7.0 LAND AND SOILS

7.1 INTRODUCTION

This section of the Environmental Impact Assessment Report (EIAR) has been prepared by DBFL Consulting Engineers and assesses the impact of the proposed development on the land and soils during the demolition, construction and operational phases of the proposed development. It will also identify the characteristics, predicted impact and mitigation measures arising from the different phases. This chapter was prepared by John Keogh, CEng, MIEI, PMP, PgDip, DipBs.

7.2 STUDY METHODOLOGY

Information on land and soils for the subject lands was assembled from the following sources:

- Site Investigation Reports;
- Geological Survey of Ireland (GSI) maps;
- Environmental Protection Agency (EPA) maps.

A site investigation of the lands was carried out by IGSL Ltd in August 2008 and 2016. The site investigations comprised twenty trial pits, thirty-two boreholes and thirty-five CBR tests, the results of which were described in interpretive reports. The bedrock Geology Map produced by the Geological Survey of Ireland (GSI) was also consulted. A plan showing the locations of these is included in drawing no. 163056-3080 in Appendix 7.1 of this chapter of the EIAR.

The assessment of the potential impact of the proposed development on the land and soils was carried out according to the methodology specified by the EPA and the specific criteria set out in the Guidelines on Information to be Contained in an Environmental Impact Statement (EPA 2002 and 2017 Draft), EIA Directive 2014/EU/52, Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA 2003), EPA Draft EIAR Guidelines 2017, Environmental Impact Assessment (EIA), Guidance for Consent Authorities Regarding Sub-Threshold Development (DoEHLG 2003), Development Management Guidelines (DoEHLG, 2007) and Guidelines for Planning Authorities and An Bord Pleanala on Carrying out Environmental Impact Assessments (DoECLG, March 2013).

7.3 THE EXISTING RECEIVING ENVIRONMENT

The subject lands are known as Clay Farm, forming part of the agricultural holding associated with Clay Farm house to the south west (which is located outside the Phase 1 and 2 landholding). The existing Phase 1 site (currently under construction, planning reg. ref. D15A/0247) is bounded by Ballyogan Road and the Luas Line “B” to the north east, an ESB substation to the east, and the Ballyogan Stream with the Phase 2 future development lands beyond to the south-west. The residential developments of Elmfield and Castle Court are located to the west of the Phase 1 site.

The Ballyogan Stream runs through the Eco Park, along the south of the Phase 1 lands and separates the Phase 1 site and the Phase 2 future development lands. The residential developments of Stepaside Park and Cruagh Wood are located to the south-west and south of the Phase 2 lands. There is an existing golf course to the east of the Phase 2 site with farm land on the western border.

The Phase 2 lands are greenfield in nature, and are currently used for agricultural purposes. A bridge over the Ballyogan Stream will be constructed as part of the Phase 2 application linking the Phase 1 and Phase 2 developments.

The total area of the Phase 1 and Phase 2 lands in the applicant's ownership is c. 34 hectares. This application relates to Phase 2 of the overall development of these lands and the application site area measures 20.5 hectares.

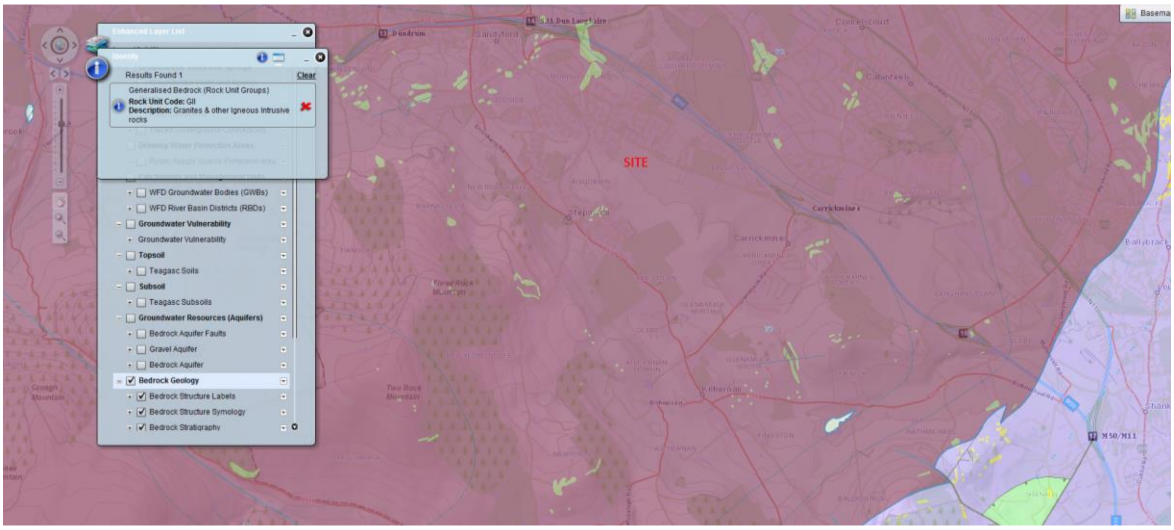
The existing ground consists of an average depth of 300mm topsoil. From the observed boreholes and trial pits, upper deposits of clay were discovered; this clay was underlain by sandy gravel in several locations. Solid bedrock was determined between approximately 3.8m and 7m and consists of strong grey brown granite.

