ARUP

Tiznow Property Company Limited (Comer Group Ireland)

City Park Development at the Former Tedcastles Site

Contaminated Land Remediation Strategy

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1. Introduction

Arup were commissioned to design and interpret a Ground Investigation (GI) to review the potential for contamination at the Former Tedcastles Site for the project called the City Park Development, hereafter referred to as the Former Tedcastles Site. This report presents a summary of the findings and highlights the proposed remedial strategy and method statement for the management of contaminated soils.

This report supplements the planning application for planning permission for a Strategic Housing Development (SHD) and has been prepared alongside the Construction Environmental Management Plan (CEMP) (267365-ARUP-XX-XX-RP-YE-0008).

1.1 Purpose

In the CEMP it was highlighted that contaminated soils are present on site. This Remedial Strategy provides a method statement for their management and remediation as part of the proposed application.

This remedial strategy considers impacts on human health, groundwater, the nearby open channels and the River Lee.

1.2 Structure

A summary of the proposed development, ground conditions and contamination found are presented in the CEMP. These are reproduced in Sections 2 and 3 of this Remedial Strategy so that the reader has all the information in one document. The contaminated soil remedial strategy is presented in Section 4 of this report and a short conclusion in Section 5.

No ground investigation or detailed assessment of the contamination are presented in this report.

2. Proposed Development

The Developer intends to apply to An Bord Pleanála (the Board) for consent for a Strategic Housing Development (SHD) with a total application area of c. 4.86ha on lands located on the Former Tedcastles Site at Centre Park Road, in Cork City. The area is considered to be a brownfield site with a number of pre-existing structures on the site which have been partially demolished.

A detailed description of the proposed development and construction strategy is presented in the CEMP and planning application documents. A summary of the earthworks that could interact with potential contamination is presented below.

2.1 Construction Phase

The proposed development is anticipated to be constructed from East to West in 4 phases, with a number of sequential subphases in each, preceded by a Mobilisation and Enabling Works Phase.

During the Mobilisation and Enabling Works, site level shall be lowered to approximately -1.30mOD. This will require the excavation of approximately 73,022m^3 soil and hardstanding. Excavation will remove made ground, some silts and potentially some sand/gravels (a summary of the ground conditions is presented in Section 3.). The excavation will require a temporary dewatering strategy.

Once the foundations are constructed fill materials will be required to build up the site to the required levels, in addition, further fill will be required for under hard and soft landscaping areas.

2.2 Operational Phase

The development will consist of:

- The construction of a strategic housing development of 823 no. apartments, resident amenity and ancillary commercial areas including childcare facilities.
- The development will comprise 6 no. buildings ranging in height from part 1 no. to part 35 no. storeys over lower ground floor level.
- The proposed development also comprises hard and soft landscaping, pedestrian bridges, car parking, bicycle stores and shelters, bin stores, ESB substations, plant rooms and all ancillary site development works.
- Vehicular access to the proposed development will be provided via Centre Park Road.

3. Ground Investigation

A geo-environmental ground investigation (GI) was carried out between September 2021 to January 2022 across a series of properties in the Cork Docklands under the ownership of the applicant. This included the Former Tedcastles Site, the subject of this report (Figure 1). The ground investigation was carried out in accordance Irish and International good practice.

