Do Nothing Scenario

In the 'Do Nothing' scenario, if the proposed development does not take place at Sandyford Central, the existing baseline conditions will remain and there would be no resulting additional impacts on the Land, Soils or Geology in the area of the project site.

9.5 Mitigation and Monitoring

9.5.1 Mitigation

This section describes a range of recommendations and mitigation measures designed to avoid, reduce or offset any potential adverse geological impacts identified.

9.5.1.1 Construction Phase Mitigation

In order to reduce the impacts on the soils and geology environment a number of mitigation measures will be adopted as part of the construction works on site. The measures will address the main activities of potential impact which include:

- Control of Soil Excavation and Export from Site;
- Sources of fill and aggregates for the project;
- Fuel and Chemical handling, transport and storage; and
- Control of Water during Construction.
- Incorporated Design Mitigation

Control of Soil Excavation

Topsoil and subsoil will be excavated to facilitate the formation of the basement levels, ramp access, construction of a new sewer and water mains connections, roadways and all other associated services. The project will incorporate the; reduce, reuse and recycle approach in terms of soil excavations on site. The construction will be carefully planned to ensure only material required to be excavated will be excavated with as much material left in situ as possible. All excavation arisings will be reused on site where possible/if suitable.

Soil stripping, earthworks and stockpiling of soil will be carried out during the works. Stockpiles have the potential to cause negative impacts on air and water quality. The effects of soil stripping and stockpiling will be mitigated through the implementation of an appropriate earthworks handling protocol during construction. It is anticipated that any stockpiles will be formed within the boundary of the excavation and there will be no direct link or pathway from this area to any surface water body.

Dust suppression measures (e.g. damping down during dry periods), vehicle wheel washes, road sweeping and general housekeeping will ensure that the surrounding environment are free of nuisance dust and dirt on roads.

Export of material from Site

Where material cannot be reused off site it will be sent for recovery/disposal at an appropriately permitted/licenced site. This is discussed further in the Construction and Demolition Waste Management Plan.

Site investigations have established that the majority of samples are suitable for an inert facility with the exception of two samples that indicated non-hazardous classifications due to elevated concentrations of selenium. All material will be managed according to the applicable Waste Management Acts and subsequent regulations. Nonetheless material which is exported from site, if not correctly managed or handled, could impact negatively on site human beings (offsite) as well as water and soil environments.

Additional Soil Classification may be required as part of the site development and regardless control of any material will be carried out in accordance with the Waste Management Act and further details are included in the Construction Management Plan and the Construction and Demolition Waste Management Plan.

Sources of Fill and Aggregates

All fill and aggregate for the project will be sourced from reputable suppliers. All suppliers will be vetted for:

- Aggregate compliance certificates/declarations of conformity for the classes of material specified for the project;
- Environmental Management status; and
- Regulatory and Legal Compliance status of the Company.

The use of fill and aggregate containing recycled or recovered materials shall be considered.

Fuel and Chemical Handling

The following mitigation measures will be taken at the construction site in order to prevent any spillages to ground of fuels and prevent any resulting soil and/or groundwater quality impacts:

- Designation of bunded refuelling areas on the site (if required);
- Provision of spill kit facilities across the site;
- Where mobile fuel bowsers are used the following measures will be taken:
  - Any flexible pipe, pump, tap or valve will be fitted with a lock and will be secured when not in use;
  - All bowsers to carry a spill kit and operatives must have spill response training; and
  - Portable generators or similar fuel containing equipment will be placed on suitable drip trays.

In the case of drummed fuel or other potentially polluting substances which may be used during construction the following measures will be adopted:

- Secure storage of all containers that contain potential polluting substances in a dedicated internally bunded chemical storage cabinet unit or inside concrete bunded areas;
- Clear labelling of containers so that appropriate remedial measures can be taken in the event of a spillage;
- All drums to be quality approved and manufactured to a recognised standard;
- If drums are to be moved around the site they should be done so secured and on spill pallets; and
- Drums to be loaded and unloaded by competent and trained personnel using appropriate equipment.

The aforementioned list of measures is non-exhaustive and will be included in the outline Construction Management Plan.