The site investigation reports indicate that while the gravelly clays are glacial in origin, the upper deposits show indications of fluvio-glacial deposition where various stages of melting and freezing have resulted in inter-bedded clays and gravels. In addition, the near-surface material is finer grained as a result of weathering.

7.3.1 BEDROCK GEOLOGY

The bedrock geology of this area is of the Generalised Bedrock Type and is identified as rock unit GII (Granite and other Igneous Intrusive Rocks). Refer to Figure 7.1 below.

Figure 7.1: Bedrock Mapping of Area by GSI



7.3.2 SUBSOIL (QUATERNARY) GEOLOGY

The quaternary period is the most recent stage of the geological time period. It marks the period of the Ice Age and the postglacial period which extends to the present day. Most surface deposits were deposited in the Quaternary Period and provide the parent materials for the soils in the area.

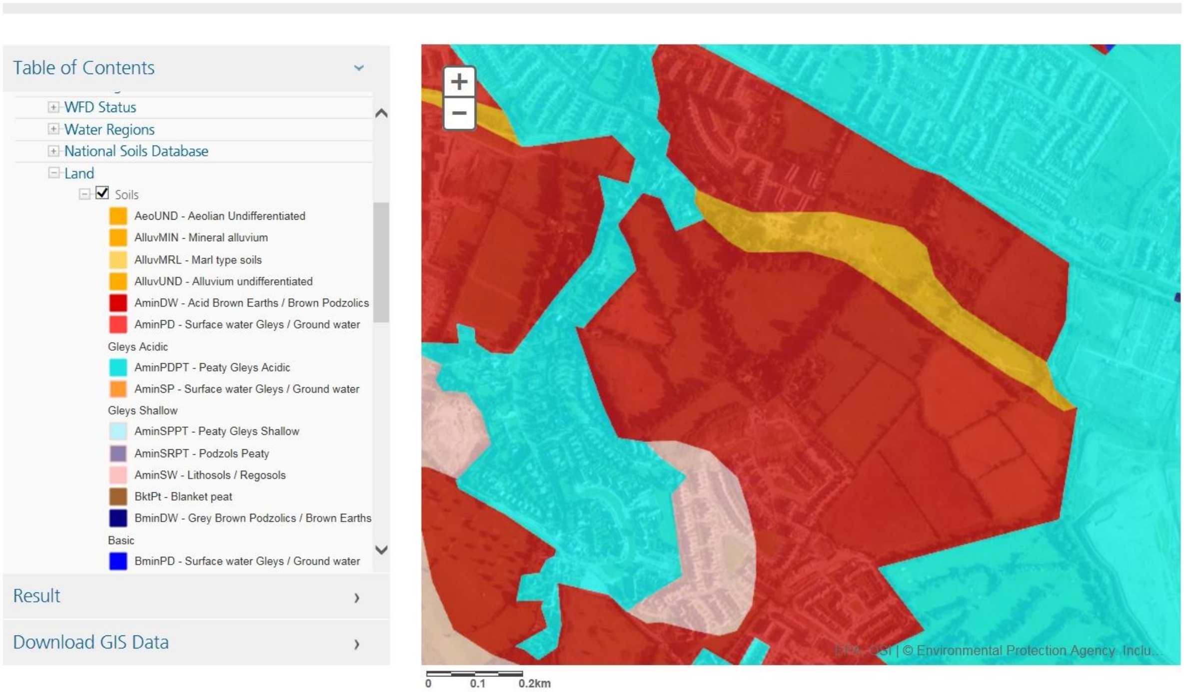
Most sediments of the Quaternary period were deposited during the Ice Age itself either directly from the huge ice sheets or by meltwater from the sheets as they melted. Ice sheets would have slowly eroded the underlying bedrock producing sediment. This sediment may include particles of all sizes ranging from clay to boulder and which when spread over the surface by glacial ice, takes the form of till (boulder clay). Alternatively, sediment may be carried and sorted by meltwater and deposited as sand and gravel, with silt and clay deposited separately in lake systems or carried away to the sea. Glacial deposits therefore contain fragments of the type of bedrock over which the ice originally passed.