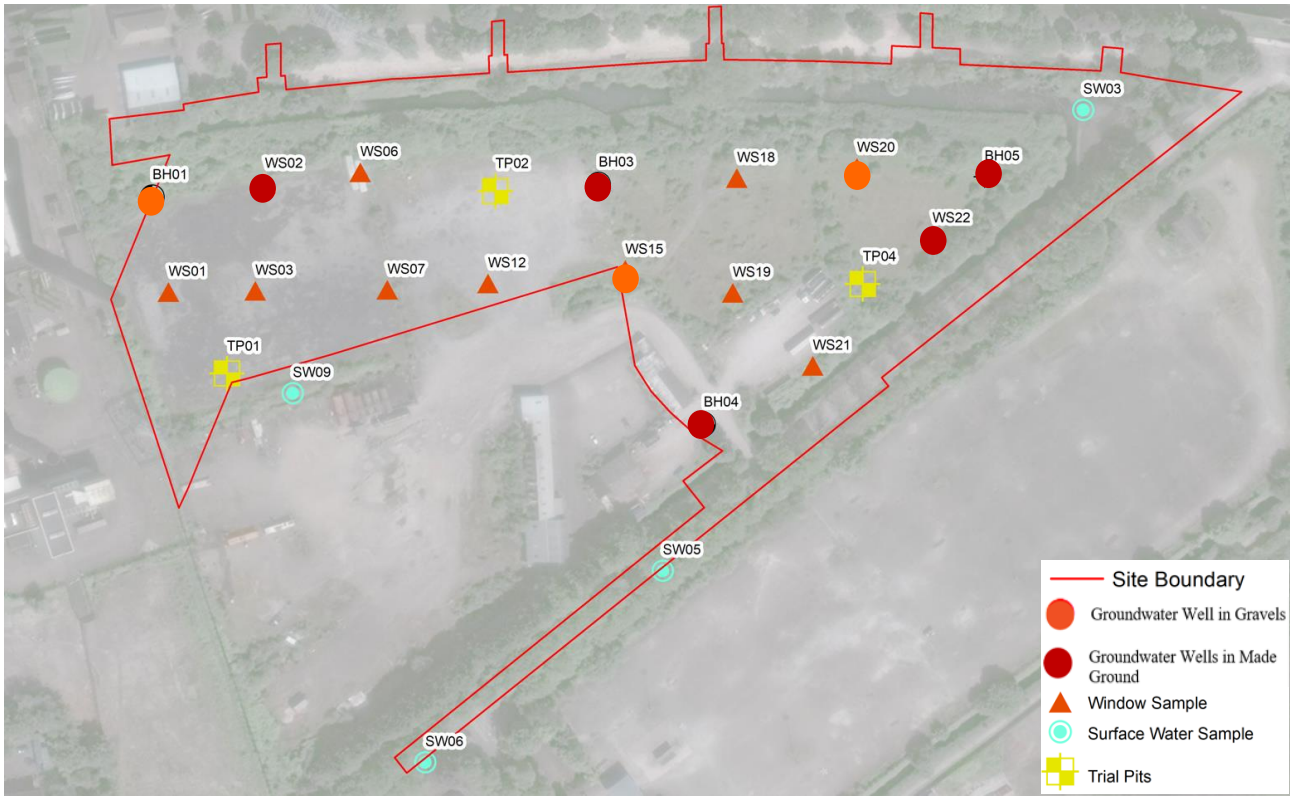

Figure 1: Ground Investigation of the Former Tedcastles Site, highlighted in red.

The Former Tedcastles Site is located to the north of Centre Park Road and to the south of the Marina, shown in Figure 1 by the red line boundary. During the GI a number of Trial Pits (TP), Window Samples (WS), Boreholes (BH) and groundwater well installations were carried out across the site (Figure 1). The

investigation was undertaken to examine the ground conditions and take geo-environmental samples of the soil and water to determine their waste classification and any risk to human health and the environment.

The existing topography of the site is slightly sloped with levels generally decreasing in elevation from approximately +5.3mOD at the northern boundary to +0.2mOD at the southern boundary.

3.1 Stratigraphy

The ground investigation for the site has found in general that the site stratigraphy is as follows:

- Made ground (comprising of sandy gravelly silt / silty sandy gravel with cobbles and boulders and typically 10% to 20% anthropogenic materials including brick, concrete blocks, pieces of glass and ceramics) from approximately 2.01 metres above Ordnance Datum, (mOD) up to -1.1mOD,
- Silt (reclaimed and natural) from approximately 0.36mOD up to a depth of -2.19mOD.
- Sand/Gravel from -2.19mOD and extending for several 10's of metres under the site.

3.2 Sample strategy

During the Ground Investigation, soil samples were collected from the trial pits and window samples. The soil samples were taken at 50m spacing, as required for an exploratory investigation according to BS 10175:2011+A2:2017, 'Investigation of potentially contaminated sites'.

The soil samples were taken at varying depths between the surface and 0.5 meters below ground level (mbgl). Subsequent samples were taken at approximately 1.0m intervals and where colour, odour or consistency indicate a change in the nature of the soil.

Groundwater samples were taken from wells with a response zone in the made ground and a response zone in the gravels. Surface water samples were taken from drainage ditches near the site and the River Lee, approximately 60m north of the site.

Ground gas measurements for carbon dioxide, methane and oxygen were collected from standpipes installed in the made ground on three occasions.

3.3 Contamination Assessment

3.3.1 Soil assessment

The soil samples were compared against Generic Assessment Criteria (GAC) for human health relevant to a '*public open space with residential land use*', based on the English Environment Agency CLEA model. This is equivalent to the most conservative proposed use of the site which includes communal spaces. The soil samples exceeded the GAC for the following:

- Metals (Arsenic, molybdenum and nickel) were above the screening limit in WSBH01 at 0.7mbgl.
- Lead was above the screening limit in WS01 at 0.9mbgl and WSBH01 at 0.7mbgl.
- Benzo[b]fluoranthene and Benzo[a]pyrene were above the screening limit in TP01 at 1.4mbgl, and TP04 at 0.5mbgl and 1.4mbgl.
- Dibenz(a,h)Anthracene was above the screening limit in WSBH03 at 1.4mbgl, TP01 at 1.4mbgl, TP04 at 0.5mbgl and 1.4mbgl, WS02 at 0.2mbgl and 0.8mbgl, WS03 at 0.5mbgl, WS06 at 0.4mbgl, WS18 at 0.2mbgl and 1.8mbgl, WS19 at 0.5mbgl and WS21 at 0.7mbgl and 1.2mbgl.
- Asbestos was detected in TP01 at 1.4mbgl, TP02 at 0.5 mbgl, TP04 at 1.4mbgl, WS02 at 0.2 and 0.8mbgl, WS19 at 0.5mbgl and WS21 at 0.7 and 1.2mbgl. Ranging from 0.001% to 0.05% of amosite and chrysotile.

