6. SOIL AND GEOLOGY

6.1 Introduction

6.1.1 Methodology

The following Environmental Impact Assessment Report (EIAR) section has been prepared by Colin O'Reilly PhD, of Envirologic Ltd., and Eugene Bolton PhD of Trinity Green, on behalf of Barrett Mahony Consulting Engineers.

The aims of this EIAR Section are to

- Conduct a review to establish baseline conditions relevant to the soils and geological environment within the site boundary, and the local surrounding environs;
- Assess the potential impacts to the soil and geological environment, which can be reasonably expected to occur as a result of the proposed development;
- Implement suitable mitigation measures to address identified adverse impacts.

Documents consulted during the preparation of this EIAR Section are listed in the References section. The report has been compiled primarily taking cognisance of:

- Guidelines for the preparation of soils, geology and hydrogeology chapters of environmental impact statement. Institute of Geologists of Ireland (2013);
- Revised guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency (2015).
- Draft Guidelines on the information to be contained in environmental impact assessment reports. Environmental Protection Agency (2017).

A site walkover survey was performed on 2nd September 2016.

6.2 Receiving Environment

6.2.1 Location

The University College Dublin campus is located 4 km south of Dublin city centre. The N11 passes adjacent to the eastern site boundary. The R112 (Foster's Avenue) and R113 (Clonskeagh Road) run along the eastern and western boundaries, respectively, with Roebuck Road connecting these along the southern boundary of the campus.

Regional topography is characterised by the Dublin Mountains, peaking 7 km to the south at Fairy Castle (536 mOD), with land sloping northwards from these towards the River Liffey, 4 km to the north, and more locally eastwards to the Irish Sea coastline, which is 1.2 km to the northeast at it's nearest point.

Land use in the surrounding area is almost entirely urbanized, being primarily of moderate density typical of suburban residential development.

6.2.2 Site Layout

The proposed application site area is approximately 12.95 ha. It is located in the southern part of the Belfield campus which itself encompasses an area of approximately 133ha.

The proposed application site boundary is irregular in shape. The main body of the application site is 450 m long from north to south and will host the primary residency blocks. The main body of the site is widest at its northern end (350 m), which comprises Phases 1 and 2 (Blocks A – E; Fulcrum Building), and narrows to 115 m progressing south where Phase 3 (Block F; Roebuck Castle) will take place. Internal access roads are included as short projections from the main area.

An overground car park is proposed at the northeastern corner of the application boundary and is referred to as the Sutherland School of Law Car Park. A second overground car park, referred to as Little Sister car park, is proposed and occupies a secondary parcel included in the application boundary, at it's northwestern corner.

6.2.3 Land

The application site currently consists of:

- Greenfield areas currently used as playing pitches;
- Gravel areas currently used as temporary car parking;
- Existing buildings in Area 2, to be demolished.

Topography through the site is flat to gently undulating with slopes a general reflection of the regional gradients.

6.2.4 Soils & Subsoils

Figure 6.1 shows the local area to have significant areas of concrete hardstanding. Where soils are mapped they are shown to be deep, basic mineral soils that display generally moderate drainage characteristics.

Local soils are classified by Gardiner and Radford (1980) as a mainly dry, grey/brown podzolic mineral with gleys occurring in flatter, depressed areas. The profile is characterised by a slightly plastic consistency and weak structure which becomes massive in the lower part of the B horizon at about 65 cm. Clay and silt contents in the surface horizon are reportedly 25-30% with clay content increasing into the B horizon. Some gravelly Brown Earths and minimal Grey Brown Podzolics are found generally on kames, crests of hillocks and terraces. They are mostly formed from fluvioglacial material.