The Site Investigations reports indicate that while the gravelly clays are glacial in origin, the upper deposits show indications of fluvio-glacial deposition where various stages of melting and freezing have resulted in interbedded clays and gravels.

7.3.3 SOILS

The EPA soils map indicates the predominant soil type in the development area to be Acid Brown Earths / Podzolics, with Alluvium along the route of the Ballyogan Stream. An extract from the EPA soils map relevant to Carrickmines is detailed in Figure 7.2 below.

Figure 7.2: Extract from EPA Soils Mapping



Site investigation information available for the majority of the Phase 1 and Phase 2 landholding indicates that the subsoil material generally comprises sandy gravelly clays overlying granite bedrock.

7.3.4 HYDROGEOLOGY

Regional Hydrogeology

Groundwater can be defined as water that is stored in, or moves through, pores and cracks in sub soils. Aquifers are rocks or deposits that contain sufficient void spaces and which are permeable enough to allow water to flow through them in significant quantities. The potential of the rock to store and transport water is governed by permeability, of which there are two types, intergranular and fissure permeability.

Intergranular permeability is found in sediments, sands, gravels and clays. Fissure permeability is found in bedrock, where water moves through (and in stored in) cracks, fissures, planes and solution openings.

When considering groundwater, it is important to consider the underlying geology, its complexity including faults, the large amounts of water and rainfall available for recharge and the overlying Quarternary deposits. The bedrock geology of this area is of the Generalised Bedrock Type and is identified as rock unit GII (Granite and other Igneous Intrusive Rocks). The bedrock mapping for the area as defined in the GSI is included as Figure 8.1 below.

The Geological Survey of Ireland has devised a system for classifying the aquifers in Ireland based on the hydrogeological characteristics, size and productivity of the groundwater resource. The three main classifications are Regionally Important Aquifers, Locally Important Aquifers and Poor Aquifers.

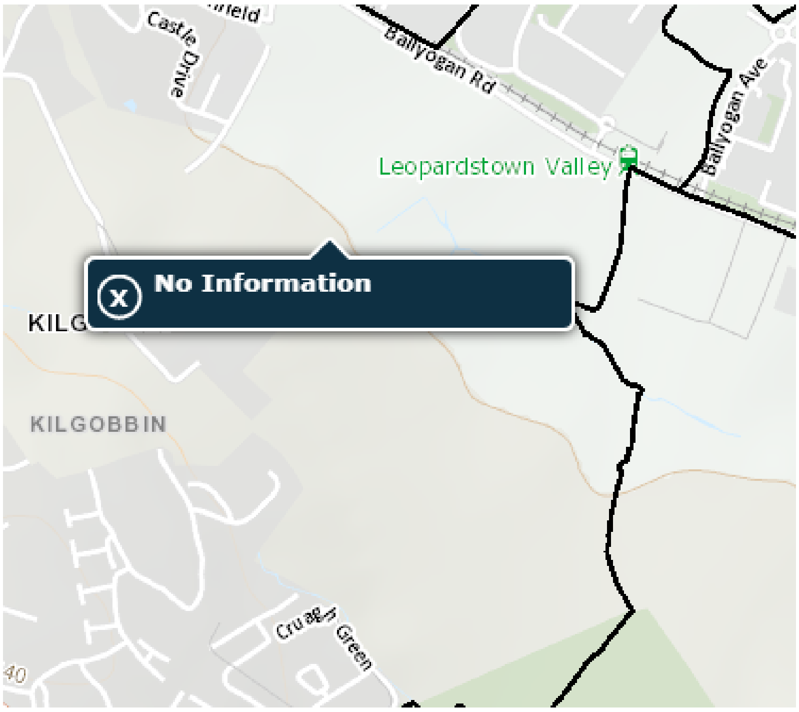
The bedrock underlying the study area is classified by the GSI as a Poor Aquifer which is generally unproductive except for local zones and the site consists primarily of Till (TLs) with no karst features in this area. Groundwater vulnerability is High.