Construction Management Plan

In advance of work starting on site, the works Contractor will author a Construction

Methodology document taking into account their approach and any additional requirements of the Design Team or Planning Regulator. The Contractor will also prepare a Construction Management Plan and Environmental Plan. The Construction Management Plan sets out the overarching vision of how the construction of the project will be managed in a safe and organised manner by the Contractor with the oversight of the Developer. The CMP is a living document and it will go through a number of iterations before works commence and during the works. An outline version of the Construction Management Plan is submitted in support of this application under separate cover. It will set out requirements and standards which must be met during the construction stage and will include the relevant mitigation measures outlined in the EIAR and any subsequent conditions relevant to the project.

Control of Water during Construction

Run-off from excavations/earthworks cannot be prevented entirely and is largely a function of the prevailing weather conditions. Earthwork operations will be carried out such that surfaces, as they are being raised, shall be designed with adequate drainage, falls and profile to control run-off and prevent ponding and flowing. Care will be taken to ensure that exposed soil surfaces are stable in order to minimise erosion. All exposed soil surfaces will be within the main excavation site which limits the potential for any offsite impacts. All run-off will be prevented from directly entering into any water courses.

During the different basement construction, after the Made Ground has been dug, it is possible water collection will occur and that a discharge licence will likely be required to enable discharge of water to sewer to keep the excavation dry. Should any discharge of construction water be required during the construction phase, discharge foul sewer will be regulated under a Discharge Licence obtained from the Regulator (Irish Water) issued under the Water Pollution Act. Attenuation, pre-treatment and monitoring of discharge water will likely be required under any Discharge Licence (Section 16 Licence). Pre-treatment and silt reduction measures on site will include a combination of silt fencing, settlement measures (silt traps, silt sacks and settlement tanks) and hydrocarbon interceptors. Active treatment systems such as Siltbusters or similar may be required depending on turbidity levels and discharge limits. Qualitative and quantitative monitoring will be implemented as per the Conditions of any Discharge Licence.

Incorporated Design Mitigation

In order to reduce the impact of the development on the lands and soils of the site, the proposed basement depth was optimised to keep the excavations required to a minimum, and hence this will reduce the amount of soils to be exported off-site and a reduction in machinery operation time. It is proposed that where soils are to be exported off-site, a local facility will be chosen where feasible, and hence reduce the carbon footprint associated with the transport and handling of the material.

9.5.1.2 Operational Phase

During the Operational Phase of the Proposed Development there will be an imperceptible impact on the geological environment from site activities.

The proposed scheme will have a combination of district and local heating systems all of which will be fuelled by mains gas. Therefore, there is no requirement for fuel oil storage removing any potential source of soil contamination.

9.5.1.3 Do Nothing Scenario

In the case where the Proposed Development was not developed no mitigation measures would be required

9.5.2 Monitoring

9.5.2.1 Construction Phase

- Monitoring of the water discharged to sewer shall be carried out as specified in any Discharge Licence associated with the Construction Phase of the Proposed Development.
- Record keeping and monitoring of import and export of materials shall be carried out in accordance with the Waste Management Act. Regular auditing of construction/mitigation measures will be undertaken (e.g. concrete pouring, refuelling in designated areas etc.).

No additional monitoring required as part of the Construction Phase.

9.5.2.2 Operation Phase

No monitoring required as part of the Operation Phase.

9.6 Residual Impact Assessment

The predicted residual impacts of the proposal are outlined in the Detailed Assessment in Table 9.7.

9.6.1 Construction Phase

The predicted impacts of the construction phase are described in Table 9.7 in terms of quality, significance, extent, likelihood and duration. The relevant mitigation measures are detailed and the residual impacts are determined which take account of the mitigation measures.

The primary residual impacts from the construction phase is the excavation of material to facilitate the basement construction. These impacts are unavoidable given the nature, requirement and design of the proposed development.

9.6.2 Operational Phase

During the Operational Phase of the Sandyford Central development site there is very limited to no potential impact on the geological environment of the area. There is no requirement for any fuel oil stores as all heating will the fuelled by mains gas.

9.6.3 'Do Nothing' Scenario

In the event that the Sandyford Central development does not progress, there would be no resulting additional impacts on the geological environment in the area of the project site.

9.6.4 Risk to Human Health

There is no apparent risk to human health, due to changes in the geological environment, resulting from this project.