The following soil samples did not exceed the human health assessment criteria but were recorded above their detection limit:

- 1,3,5-Trimethylbenzene was above the detection limit (DL) in WSBH05 at 1.1mbgl and TP04 at 1.4mbgl.

- 4-Chlorotoluene, Tert-Butylbenzene, and N-Butylbenzene was above the DL in WSBH04 at 0.6mbgl.
- Sec-Butylbenzene was above the DL in WSBH04 at 0.6mbgl and WSBH05 at 1.1mbgl.
- 4-Isopropyltoluene was above the DL in WSBH04 at 0.6mbgl and WS02 at 0.8mbgl.
- 1,2-Dibromo-3-Chloropropane was above the DL in WSBH05 at 1.1mbgl
- 2-Methylnaphthalene was above the DL in WSBH05 at 1.1mbgl, TP04 at 0.5mbgl and 1.4mbgl, and WS02 at 0.8mbgl.
- Carbazole was above the DL in WSBH03 at 1.4mbgl, WSBH04 at 0.6mbgl, WSBH05 at 1.1mbgl, TP01 at 1.4mbgl, TP04 at 0.5mbgl and 1.4mbgl, and WS02 at 0.2mbgl and 0.8mbgl.
- (SVOC TIC) Dibenzothiophene was detected in TP01 at 1.4mbgl and WS02 at 0.8mbgl.

Soil plans were compiled for the Former Tedcastles Site highlighting the contaminants of concern, with results recorded in concentrations over their soil screening limit (SSL). The plans show the contaminant exceedances from 0mbgl to 1mbgl (Figure 2) and 1mbgl to 2mbgl (Figure 3). Below 2mbgl, no exceedances of the human health criteria were noted.

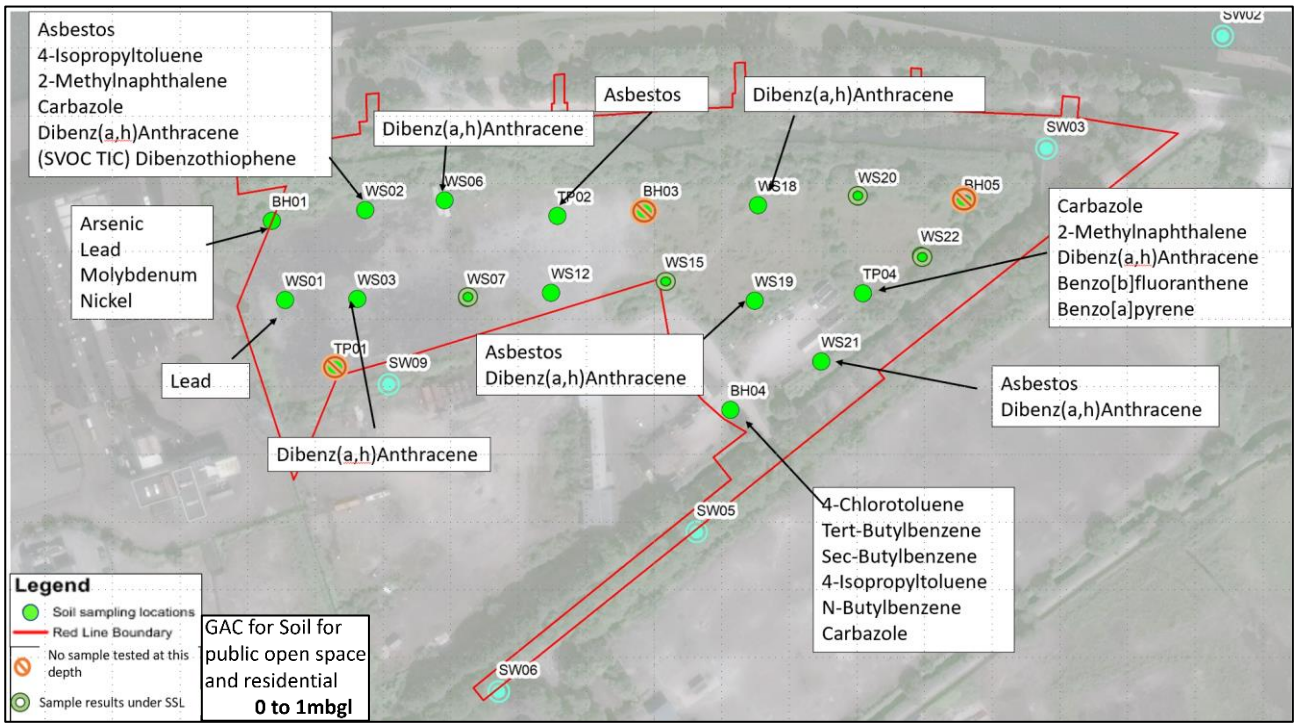

Figure 2: Soil plan for the Former Tedcastles Site from 0mbgl to 1mbgl. *Red line boundary to be updated*