Figure 6.1 General Soils Classification Map

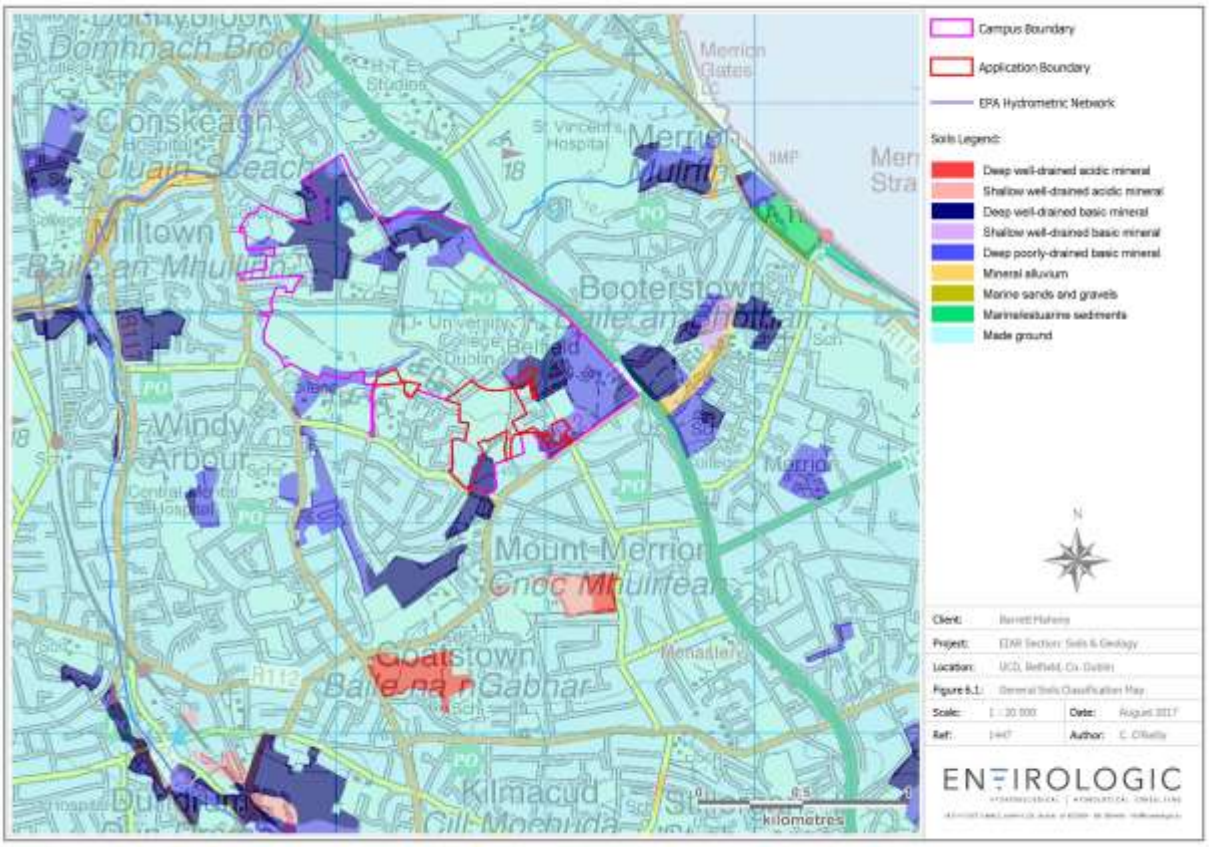


Figure 6.2 shows soils at the site are underlain by a calcareous glacial till which was carried in from the Irish Sea and intermixed with local limestone and shale.

Figure 6.2 Quaternary Geology Map

IGSL performed site investigation works in January 2016 (site investigation locations shown in Figure 6.3; report included as Appendix 6.A). These works reported that Area 1 consists generally of the following strata:

- 1.0 – 1.6 m soft to firm made ground, underlain by
- Firm silty clay or thin layer of sandy gravel (TP2), underlain by
- Firm to very stiff brown/grey brown sandy gravelly clay (boulder clay), underlain by
- Hard grey/black sandy, very gravelly clay.

Particle size distribution analysis performed on subsoils in Area 1 showed them to be a slightly sandy, slightly gravelly CLAY. This is a till known locally as Dublin boulder clay.

Subsoil in Area 2 was described as containing lenses of sand in a wider gravel layer. Site investigation locations in Area 2 are BH 6 and TP4, which were logged generally as:

- 1.8 – 2.2 m soft fill, underlain by
- loose to medium density gravelly sand, underlain by
- dense, coarse angular gravel between 4.8 – 5.6 m (shell and auger drilling ceased at 5.6 m).

Particle size distribution on a sample obtained at 3 m below ground from BH6 classified subsoil as slightly clayey/silty, sandy, GRAVEL with occasional cobbles.