An infiltration test was carried out on site in accordance with the BRE Digest 365 and an infiltration rate of 0.033m/hr (or $9.2x10^{-7}$m/s) was recorded.

Figure 7.3: Extract from GSI Quarternary Mapping

There are no groundwater wells or springs recorded on the GSI Quaternary mapping on or near the site.

Figure 7.4: Extract from GSI Groundwater Data Viewer showing groundwater wells and springs



Notwithstanding the above, following a site inspection by the project ecologist, a potential calcareous spring, was discovered at approximate location shown in Figure 7.5 below.

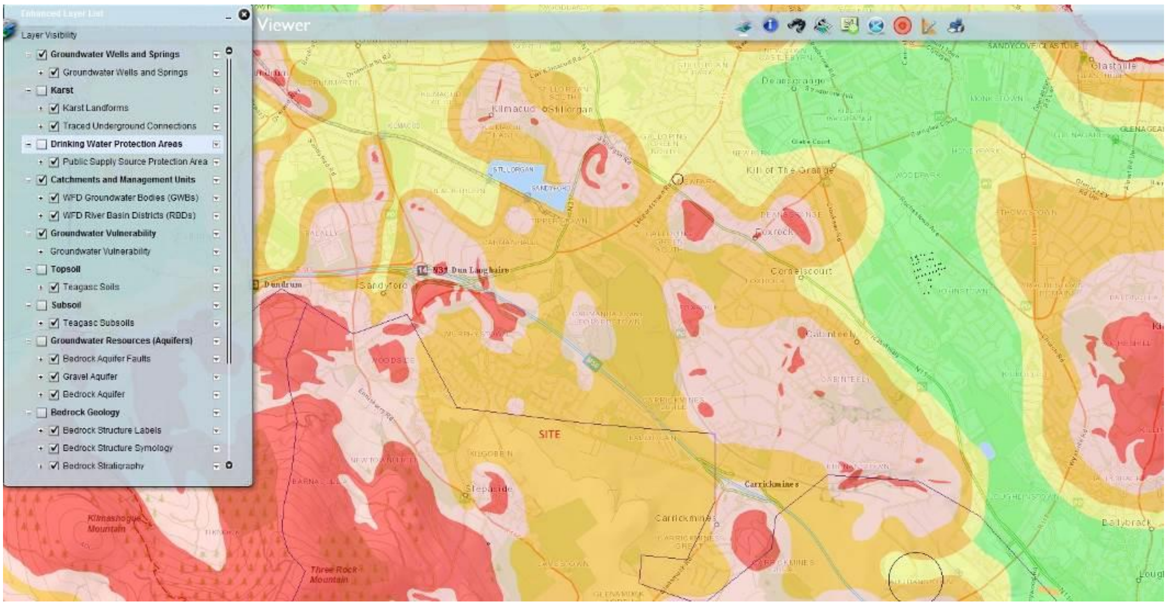
Figure 7.5: Location of calcareous spring

Groundwater vulnerability

Aquifer or groundwater vulnerability is a relative measure of the ease with which the groundwater could be contaminated by human activity and depends on the aquifer's intrinsic geological and hydrogeological characteristics. The vulnerability is determined by the permeability of any overlying deposits. For example, bedrock with a thick, low permeability, clay-rich overburden is less vulnerable than bedrock with a thin, high permeability, gravelly overburden.

Groundwater vulnerability categories are defined by the GSI as – Extreme rock at or near surface or karst (X), Extreme (E), High (H), Moderate (M) and Low (L) for mapping purposes and in the assessment of risk to ground waters. The classifications are based on the thickness and permeability of the sub-soils overlying the aquifer. The GSI has classified the aquifer vulnerability underlying the site as High.