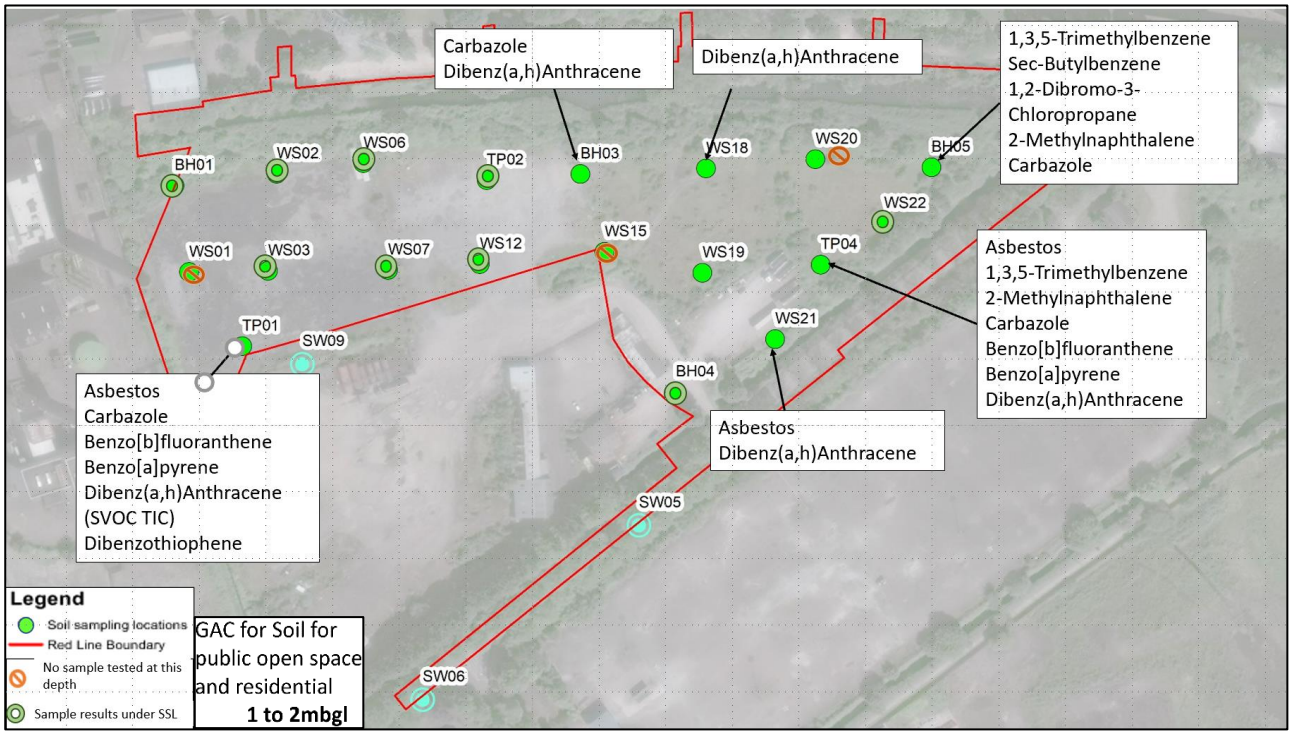

Figure 3: Soil plan for the Former Tedcastles Site from 1mbgl to 2mbgl. *Red line boundary to be updated*

3.3.2 Water assessment

Water samples from the made ground, gravel and the open channels were compared with Environmental Quality Standards (EQS).

Some elevations in the water quality from the made ground, gravel and the open channels were noted. The following summarises the water quality for the Former Tedcastles Site.

General water quality

- Groundwater samples collected from the made ground, gravels and open channels showed elevated ammoniacal nitrogen above the screening value. This is considered to be a background concentration. Ammoniacal nitrogen was also found to be above the screening standard in the River Lee but in quantities of generally an order of magnitude lower than the other water samples collected.
- Naturally occurring inorganic compounds: chloride, sulphate, potassium, magnesium and sodium exceed the screening standards in the water samples across the made ground, gravels and open channels. These compounds are associated with brackish conditions.

Made ground

- The made ground water samples from WS02, WS15 and WS22 indicate brackish water.
- The made ground water samples contained metals elevated above the screening limit for: barium, chromium, iron, manganese and zinc.

Gravels

- The gravel water samples contained metals elevated above the screening limit for: cadmium, chromium, iron, manganese and nickel.