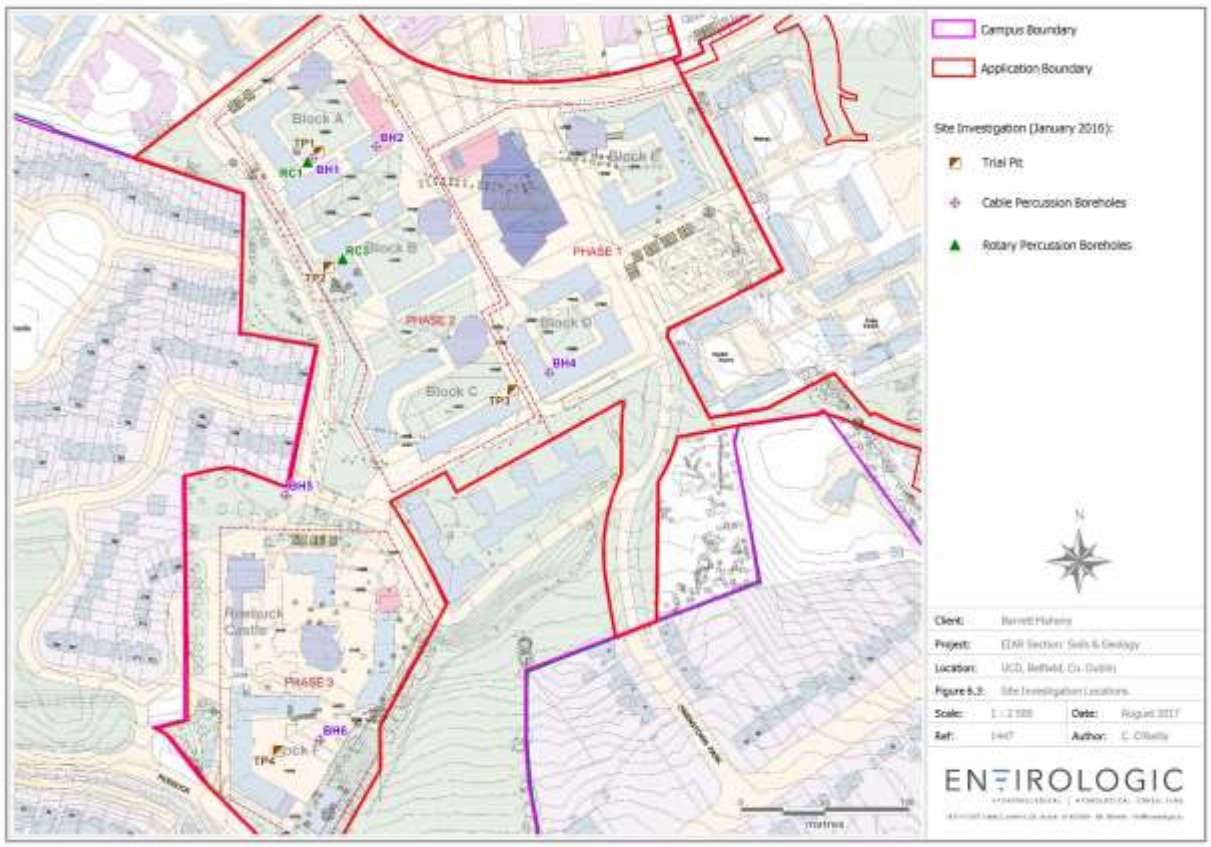


Figure 6.3 Site Investigations Location Map

In the surrounding area alluvials are shown flanking natural surface watercourses (Figure 6.2). There are no alluvial deposits mapped within the application site boundary. Intermittent gravel deposits are mapped in the vicinity. It is likely that the substrate encountered in Area 2 is consistent with an isolated fluvioglacial deposit. The depth of this deposit was not confirmed.