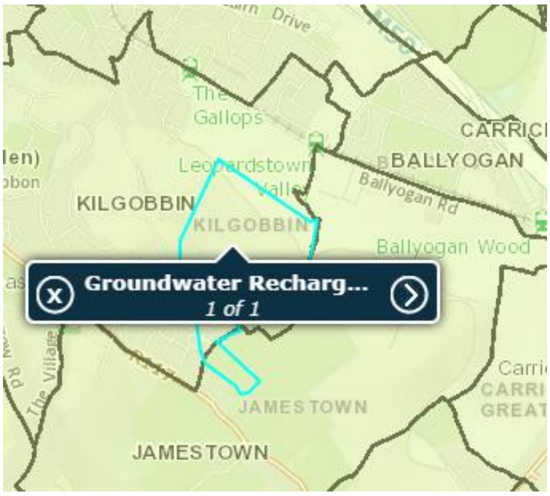
Figure 7.6: Extract from GSI Groundwater Vulnerability Mapping



Recharge

Effective rainfall is the amount of rainfall available as either recharge to ground or run-off to surface water after evaporation or taken up by plants and is 642mm/yr. The recharge coefficient, which is the proportion of effective rainfall to recharge groundwater, is 60%. Recharge is the amount of rainfall that replenishes the aquifer, it is a function of the effective rainfall, the permeability and thickness of the subsoil and the aquifer characteristics. According to GSI the maximum recharge capacity to the bedrock is 100 mm/yr across the site.

Figure 7.7: Extract from GSI Groundwater Data Viewer



Groundwater Recharge (mm/yr):

Effective Rainfall	642
GW Vulnerability	H
Subsoil Permeability	M
Soil Drainage	DRY
Subsoil Type	
PEAT	NOT PEAT
Peat Area(In SG Aquifer)	0.00
Sand / Gravel Subsoil	NOT SG_SUBSOIL
Aquifer Category	
Sand/Gravel Aquifer	
Hydrogeological Setting	2.v
Recharge Coefficient (%)	60.00
Recharge-mm/year-*Pre-Cap	100
Recharge Cap Apply?	Y
Maximum Recharge Capacity (mm/yr)	100
Average Recharge (mm/yr)	
GW Vulnerability Description	High
Subsoil Permeability Description	Moderate
Subsoil Description	Till derived chiefly from granite
Aquifer Description	Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
Hydrogeological Setting Description	Moderate permeability subsoil overlain by well drained soil

Site Hydrogeology

Site investigation data shows the groundwater level in the site at the time of investigation approximately 1m below ground. The hydraulic conductivity of the clay is of the order of $1x10^{-8}$m/s (low to medium) as shown by the infiltration test carried out on site.

Groundwater Quality

Under the requirements of the Water Framework Directive, the Dublin groundwater body was classified as having an overall good status for water quality and quantity 2010-2015. However, it is classified as ‘at risk’ of not achieving at least good ecological or good chemical status/potential by 2015. No site specific water quality data is available from the site investigation.

Groundwater Flood Risk

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during later winter/early spring when the groundwater table is already high. If the groundwater level rises above surface level, it can pond at local points and cause periods of flooding. As stated in above, groundwater levels were found to be at approximately 1m below ground level, however this could also represent rainfall which cannot drain quickly enough through the low permeability till. The risk of groundwater flooding is therefore considered to be low to medium.

7.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed Phase 2 development under consideration involves the construction of 927 no. residential units (365 no. houses and 562 no. apartments), a childcare facility of 607 sq.m and 2 no. retail units each with a GFA of 85 sq.m and includes the associated section of the Clay Farm Loop Road from the bridged link with Phase 1 to the south western site boundary, associated internal roads, pedestrian and cycle paths, open space, and all associated site and infrastructural works. Vehicular access will be from the Ballyogan Road signal controlled junction through the completed Phase 1 lands and across a new bridge over the Ballyogan Stream linking Phase 1 and Phase 2. A further vehicular connection will be provided to Cruagh Wood housing estate to the south.

Surface water drainage (including Sustainable Drainage Systems - SuDS), foul water drainage, water supply and road network will be constructed to service the proposed development.

It is envisaged that all structural loads will be carried to either bedrock or the over-lying layers of stiff brown clay, by use of conventional foundations. These will generally be situated beneath load bearing walls.

Surplus materials from these excavations will be disposed of off-site.

7.5 POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

The predicted impacts of the proposed development with regard to the soil environment will be assessed for the construction and operational phases.