Open channels

- Trichloromethane and 1,1,1-Trichloroethane were in concentrations above the detection limit in SW06.
- Per- and poly-fluoroalkylated substances (PFAS) was detected and above the screening limit in SW05. However, PFAS was not detected in SW03.

3.3.3 Ground gas assessment

Ground gas samples were measured for standpipes installed in the made ground. Differential pressure, borehole pressure flow, carbon dioxide, oxygen and methane were recorded during the three monitoring rounds. Based on the BS8485 2015, the results of the ground gas measurements categorised the hazard potential as *very low* with no special measures required for ground gas for the Former Tedcastles Site development.

3.3.4 Summary of contamination assessment

Based on the soil assessment, the soil between 0mbgl to 2mbgl is of poor quality in terms of risk to human health, with the presence of asbestos, polycyclic aromatic hydrocarbon (PAH), elevated metals, and benzene and toluene amongst others. Below 2mbgl, no significant risks were noted in relation to contaminants in the soil.

From the water assessment, the sand/gravel has an overall moderate quality, however, there are elevated concentrations in some determinands which are likely linked to off-site sources and background concentrations. Should it be necessary to dewater the gravel during construction, and dependant on the proposed discharge location, treatment is likely to be required.

Manganese was found to be elevated in the made ground and gravel groundwater samples. Manganese is usually linked to the breakdown of hydrocarbons. There were high levels of hydrocarbons observed in the soil on site. Hence, the concentrations of manganese in the groundwater may be linked to the soil on site and/or an off-site source.

The water quality in the open channels surrounding the site indicates brackish conditions with some elevated metals. During a site visit, a white film was observed on the water in the drainage channel that runs next to Centre Park Road. Due to this observation, per- and poly-fluoroalkylated substances (PFAS) were tested for in the water sample and was found to be present at this location (SW05).

Water quality monitoring carried out at the site indicated that the water quality in the made ground could impact on the water quality in the open channels surrounding the site. However, there is no evidence that the soil and water are impacting the water quality in the River Lee.

Based on the ground gas monitoring, no ground gas protection is recommended for the development.

3.4 Preliminary Waste Assessment

Soil to be disposed off-site has been classified as 17 05 04 and has been preliminarily assessed according to the Guidance of the Classification and Assessment of Waste. Further testing will be required at a rate determined by the waste receiver and the results from that will provide information on the final waste classification of the soil will be based. The waste soil classification was carried out using the Hazwaste Online (HWO) Tool and the leachate results have been compared to Waste Acceptance Criteria (WAC), ISBN 978-1-84095-880-5.

Based on the HWO tool, out of the 49 total samples tested, 6 are classified as Hazardous, 5 are classified as Non-Hazardous and the remaining 38 are classified as Inert. The Hazardous samples have been classified as such due to elevated levels of; chromate, pH and hydrocarbons. The Non-Hazardous samples have been classified as such due to the presence of asbestos in soils (AiS) at less than 0.1%.

There was no pattern in the spacing or depth of the AiS, therefore, it is quite probable that asbestos is present throughout the made ground (see the Figure 4). Consequently, as a preliminary worst case assessment, all made ground samples in the Former Tedcastles Site that are not already deemed Hazardous, will be classified as Non-Hazardous with trace asbestos. This is only an initial analysis and further testing could confirm a different pattern. The natural soil under the made ground was seen to be free of contamination and can be classed as suitable for disposal to an inert landfill.