9.6.5 Cumulative Effects with other Existing/Approved Developments

The cumulative impacts take into account the combined effects of the proposed development and other proposed projects in the surrounding area. Cumulative impacts occur as a result of actions taking place in the same area and within the same timeframe as the proposed 'Sandyford Central' development.

The site is located within the Sandyford Urban Framework Plan 2016-2022 which was adopted as Appendix No. 15 to the County Development Plan 2016-2022. According to the Plan, the site is zoned 'Zone 1: Mixed Core Area – Inner Core'.

Planning has been granted by An Bord Pleanála (Reg. Ref. ABP-304405-19) for the adjacent site, Rockbrook, by IRES Residential Properties Limited for Strategic Housing Development. The development, which is known as RB Central with a total gross floor area of c. 41,347 sq m (excluding basements) will consist of 428 no. apartments comprising two blocks arranged around two courtyards ranging in height from five to fourteen storeys (including ground floor mezzanine, all over three existing part-constructed basement levels) comprising 32 No. studio apartments; 122 No. 1 bedroom apartments; 251 No. 2 bedroom apartments and 23 No. 3 bedroom apartments. The development will also include a crèche (486 sq m) with ancillary outdoor play areas; 4 No. ground floor local/neighbourhood retail units (862 sq m); communal community residents' facilities (934 sq m in total).

Given the basements proposed (two full, two semi-basements and two Lower Ground) and the omission of full basement for four structures, the cumulative impact of the basement excavations for the Sandyford Central development combined with the nearby already built basements is slight negative on the surrounding land and soils environment.

Constraint		Impact Assessment							
Activity/ Source	**Construction Element**	**Impact Description**	**Quality**	**Significance**	**Extent**	**Likelihood**	**Duration**	**Mitigation**	**Residual Impact**
Earthworks	Site Clearance Basement Excavation Basement Construction	Excavation of Natural Soils and Subsoil for basements, attenuation tanks, drainage etc.	Negative	Moderate	Local	Certain	Permanent	The minimum amount of space to construct the project has been designed for. Material will be reused on site where possible.	Slight Negative
Earthworks	Basement Excavation	Soil erosion causing airborne dust and/or nuisance dust on public roads and neighbouring properties	Negative	Slight	Local	Unlikely	Short-term	Dust suppression measures will be implemented to minimise dust generation during extended dry periods. Dust monitoring will be conducted throughout the excavation period. Vehicle wheel wash facilities will be installed at site exits and a road sweeping programme will be implemented	Imperceptible
Earthworks Altering Groundwater/ Surface water	Basement Excavation	A degree of fill will be required during the works which will include imported fill and	Negative	Slight - Moderate	Local (maybe a number of quarry sites)	Likely	Long-term	Contract and Procurement Procedures will ensure that all aggregates and fill material required for the construction are sourced from reputable suppliers. Declarations of conformity/compliance certificates will be required to ensure all	Imperceptible

Constraint		Impact Assessment							
Activity/ Source	**Construction Element**	**Impact Description**	**Quality**	**Significance**	**Extent**	**Likelihood**	**Duration**	**Mitigation**	**Residual Impact**
	Basement Excavation							aggregates supplied meet the specified engineering specifications.	
	Basement Construction	Excavation of a volume of Made ground within site	Positive	Slight	Local	Likely	Long-term	Made ground will have been classified in accordance with the Waste Soil Acceptance criteria as part of the site investigation and disposed of at the relevant suitable facility. Where soil is classified as suitably inert, it will be reused were possible in the build.	Imperceptible
Storage of potentially polluting materials	Site Clearance and Basement Excavation	Potential leak or spillage from construction related liquids on site	Negative	Significant	Local	Unlikely	Short-term	Good housekeeping on all project sites and proper handling, storage and disposal of any potentially polluting substances can prevent soil and/or water contamination. Designated and bunded storage areas will be maintained.	Imperceptible

Constraint		Impact Assessment							
Activity/ Source	**Construction Element**	**Impact Description**	**Quality**	**Significance**	**Extent**	**Likelihood**	**Duration**	**Mitigation**	**Residual Impact**
Discharge to Ground	Basement Excavation and Construction General Construction	Potential contaminated run-off percolating to ground and the underlying aquifer	Negative	Significant	Local	Unlikely	Short-term	There will be no direct discharge to groundwater or land during construction. However indirect discharges to the underlying bedrock aquifer and land may occur and the aquifer vulnerability will increase, albeit not significantly given the thickness of Boulder Clay beneath the site, as the subsoil is removed from site. Protection of groundwater and land from potentially polluting substances will be dealt with through a number of measures including correct handling and storage of potentially polluting substances.	Imperceptible

Table 9.7: Impact Determination – Construction Phase.