7.5.1 Construction Phase

It is anticipated that the development site works and excavation proposals will not be deep enough to impact the underlying bedrock geology during the construction phase. It is therefore considered that the greatest impact of the construction will arise from the extensive stripping and wide scale excavation of soils and sub-soils to prepare and construct the development.

The main volume of excavation will be from the planned basements and undercroft car-parking to be constructed as part of the proposed apartment buildings to the north of the site near to the Ballyogan Stream, in addition, excavation will be necessary for the proposed underground surface water attenuation systems. Reusable excavated soils and rock will be retained on-site for backfilling or drainage purposes to reduce the total volume of imported material. It is anticipated that the impact on soils arising from the construction phase will be short term and moderate.

The initial development of the site would involve extensive stripping of the topsoil (approximately the upper 300mm of soil). Excavation of subsoil layers would be required to facilitate site development works, in particular the construction of foul and surface water sewers and underground surface water storage structures (attenuation). It is envisaged that non-reusable excavated material will be removed off-site.

Removal of the upper soil layers would be necessary across a large area of the site. Top-soil will initially be stripped from the lands and stored for later re-use in the landscaping for the developments. It is envisaged that there will be surplus top-soil produced by the site. This surplus will be removed off-site.

In addition, the installation of the proposed surface water storage structures will require a significant quantity of subsoil to be excavated to provide sufficient storage volumes for storm events. The construction of swales and bioretention areas would require a shallow excavation up to approximately 750mm below existing ground level. The above ground long-term storage basin proposed as part of the surface water attenuation scheme will be constructed using suitable excavated material, with topsoil finish to form an above ground berm to shape the basin for storage purposes.

Earthworks and the removal of topsoil would expose subsoil layers to the effects of weathering and may result in the erosion of soil, particularly in times of adverse weather conditions. Surplus subsoil caused by excavations for foundations, roads and drainage should be stockpiled and taken off-site to a licensed landfill facility.

Increased traffic associated with the construction works would have the effect of compacting existing subsoil layers within the site. The regular movement of heavy machinery and plant to and from the site would also result in an increased risk to the integrity of the surrounding road network, as well as facilitating the unwelcome transfer of mud and dust to surrounding access routes.

It will be necessary to import materials to site; in particular large volumes of stone will be required for construction of the roads, foundations and services. Also, large quantities of concrete, bricks, steel, tar etc. will all be delivered to site by lorry. Road levels have been designed in accordance with TII Design Manual for Roads and Bridges (DMRB) as well as the Design Manual for Urban Roads and Streets (DMURS), with an aim to balance cut and fill earthworks throughout the site.

Landscaping for the developments will reduce the initial impact from the construction phase and will protect the soils again from weathering and erosion. The impacts on the underlying bedrock geology arising from the construction phase will be imperceptible. The greatest impact will be to the soils from the construction activity as soil levels will be greatly altered throughout. However final landscaping should reduce and address these impacts. It is anticipated that the impact on soils arising from the construction phase will be short term and moderate.

For construction of the bridge, a temporary structure or culvert will be required to span the existing stream through the construction area to allow access from Phase 1 to Phase 2 for construction works. The hydraulic flow of the existing stream will be maintained throughout the construction phase. Bank stabilisation will be achieved by a proprietary geogrid or temporary stone armour.

There is a potential risk of localised contamination from construction materials leeching into the underlying soils by exposure, dewatering or construction related spillages resulting in a Permanent Negative impact on the soils. In the case of soils, the magnitude of this impact is Small Adverse as it may result in the requirement to excavate/remediate a small proportion of contamination or result in a low risk of pollution to the soils. As a result, its significance is Imperceptible for all important soils features.

There is a potential risk of localised contamination of the groundwater due to construction activities i.e. construction spillages, leaks etc. resulting in a Permanent Negative impact on the groundwater. This gravelly clay will limit the potential for contamination to infiltrate into the underlying aquifer. No excavations are anticipated to take place into the bedrock. For these reasons, the impact is Negligible on the groundwater contained within the bedrock aquifer. As a result, its significance is imperceptible.

There is a potential risk that the flow of the possible calcareous spring may be impacted during construction. At construction stage, the source of the spring outflow will be confirmed and located following removal of topsoil in the area. If the spring exists, a filter drain will be provided through the proposed open space are and will discharge to the existing ditch along the eastern boundary as is the current flow regime.