6.2.5 Soil Quality

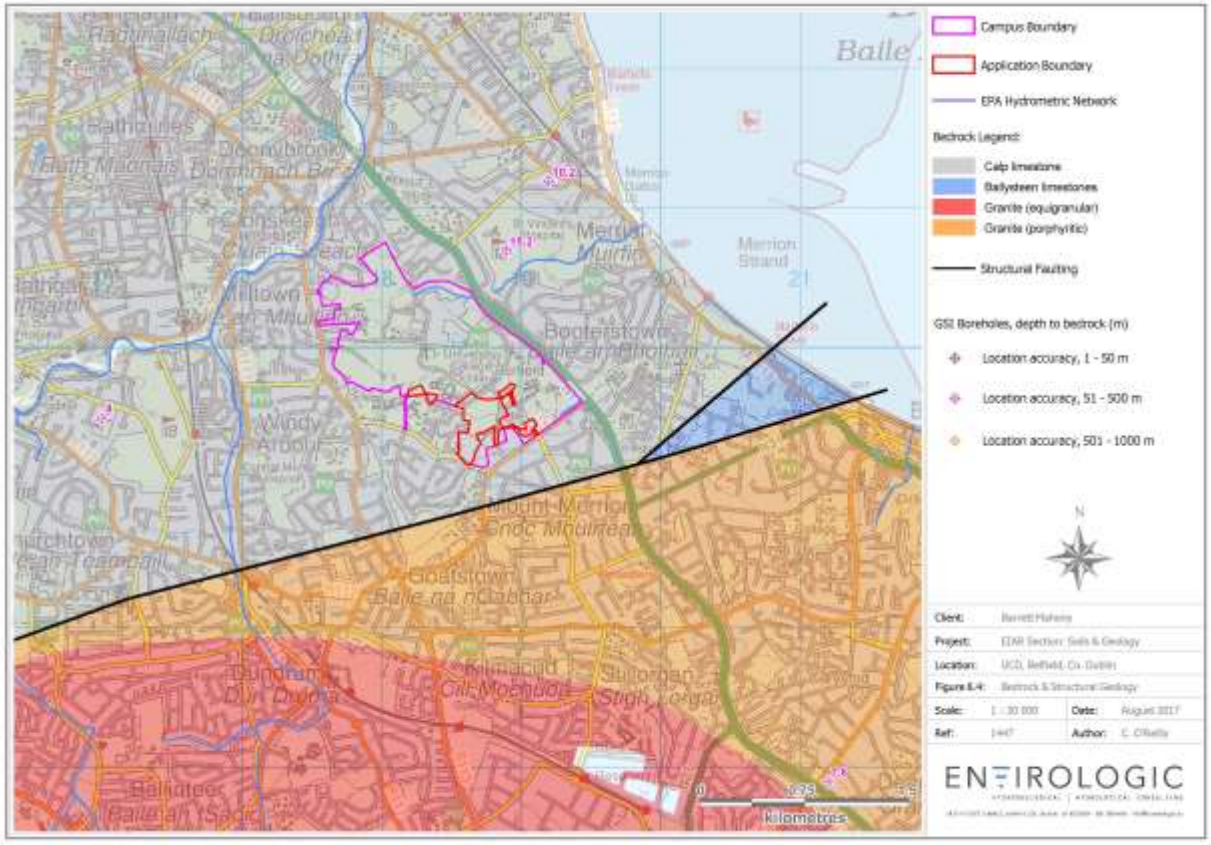
A number of soil samples were retrieved during the IGSL site investigation. Results showed all soils to be slightly alkaline. Soil samples from Area 1 were classified as inert. The single soil sample from Area 2 returned slightly elevated TOC. No further investigation was deemed necessary following this result but it was recommended that further sampling be performed during construction phase to confirm destination for off-site disposal of any excavated material.

6.2.6 Bedrock & Structural Geology

Figure 6.4 presents bedrock and structural geology. The subject site and surrounding area is mapped as being underlain by Calp, a dark-grey to black limestone and shale. These thick sequences of muddy limestone accumulated in an area of deep water referred to as the Dublin Basin.

The Leinster Granites emerge to the south of Belfield campus, separated from the limestones along the Donnybrook-Tallaght syncline.

Figure 6.4 Bedrock & Structural Geology Map



6.2.7 Depth to Bedrock

There are no outcrops of the Carboniferous rocks in the area, being covered with a thick blanket of boulder clay. GSI bedrock data in the area is somewhat limited (see Figure 6.4) but shows that:

- bedrock at 15.2 m, 1 km north of site;
- bedrock at 10.2 m, 1.5 km north of site;
- bedrock at 4 m, 2.1 km west of site;
- bedrock at 20 m, 3.1 km west of site.

No bedrock exposures were observed within the site boundary, or in the local vicinity, during the site walkover. Bedrock was not encountered during site investigation works, rotary drilling ceased at a depth of 10 m below ground.