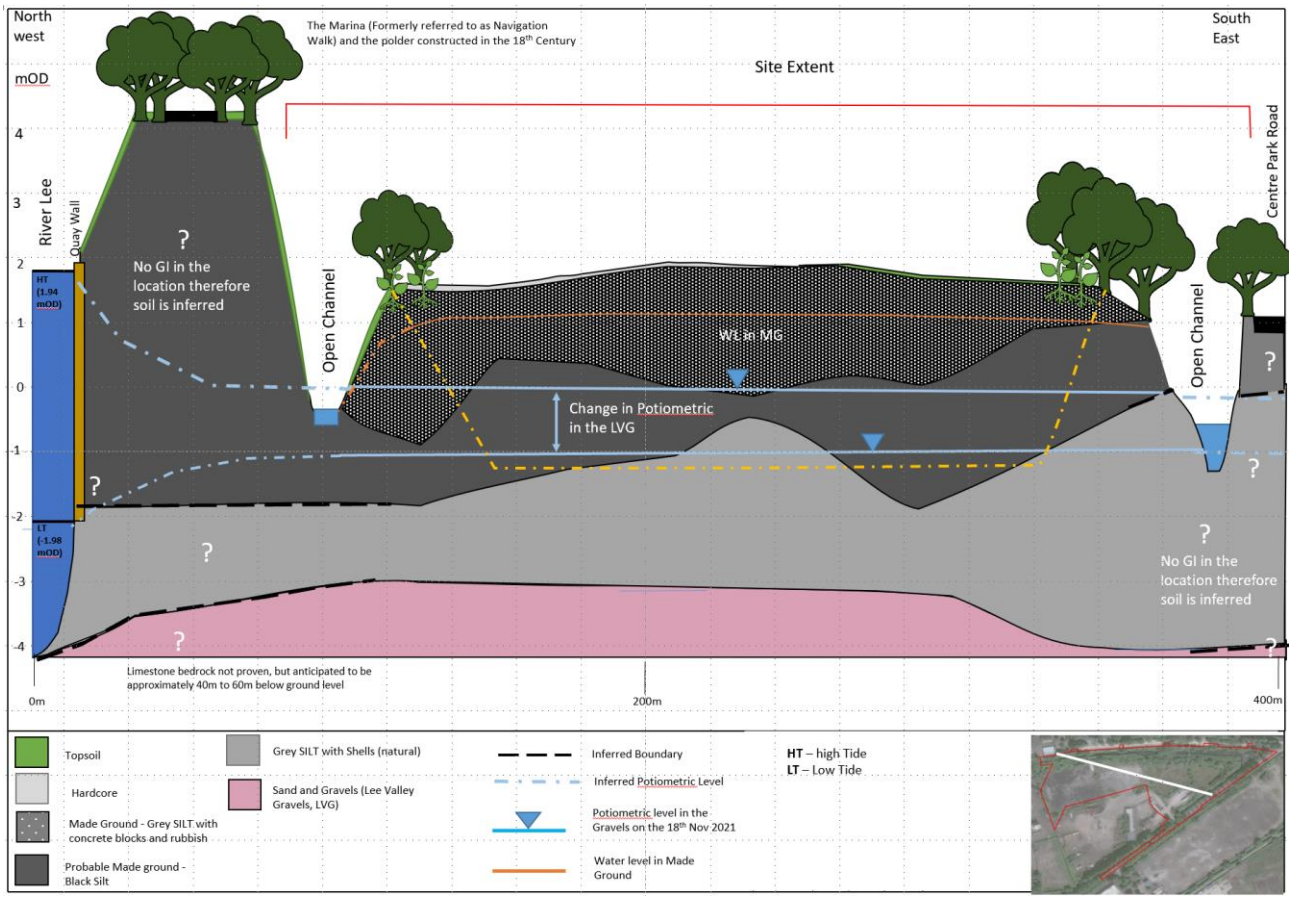

Figure 4: Conceptual site model highlighting ground conditions and indicative excavation line.

3.5 Contaminants of Concern

Based on the ground investigation carried out to date, the principal contaminants of concern are considered to comprise metals, hydrocarbons and asbestos, which are assumed to be present throughout the made ground. PFAS is also a contaminant of concern, which was detected in the surface water sample from the drainage channel that runs parallel to Centre Park Road. PFAS is likely to be present in the sediment in the drainage channel.

The main pathways for these contaminants to reach site users (construction workers and future residents) are though dermal contact with the soil or consuming produce grown in the soil (metals and hydrocarbons) or inhalation of dust generated by the soil (AiS).

Exposure to the metals and hydrocarbons in the soil are considered to be a long-term issue and short-term exposure is not envisaged to have any significant impacts on health of those exposed to them. However, there is no safe limit for asbestos, hence, even short-term exposure is considered potentially harmful.

For the soil on site, as AiS presents the greatest risk to receptors, if soil exposure is minimised to reduce the impact of AiS then this will manage the risks from metals and hydrocarbons. Consequently, the remedial measures presented in the following section are considered in relation to the risk principally from AiS.

There are adverse health and environmental impacts associated with PFAS. Exposure to the surface water at SW05 and the sediment in this drainage channel are considered potentially harmful to the environment. The main pathway for PFAS to reach users is through contact with the water.

The PFAS may reach environmental receptors downstream through mobilisation of contaminated sediment or transport of dissolved PFAS present in the sediment. In addition, during the construction there is a risk of PFAS coming in to contact with the gravels underneath the sediment in the drainage channel if construction is poorly managed.

4. Management of Contaminated Soils

The final design of any remediation will be subject to the detailed design. This will include a detailed Soil Management Plan that will include a volumetric assessment of what soil will be reused, where and all necessary conditions required to allow it to be reused. In this section, the framework required to remediate the PFAS contamination and prepare the Soil Management Plan is highlighted.

4.1 Construction Phase

4.1.1 PFAS remediation

During the construction phase, it will be necessary to investigate the sediments in the drainage channel that runs parallel to Centre Park Road as PFAS is present in the surface water at this location and is likely to be present in the sediment. The sediments will need to be tested to understand the extent of contamination (depth and lateral extent).

A risk assessment will need to be carried out to assess the impact of the presence of PFAS on the gravels and the surrounding water courses, and to account for any seepage from the gravels into the base of the drainage channel. The risk assessment will determine a minimal concentration that can be left in place and will recommend an area and depth to be dug up and disposed of off-site. The risk assessment shall consider the depth to the gravels to prevent breaching the silt under the open channels and opening a pathway to the underlying gravels.