The potential likely and significant impact on hydrogeology during the construction phase is considered to be short term, temporary and moderate without mitigation measures in place.

7.5.2 OPERATIONAL PHASE

The day-to-day activities of the completed development would be unlikely to have any direct impact on the groundwater environment. Minor impacts may include reduced infiltration and therefore reduced recharge volumes entering the groundwater. This is directly related to the creation of impermeable development areas which pending their arrangement could increase run-off volumes and reduce existing “greenfield” infiltration potential. The risk of spills or leaks of fuels and oils from residential vehicles may impact if the surface water system is not designed to address this.

On completion of the construction phase, it is not envisaged that there would be a further direct impact on the soil or geology structure. Ensuring appropriately designed and constructed site services will protect the soils and geology from future contamination arising from operation of the developments.

The impacts on soils and geology arising from the operational phase will be temporary and imperceptible.

7.6 POTENTIAL CUMULATIVE IMPACTS

Given the scale of the proposed residential development, the permitted development on the Phase 1 lands for 425 no. residential units, which was also subject to an environmental impact assessment, and the capacity of the surrounding environment to accommodate a development of this nature, it is considered that the overall cumulative development in the area will have a moderate, long term impact on the land, soils and geology of the area, through the additional buildings, infrastructure and hardstanding required for residential development on the subject lands. However, provided sufficient mitigation measures are in place, as required under this EIAR and the EIS for Phase 1, at each of the developing sites the overall impact on land and soils will be neutral.

7.7 DO NOTHING IMPACT

If the proposed development did not proceed there would be no impact on the existing land, soils or geology of the site. It is envisaged that the land use would remain unchanged as mainly agricultural.

7.8 REMEDIAL AND MITIGATION MEASURES

7.8.1 Construction Phase

In order to minimize the impact of construction on the site's land, soils and geology the following mitigation measures should be implemented.

L&S CONST 1:

- Existing topsoil should be retained on site to be used for the proposed development. Topsoil should be stored in an appropriate manner on site for the duration of the construction works and protected for re-use on completion of the main site works.
- Top-soiling and landscaping of the works should take place as soon as finished levels are achieved, in order to reduce weathering and erosion and to retain soil properties.
- The provision of wheel wash facilities close to the site entrance to reduce the deposition of mud, soils and other substances on the surrounding road network.
- The construction phase should be monitored, in particular in relation to the following;
  - Protection of topsoil stockpiled for re-use;
  - Adequate protection from contamination of soils for removal;
  - Cleanliness of adjoining road network;
  - Prevention of oil and petrol spillages;
  - Dust control.
- Where feasible, the extent of excavation works and depths for dwellings and roads should be limited through design to minimize disturbance of the original soil and subsoil formations and to retain soil structure. This will also help to reduce the volumes of backfill and material to be removed off-site.
- Reusable excavated gravels, sands or rock should be retained on-site for backfilling or drainage purposes to reduce the total volume of imported material.
- Excavated materials should be visually assessed for signs of contamination. Should material appear to be contaminated, soil samples should be analysed by an appropriate testing laboratory. Contaminated material should be treated in accordance with the Waste Management Regulations, 1998.
- Excess fill, unsuitable material and suitable material will be removed off-site. Removal should be in accordance with the relevant Waste Management Regulations.

- Oil and fuel stored on site should be stored in designated areas. These areas shall be bunded and should be located away from surface water drainage.
- Refuelling of construction machinery shall be undertaken in designated areas located away from surface water drainage. Spill kits shall be kept in these areas in the event of spillages.
- Hazardous waste shall be dealt with in accordance with the Waste Management (Hazardous Waste) Regulations, 1998.
- All potentially hazardous materials shall be securely stored on site.

7.8.2 Operational Phase

No significant long-term impact on the soil resulting from the proposed operational phase of the development is predicted. Once the development is completed, risks to the land and soils will be from pollutants deriving from the use of the dwellings and/or from contaminated surface water run-off.

L&S OPERAT 1: The surface water run-off from the development should be collected by an appropriately designed system. This system should ensure that contaminants are removed prior to discharge e.g. via a light liquids separator or by an appropriate treatment train of Sustainable Urban Drainage Systems as outlined in the Greater Dublin Strategic Drainage Study (GDSDS). Any separators and drainage systems should be maintained and operated by the facilities management company (prior to taking in charge by the Local Authority) in accordance with the manufacturers recommendations.