6.2.8 Geological Heritage

The site does not lie within a geological heritage area. The nearest such designation is 1.8 km to the northwest where limestone bedrock outcrops on a natural weir in the River Dodder.

6.2.9 Use of Natural Resources

Natural resources used in the construction phase will include bedrock, sand and gravel for the production of precast concrete, readymix concrete, readymix mortar, blocks and bricks. Processed timber will be used in the construction phase. These raw materials will most likely be sourced within the Leinster region. Diesel will be consumed in the manufacturing of these materials, haulage to the site, site machinery, and haulage of stripped overburden from site.

Natural resources used in the operation phase will primarily be electricity, a portion of which can be sourced from renewable sources.

6.3 Potential Impacts

The procedure for determination of potential impacts on the receiving soil and geological environment is to identify potential receptors within the site boundary and surrounding environment and use the information gathered during the desk study and site walkover to assess the degree to which these receptors will be impacted upon. Impacts are described in terms of quality, significance, duration and type. The impact definitions and criteria are further detailed in Appendix 6.A.

Development will require removal of overburden. The proposed basement will involve significant excavation of soils and subsoils, extending into the Dublin boulder clay.

In accordance with the NRA Guidelines the site is deemed to be an attribute of 'Low-Medium' importance, as a function of the poor to medium quality soils, respectively. These soils are of importance at a local scale only.

The potential impacts from the construction and operational phases of the proposed development are summarised in Table 6.1, using the headings discussed under the criteria for determination of impacts (Tables 6.B.1, 6.B.2, 6.B.3). The impact definitions and criteria are further detailed in EPA Guidelines (EPA, 2015).

6.3.1 Cumulative Impacts

The operational phase could be considered to involve an intensification of use on the Belfield campus. When considered in tandem with other existing developments in the area, the proposed development will involve further removal of soils/subsoils in addition to those previously removed. The soils/subsoils are deemed to be of low quality in terms of geological/agricultural importance and therefore the contribution to cumulative impacts to the local soil and geological environment is deemed to be negligible.

6.3.2 Unplanned Events

Consideration has been given to environmental impacts associated with unplanned events such as accidents, floods, etc. Section 7.3.8.2 of this EIAR has shown that the risk of flooding on the site is negligible Heavy Rainfall events during the construction phase may give rise to increased risk of sediment loss. Suspended sediment control measures have been designed to cater for such events. Several independent mitigation measures will be implemented for entrapment of mobilised sediment to compensate for surcharging of any one of these control measures.

Unplanned events such as those listed will not have an impact on the soils and geology environment during the operational phase.

6.3.3 Do-Nothing Scenario

The proposed development is an intensification of use in line with existing activities within the Belfield campus. The proposed development will not introduce any new potential impacts to the soils and geological environment when compared to the current operational phase.

6.4 Mitigation Measures

The significant potential impacts identified in Table 6.1 are resolved under the mitigation measures set out under Table 6.2.

Table 6.1 Summary of Potential Impacts

Activity	Attribute	Character of Potential Impact	Importance of Attribute (refer to Table 5A.1)	Magnitude of Potential Impact (refer to Table 5A.2)	Term	Significance of Potential Impact (refer to Table 6A.3)
Construction Phase						
Stripping of soil necessary to facilitate installation of hardstanding and building footprints	Soil	Excavation and removal of topsoil	Low (poor quality soils) – Medium (moderately drained soils)	Adverse: Moderate (exacavate and replace soft, mineral soils)	Permanent	Slight - Moderate
Handling of soils, subsoils	Soil, subsoil	Potential for soil erosion and dust generation	Low (poor quality soils) – Medium (moderately drained soils)	Adverse: Negligible	Temporary	Imperceptible
Removal of subsoil to facilitate foundations and basement car park	Subsoil	Excavation and removal of subsoils	Low (low permeability boulder clay)	Adverse: Small (irreversible loss of high proportion of low fertility soils)	Permanent	Slight
Encountering contaminated subsoils during excavation	Subsoil	Risk to construction workers; Migration of vapour through building	Low (low permeability subsoil)	Adverse: Significant	Short – long term	Slight - Profound
Minor excavation of bedrock may be required to establish suitable foundation for building	Bedrock	Excavation of weathered bedrock	Calp limestone	Adverse: Negligible	Permanent	Imperceptible
Use of fuels/hydrocarbons	Soil, subsoil, bedrock	Potential for contamination of exposed subsoils and/or bedrock as a result of spillages/leakages.	Medium	Adverse: Moderate	Short term	Moderate/Significant
Washout of cement trucks	Subsoil	Potential for contamination of exposed subsoil	Medium	Adverse: Moderate	Short term	Moderate/Significant
Cutting around basement excavation	Soil, subsoil	Undermining	Low	Adverse: Moderate	Permanent	Slight/Moderate