During the remediation of the sediments, measures will need to be put in place to stop the sediments and PFAS contamination from being mobilised and to allow access for an excavator to remove the sediment. Further samples will need to be taken in the drainage channel, where the new sediments have been exposed, to verify the base of the drainage channel is clean material. During the excavation, the sediment samples will be kept separate from soil on site and measures will be put in place to prevent water escaping from the excavated sediments. Once excavated, the sediments shall be classified and disposed of as required. Reuse of the sediments in the drainage channel, onsite or offsite, will not be possible.

4.1.2 Soil management and asbestos in soil

During the excavation of the soils on the Former Tedcastles Site, the soil can either be excavated and disposed of to a suitable landfill or, subject to regulatory approval, it can be excavated and retained for potential reuse on site or reused elsewhere. There is a requirement for non-engineered fill around the foundations once constructed which could take a portion of the excavated soil. The onsite reuse could include the contaminated soils (with or without treatment). Reuse offsite could include the inert natural soils under the made ground. This would be carried out under an Article 27.

Considering the AiS content of the made ground, if the soil is retained on site for potential reuse, then there is a potential legal requirements such as environmental licensing/permitting that will need to be agreed with the local waste regulator Cork City Council and or the Environmental Protection Agency.

The key to retaining soil onsite and demonstrating that it can be re-used, will be understanding the risk of respirable asbestos becoming airborne. This shall be determined by risk assessment and review of additional testing of the soil such as dustiness testing. If the risk is significant then the designer shall need to incorporate measures during construction and operation to mitigate against any risk.

Standard mitigation measures for the construction phase, including excavation, stockpiling, and disposal of the soil are outlined in the CIRIA C733 Asbestos in Soil and Made Ground: A guide to understanding and managing risks (hereafter referred to as CIRIA C733). These include measures such as:

- Maintaining an exclusion zone around the area of the dig;
- Use of personal protection equipment (PPE) such as respiratory protection and full body disposable suits;

- Controlling surface water run-off from contaminated soil;
- Spraying soil to minimise dust generation; and
- Covering exposed soils.

Figure 5 summarises the different risks involved in dealing with AiS and how these can be managed by standard mitigation measures.

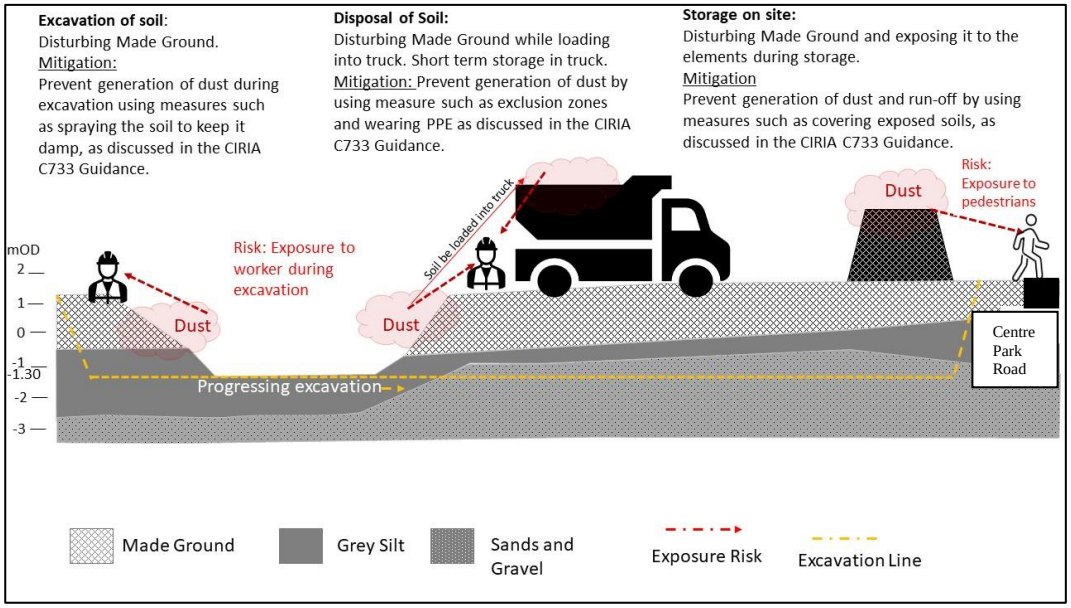

Figure 5: Different risks involved in dealing with asbestos in soil and standard mitigation measures. The geology and elevations are indicative.

It is likely that the construction will involve some soil to be disposed of off-site. Following the 2013 HSA Asbestos Guidance Document entitled Asbestos-containing Materials (ACMs) in Workplaces Practical Guidelines on ACM Management and Abatement, collection, transport, and disposal of asbestos waste should only be undertaken by an authorised waste collection permit holders under the Waste Management (Collection Permit) Regulations, 2007, (S.I.No.820 of 2007) and waste sent to an appropriately authorised facility for disposal.