9.7 Summary

9.7.1 Summary of Likely Significant Environmental Effects

Based on the regional and site-specific information available the type of Geological / Hydrogeological Environment as per the IGI Guidelines is Type A – Passive geological / hydrogeological environment.

The Proposed Development will not give rise to any likely significant long-term effects. Slight negative short-term effects will be experienced during the Construction Phase with the removal of soil for basement construction.

9.7.2 Summary of Proposed Mitigation and Monitoring Measures and Their Influence on Design

Proposed mitigation and monitoring measures relate to the Construction Phase only and are summarised under the following aspects:

- Control of soil excavation and export from Site.
- Sources of fill and aggregates for the project.
- Fuel and chemical handling, transport and storage.
- Control of water during the Construction Phase.
- Monitoring shall be carried out as specified in any Discharge Licence associated with the Construction Phase of the Proposed Development.
- Record keeping and monitoring of import and export of materials shall be carried out in accordance with the Waste Management Act.

9.7.3 Summary of Residual Impacts

The primary residual impact from the Construction Phase is the excavation of material to facilitate the different basement construction. This impact is unavoidable given the nature, requirement and design of the Proposed Development. The significance of this impact will be diminished through; the reduction of the amount of material requiring excavation through the design; management of work on site; reuse of material on site where possible and reuse of material offsite where possible. While the effect from excavation will be slight negative, overall the effect of the project will be not significant.

9.8 References and Sources

The sources for the geology desk study were sourced from the following:

- Environmental Protection Agency Envision Data Viewer: http://gis.epa.ie/Envision
- Environmental Protection Agency (2017). Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Draft)
- Farrell, E.R., and Wall D. (1990). Soils of Dublin, Institution of Engineers of Ireland, 115, 78-9.
- Geological Survey of Ireland Geotechnical Data Viewer

http://spatial.dcenr.gov.ie/GeologicalSurvey/GeoTechnicalViewer/index.html
- Geological Survey of Ireland National Groundwater Viewer http://spatial.dcenr.gov.ie/GeologicalSurvey/Groundwater/index.html
- Geological Survey of Ireland General Data Viewer http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple
- Geological Survey of Ireland GeoUrban Data Viewer http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GeoUrban
- Geological Survey of Ireland Quaternary Geology map of Dublin.
- Geological Survey of Ireland Geotechnical Database (Reports No 1069, 56, 4901, 392, 707, 4688 and 4690).
- Looby, M. & Long, M. Deep Excavations in Dublin, Recent Developments. Paper first presented to a meeting of the Geotechnical Society of Ireland at Engineers Ireland, 22 Clyde Rd, Dublin 4, on 11th December 2007.
- Long, M., Brangan, C., Menkiti, C., Looby, M. & Casey, P. 2012. Retaining walls in Dublin Boulder Clay, Ireland. Proceedings of the ICE – Geotechnical Engineering [Online], 165. Available: http://www.icevirtuallibrary.com/content/article/10.1680/geng.9.0091.
- Long, M. & Menkiti, C.O (2007). Geotechnical Properties of Dublin Boulder Clay. Geotechnique, No. 7, 595-611.
- Long, M. & Murphy, B. (2003). Difficulties with Ground Anchorages in Hard Rock in Dublin, Ireland. Geotechnical & Geological Engineering, 21, 87-111.
- Metro North Railway Order Application – An Bord Pleanála Further Information Request, Item 19 Groundwater and Hydrogeology, Pages 18-34, 2010.
- McConnell, B. and Philcox, M., (1994). Geology of Kildare-Wicklow: A geological description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 16, Kildare-Wicklow. Geological Survey of Ireland.
- Skipper, J., Follett, B., Menkiti, C.O., Long, M. & Clark-Hughes, J. (2005). The engineering geology and characterisation of Dublin Boulder Clay, QJEGH, 38, 171-187.

In addition to the general relevant sources listed the following site-specific information sources were reviewed as part of the baseline data collection:

- Ground Investigations Ireland (GII) Report 2019 (Appendix 9.1).