Slope cutting around basement excavation	Soil, subsoil	Bank stability	Low	Adverse: Moderate	Permanent	Slight/Moderate
Operational Phase of Proposed Development						
Use of fuels/hydrocarbons	Soil, subsoil, bedrock	Potential for contamination of subsoils and/or bedrock as a result of spillages/leakages.	Medium	Adverse: Moderate	Short – long term	Moderate/Significant
Overall development	Bedrock	Impact to geological heritage sites	None present	n/a	n/a	n/a

Table 6.2 Summary of Mitigation Measures

Activity	Attribute	Character of potential impact	Mitigation measure	Predicted impact
Construction Phase				
Stripping of soil necessary to facilitate installation of hardstanding and building footprints	Soil	Excavation and removal of topsoil	Stripped soils shall be temporarily stockpiled on site prior to removal. Destination of stripped soils to be agreed with client. Movement of material shall be minimised in order to reduce degradation of soil structure and generation of dust.	Slight
Handling of soils, subsoils	Soil, subsoil	Potential for soil erosion and dust generation	Soil handling and placement shall only take place during appropriate weather conditions and when the soils are in optimum condition (moist but friable). Soils shall not be moved when they are too dry or during unusually windy weather conditions. Conversely soils should not be handled when moisture content is so high it results in smearing.	Neutral
Removal of subsoil to facilitate foundations and basement carpark	Subsoil	Excavation and removal of subsoils	Excavated subsoils shall be temporarily stockpiled on site prior to removal.	Slight

Encountering contaminated subsoils during excavation	Subsoil	Migration of contaminants from historical activities to subsoils underlying subject site	Previous site activities do not suggest any contamination. Should any unusual staining or odour be noticed, samples of soil/subsoil shall be analysed by an accredited laboratory. A hydrogeologist shall be engaged to oversee such works. If contaminated soil is encountered it will be required to be removed by a licensed contractor. Further trial pitting shall be carried out in vicinity of TP4 prior to construction works in Area 2.	Neutral
Minor excavation of bedrock may be required to establish suitable foundation for building	Bedrock	Excavation of weathered bedrock	No bedrock was encountered within 10 m of surface during site investigation works. It is not envisaged that bedrock will be encountered during construction phase.	None
Use of fuels/ hydrocarbons	Soil, subsoil, bedrock	Potential for contamination of exposed subsoils and/or bedrock as a result of spillages/leakages.	Potentially contaminating substances will be stored in designated areas that are isolated from surface water drains or open waters. Hazardous wastes such as waste oil, chemicals and preservatives will be stored in sealed containers. Fuelling, lubrication and storage areas will be in a designated area, not within 30 m of drainage ditches or surface waters. All waste containers will be stored within a secondary containment system (e.g. a bund for static tanks or a drip tray for mobile stores and drums). The bunds will be capable of storing 110% of tank capacity, plus a minimum 30 mm rainwater allowance where the bund is uncovered. Where more than one tank is stored, the bund must be acapable of holding 110% of the largest tank or 25% above the aggregate capacity. Drip trays used for drum storage must be capable of holding at least 25% of the drum capacity. Regular monitoring of water levels within drip trays and bunds due to rainfall will be undertaken to ensure sufficient capacity is maintained at all times. There will be no storage of fuels on site. Refuelling shall be by mobile bunded bowser at a designated area, i.e. ste compound, or where possible off-site. An adequate supply of spill kits and hydrocarbon absorbent packs shall be stored in this area.	Neutral