Notification

A risk assessment shall be carried out by a competent person and in line with Section 6 of the 2013 HSA Asbestos Guidance Document. Where the risk assessment indicated that an asbestos work activity is high risk, then it is required to submit a notification in writing to the HSA. Section 16 of the 2013 HSA Asbestos Guidance details the requirements on notification to the HSA.

An exemption to notification to the HSA is when the risk assessment indicates lower risk asbestos work activities where exposure is low and sporadic. Discussion with the Cork City Council will help advise weather Notification to the HAS will be required.

The Safety, Health and Welfare at Work (Asbestos) Regulations

The Safety, Health and Welfare at Work (Asbestos) Regulations 2006 - 2010 apply to all work activities which expose people to risks arising from the inhalation of dust from asbestos or asbestos containing materials.

The main risk relates to dry soils and generating dust during excavation or by vehicular activity. The likely airborne fibre concentrations released from AiS will depend on the types of activities involved (hand digging or mechanic digging etc), the amount and the types of Asbestos being disturbed. During the construction phase the generation of dust must be managed by measures such as PPE, exclusions zones, good site awareness, site management, asbestos specific mitigation measures and appropriate training of staff. Part 2 of the CIRIA C733 details the management of risks associated with asbestos in soil and made ground.

Monitoring

The contractor who carries out the earthworks shall be required to demonstrate that the control measures do not release airborne asbestos fibres. It is a mandatory requirement, as stated in the 2013 HSA Asbestos Guidance Document to implement an air monitoring program by an independent analyst during the removal of the asbestos in soil.

In addition, the contractor shall keep a watching brief to manage any unforeseen hotspots that may be encountered during the dig.

Storage of soil on site

Waste soil can be temporality stored on site during the construction phase. Storage of the waste soil should follow Section 17 of the 2013 HSA Asbestos Guidance Document, which states that the waste soil '*must be placed in a dedicated lockable skip or suitable controlled compound'*. There needs to be clear agreement on who is responsible for the waste soils stored on site. Care and diligence should be exercised when looking at both storage and disposal.

The main risk to storing soils on site relates to dry soils and generating dust allowing fibres to become airborne. The soil can be stored as stockpiles on site but good site management of these shall be implemented to prevent the generation dust and prevent any potential runoff from the stockpile. The CIRIA C733 outlines good management measures relevant to any soils with AiS stored on site.

4.2 Operational Phase

The sediment containing PFAS that presents a risk to the environment will be removed from site during the construction phase. Consequently, there will be no risk to the environment during the operational phase.

The soil containing asbestos may have suitable engineering properties that could make it useful as a fill material. Subject to the necessary regulatory approval during the detailed design analysis shall be undertaken to consider the potential options for reuse of the soil. Suitable potential re-use options include between pile caps, under hard and soft landscaping under areas such as communal spaces. The detailed design shall consider the necessary control measures to prevent site users being exposed to the AiS where contaminated soil is reused.

The CIRIA C733 states that AiS should be at a suitable depth below the ground level dependant on the risk of site users being exposed to the soil. In areas where soil is uncovered and in communal spaces, a significant thickness of clean materials is required to act as a barrier material. When soil is covered by infrastructure, such as roads and buildings, the thickness of the barrier can be reduced.

5. Conclusion

Based on the investigation and assessments carried out to date, the biggest risk to human health or the environment during the development of the Former Tedcastles Site is the presence of asbestos in soil (AiS) and per- and poly-fluoroalkylated substances (PFAS) in sediment. Other soil contaminants exist but will be dealt with by the same measures that shall be employed for the AiS.

During construction and the operation of the development, there is the potential for asbestos fibres to become airborne. The likely airborne fibre concentrations released from AiS will depend on the types of activities involved (hand digging or mechanic digging etc), the amount and the types of asbestos being disturbed.

Suitable standard measures such as continued dampening of soil during excavation, disposal or stockpiling will help prevent generation of dust. The CIRIA C733 provides suitable guidelines on how to reduce the risks from the presence of AiS during construction and operation of the proposed development.

Exposure to the surface water and the sediment in the drainage channel is considered potentially harmful to the environment. Further investigation shall be carried out to understand the extent of the PFAS

contamination in the sediment of the drainage channel. PFAS may reach environmental receptors downstream through mobilisation of contaminated sediment or transport of dissolved PFAS present in the sediment. A risk assessment will be carried out to determine a safe concentration that can be left in the sediment. If necessary, the sediment that possess a risk shall be excavated and removed from site.

In line with best practice and subject to regulatory approval, during the detailed design, options to reduce disposal of soil will be followed. The re-use of soil containing asbestos shall be subject of a risk assessment and discussed and agreed with Local Authorities or the EPA, as necessary. Where disposal of waste is unavoidable, this shall be done in accordance the necessary waste regulations.