L&S OPERAT 2: All waste generated by the everyday operation of the development should be securely stored within designated collection areas. These should have positive drainage collection systems to collect potential run off. Operational waste should be removed from site using licensed waste management contractors.

7.9 PREDICTED IMPACTS OF THE PROPOSED DEVELOPMENT

Construction Phase

The proposed development will alter the current land use from agricultural to a residential development and associated public open space and landscape areas. The impact on land, soil, geology and hydrogeology from accidental spillages of fuel and lubricants used during the construction phase of the development is predicted to be minimal when stored and used in a responsible manner. After implementation of the mitigation measures recommended above for the construction phase, the proposed development will not give rise to any significant long term adverse impact. Moderate negative impacts during the construction phase will be short term only in duration.

Operational Phase

There are no long term impacts on soils.

7.10 MONITORING

Soil removed during the construction phase is to be monitored to maximise potential for re-use on site. Monitoring of any hazardous material stored on-site will form part of the proposed Construction & Waste Management Plan. A dust management/monitoring programme should be implemented during the construction phase of the development. The quantities of topsoil, subsoil and rock removed off site will be recorded.

7.11 REINSTATEMENT

In open space areas where finished ground levels are altered and extensive excavation of topsoil and subsoil is required, the areas should be seeded and landscaped in a timely manner to ensure weathering of subsoils is limited.

7.12 INTERACTIONS

The design team has been in regular contact with each other throughout the design process to minimise environmental impacts and to ensure a sustainable and integrated approach to the design of the proposed development. There is an interaction between soil and waste management which may require the removal of soil off site to a suitable licensed facility. There is an interaction between geology for the site and hydrogeology and biodiversity, as discussed above and in the Water and Biodiversity chapters of the EIAR.

7.13 DIFFICULTIES ENCOUNTERED IN COMPILING

No particular difficulties were encountered in completing this section.

7.14 REFERENCES

- Site Investigations Report by IGSL
- GSI On Line Mapping
- EPA On Line Mapping
- Site Specific Flood Risk Assessment by DBFL
- Engineering Services Report by DBFL

APPENDIX 7.1 – DRAWING NO. 163056-3080, SITE INVESTIGATION PLAN

ON ORIGINAL

0 5 10 15 20 25 30 40 50mm

NOTES:

1. ALL DIMENSION AND LEVELS IN METRES, EXCEPT IF NOTED OTHERWISE.
2. ALL LEVELS TO **MALIN HEAD** DATUM.
3. CO-ORDINATE SYSTEM IS: **ITM GRID**

EXISTING SI (DATED 2008)

CBR99	—	CBR TEST (24 NO.)
BH99	—	BOREHOLE (29 NO.)
TP99	—	TRIAL PIT (13 NO.)
+ SPG	—	STANDPIPES (GAS)(5 NO.)
+ SP	—	STANDPIPES (WATER)(9 NO.)

EXISTING SI (DATED 2016)

CBR99	—	CBR TEST
RC99	—	ROTARY CORE BOREHOLE & ROCK CORE
TP1	—	TRIAL PIT

REV.	DATE	DESCRIPTION	BY	CHKD.

PLANNING

DESIGNED	JBK	PREPARED	KJL'E
DATE	AUG 2017	CHECKED	CFD

DBFL Consulting Engineers

DUBLIN OFFICE Ormond House, Upper Ormond Quay, Dublin 7, Ireland.
PHONE +353 1 400 4000
FAX +353 1 400 4050

WATERFORD OFFICE Unit 2, The Chandlery, 1-2 O' Connell Street, Waterford, Ireland.
PHONE +353 51 309 500
FAX +353 51 844 913

EMAIL info@dbfl.ie SITE www.dbfl.ie

PROJECT

RESIDENTIAL DEVELOPMENT AT CLAY FARM, BALLYOGAN ROAD, DUBLIN 18 PHASE 2

DRG. TITLE

SITE INVESTIGATION

ARCHITECT

O'MAHONY PIKE ARCHITECTS

SCALE	1:1000 (A0)	FILE REF.	163056-3080
DRG. NO.	163056-3080		