Washout of cement trucks	Subsoil	Potential for contamination of exposed subsoil	All ready-mixed concrete shall be delivered to site by truck. A suitable risk assessment for wet concreting shalll be completed prior to works being carried out. Washdown and washout of concrete trucks will take place at an appropriate facility off-site.	Neutral
Cutting around basement excavation	Soil, subsoil	Undermining near existing buildings	Should basement construction be envisaged close to existing buildings or roads a retaining wall will be required to suppor thte soils and help to prevent undermining. A traditional sheet pile wall would suffice (IGSL, 2016).	Neutral
Slope cutting around basement excavation	Soil, subsoil	Bank stability	Conventional side slopes wil be adopted during basement excavation. Temporary slopes of about 25 degrees in the made gruond and 30 degrees in the Dublin boulder clay is recommended (IGSL, 2016). Slopes shall be protected by netting. A narrow exclusion area at the base of the excavation will be installed. Slope stability to be assessed by suitably qualified engineeer.	Neutral
Operational Phase				
Use of fuels/hydrocarbons	Soil, subsoil, bedrock	Potential for contamination of subsoils as a result of spillages/leakages.	There will be no parking or other activities on non-hardstanding areas that could enable contamination of soils/subsoils. All runoff generated on hardstanding areas will enter a lined attenuation pond prior to being transferred to the stormwater drainage network.	Negligible

6.5 Residual Impacts

Residual impacts refer to the degree of environmental change that will occur after the proposed mitigation measures have taken effect.

The construction phase will primarily involve stripping of soils/subsoils to expose suitable foundation conditions. Assuming implementation of the mitigation measures described above the residual impacts on the soil and geological environment during the construction phase are assessed to be temporary and slight.

Assuming implementation of the mitigation measures described above the residual impacts on the soil and geological environment during the operational phase are assessed to be long-term and negligible.

6.5.1 Monitoring

6.51.1 Construction Phase

A designated person from the project management team will have overall responsibility for ensuring that all construction operations are carried out in such a way as to minimise potential impacts to soils and geological receptors. This person will also have the responsibility of monitoring the performance of any pollution control measures adopted.

A project-specific Construction and Environmental Management Plan (CEMP) will be established and maintained by the contractor during the construction and operational phases. The CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures during a site induction meeting.

6.5.1.2 Operational Phase

No monitoring of the soil and geological environment will be performed during the operational phase.

6.5.1.3 End of Use

There is no planned timeline for the longevity of the proposed development. At end of use stage the buildings would most likely be demolished. Materials such as concrete, brick, tiles, etc. can be recovered and crushed for use as an aggregate in the construction industry. Other materials such as timber can be recycled. Materials unsuitable for re-use or recycling would most likely be destined for inert landfill (typically in the restoration of exhuasted quarry sites).

6.6 Conclusion & Summary

The proposed development site is situated within an urban environment in south County Dublin. Soils are deep and generally moderately drained. Across many parts of the application site soils have already been removed to make way for existing structures, roadways and temporary car parks. There will be permanent removal of soils as part of site preparation. Excess soil shall be removed off-site and re-used.

Subsoils are a stiff, dense, gravelly till, referred to as Dublin boulder clay. Subsoils will be excavated and removed off-site to make way for foundations and a large basement car park. These subsoils are not considered to be of geological importance. Sands and gravels were encountered in the southern part of the application site. It is likely that where it is necessary to excavate this material it can be re-used for site contouring purposes.

The risk to soil/subsoil quality from accidental spillages and leaks is deemed to be low assuming all mitigation measures described in this document are adhered to.

Bedrock was not encountered during site investigation and it is not envisaged that it will be exposed during construction works.

There are no sites of geological heritage on or in the vicinity of the site that will be impacted upon by the proposed development.

There are no historical activities that would suggest potential for contaminated soils/subsoils. It is possible that during construction works, local areas of historical contamination may be encountered (e.g. beneath historical heating oil containers). Upon encountering potentially contaminated soils, more extensive trial pitting and soil sampling will be carried out to characterise the extents and type of contamination, with identified material removal off-site by an appropriately licensed contractor.

Potential impacts to the soils and geological environment have been assessed, and appropriate mitigation measures shall be implemented. There are no likely significant impacts on the geological environment associated with the proposed development of the site. It is not anticipated that any impacts will arise following the implementation of the mitigation measures outlined in the EIAR.

6.7 References

BS 5930. 1999. Code of practice for site investigations. B.S. 5930 of 1999.

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Appendix 6.A: IGSL Site Investigation Report

Appendix 6.B: Impact Definitions