Baseline for Environmental Assessment of Contamination and Remediation

Volume 2

AS PART OF PREPARATION OF THE

STRATEGIC DEVELOPMENT ZONE
PLANNING SCHEME
FOR
POOLBEG WEST
(SI No. 279 of 2016)

for: **Dublin City Council**

Civic Offices

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Sources of Baseline Information to support the Environmental Assessment of Contamination and Remediation

These lands and their surroundings have been the subject of extensive previous site investigations and reporting. Three sets of reports summarise all of the most relevant investigations and findings. These reports – which are reproduced in full in the following pages - are as follows:

1. Site Description of IGB Site ARUP, 2016 Site History and Surrounding Land Use

2. Section 7 of EIS for Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme – Geotechnical, Soils & Ground Conditions Malone O'Regan, 2009

3. Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme Geotechnical Report *Mott MacDonald Pettit May 2008*

1. Site Description of IGB Site ARUP (2016)

Site History and Surrounding Land Use

The IGB site originally formed part of Dublin Bay. Historic maps from the National Library of Ireland show that the original shore line ran close to the Beach Road/Irishtown Road line. Ringsend was reclaimed early in the 19th century as the South Docklands continued to develop in an easterly direction along the banks of the River Liffey.

Dublin Corporation operated a landfill at Ringsend post-1948 to 1978, on reclaimed land forming the Poolbeg Peninsula. Dublin Corporation maps indicate that the infill material was predominantly domestic waste.

IGB production operations commenced at the site in 1967 and ceased in 2006.

A photograph of the pre-remediated site is provided below.

Photograph 1: Aerial Photograph of the Irish Glass Bottle Site prior to remediation

Site Description and History

Site Decommissioning, Demolition and Remediation (DDR) works were completed at the former Irish Glass Bottle facility between December 2007 and December 2008. The DDR works were designed to remove all vestiges of plant, buildings, operations and ancillary services associated with glass bottle manufacture at the facility in order to facilitate surrender of the site IPC Licence from the EPA. The DDR works were carried out with cognisance to **the site masterplan** which involved redevelopment of the site as a mixed use development.

Throughout the decommissioning, demolition, and remediation works on site, special consideration was given to the fact that the site was situated on an old landfill.

In particular the remediation strategy and remediation site specific target levels (SSTLs) were designed with reference to the scenarios allowed for in the site development masterplan, specifically in relation the necessary levels of excavation required to facilitate site redevelopment. The principles taken into consideration in designing the formation dig level are described below:

- The site's proximity to the sea and the possible influence of global warming effects was considered. As such the site nominal 'ground' levels were designed to be an order of 1 to 2 m higher than historical levels.
- An excavation level of nominally 2 m was chosen to ensure removal of all IGB production facility buildings and infrastructure.
- The provision of basement space, beneath the future proposed mixed use development for car-parking and ancillary services was chosen as a method to create a wide (and ventilated) physical barrier between the existing legacy fill and the future habitable space of the new development. This option allowed for leaving deeper deposits of the legacy landfill in place, hence reducing the quantity of waste that required export and disposal. This also ensured that large quantities of fill material would not require to be imported to the site for future development. This option created the most environmentally sustainable solution.
- Inert material produced during the demolition and excavation activities was re-used onsite where possible as crushed capping material and for establishing road footprints. This minimised the quantity of waste disposed off site and was in keeping with the EPA published "National Hazardous Waste Management Plan 2008-2012".

The site remediation works were completed with a view that no further remediation would be necessary and any additional protection measures required for future site development would be those normally implemented in the redevelopment of such brownfield sites.

The Decommissioning, Demolition and Remediation works rendered the site to a position where all traces of the licensed facility and a proportion of the legacy landfill (approximately 2 m depth) was removed from the site. Licence Surrender was granted from the Environmental Protection Agency in October 2009.

The site has remained dormant and undeveloped since this time frame.

Remediation Works

Upon completion of the decommissioning, demolition and remediation works at the site in December 2008, the site was closed and remote security was implemented. These works rendered the site to a position where all traces of the licensed facility and a proportion of the legacy landfill had been removed from the site. It was recognised that the residual material in place in the current remediated site comprised of consolidated domestic refuse and therefore appropriate and conservative protection measures were taken into consideration. As such, the site was covered with an inert capping layer ready for re-development.

The site layout reflected the proposed development plan for the site in terms of positioning of earthen roads and the positioning of services required for future site works. The current site condition also addressed the fact that planning for the proposed development was not in place at the time of licence surrender so the site would remain in an interim state until future development works commenced.

The site layout in this interim condition is described below.

Formation Capping Layer

A capping layer of 300 mm thickness is in place over the excavated landfill material on site. This ensures that site users in the interim condition are not directly exposed to landfill material. The material for the capping layer was provided by site won hardcore and on-site crushing of brick/concrete produced during the demolition phase of works on site. All surplus crushed material was stockpiled on site.

Perimeter Berm

The site excavation profile developed with cognisance to the proposed development plan for the site, allowed for a 7.5 m wedge to be left in place around the perimeter of the site. There are a number of major utility pipes and cables running close to the site boundary along Sean Moore Road and South Bank Road which have not been disturbed by virtue of leaving this berm in place. A slightly wider berm area was allowed for at the site entrance, due to the recessed position of the site entrance gates.

The sides of the berm incline at a slope of 1:2.5 into the excavation and are capped with a cover of 300 mm of crushed site won material. The material within the berm is similar to the material removed from elsewhere within the site during excavation, and consists of residual legacy landfill material.

A photograph of the perimeter berm and capping layer in place is provided below.

Photograph 2: site condition showing the perimeter berm

Services

The original site services (such as water and electricity supplies and foul sewer connections) were moved and terminated at the site boundary ready to facilitate future development requirements. The site heavy fuel oil supply line was plugged and terminated at the site boundary.

Build Up of Road Footprints

The lower level footprints of four earthen roads were formed on site during excavation works on site. These northwest-southeast trending road footprints have a finished level of +3.5 m OD and are capped with 300 mm of crushed stone.

The formation of the road footprints in these locations were in line with the design principles set out in the proposed masterplan for the site.

Stockpiles

A number of stockpiles of site won crushed material, produced during the demolition works remain on site for future use in site development. It was intended that this material will be re-used on site, and would not be removed from site.

Photograph 3: Aerial photograph indicating the rood footprints and stockpiles present

In order to surrender an IPC Licence a number of conditions must be satisfied. These conditions are stipulated in Section 95 of the Environmental Protection Agency Act 1992 as amended by the Protection of the Environment (PoE) Act 2003 (the "EPA Act 1992 as amended").

Firstly the licensed activity or installation must be considered. The PoE Act requires that the EPA must be satisfied that the particular activity is "not causing or likely to cause environmental pollution". In response to this requirement, a CRAMP (Closure, Restoration and Aftercare Management Plan) for the IGB site was agreed with the EPA.

In addition to the licensed activity, surrender of an IPC Licence also requires consideration of the site on which the licensed facility is located. The PoE Act stipulates that the EPA must be satisfied that the "site of the activity is in a satisfactory state" in order to accept licence surrender. The Quantitative Risk Assessment prepared for the site end use scenarios addressed this requirement.

Closure, Restoration and Aftercare Management Plan

The Closure, Restoration and Aftercare Management Plan (CRAMP) [1] for the IGB site documented the site conditions and mapped the path to clean closure of the site. The plan fully described the methodology to be used in each of the decommissioning, demolition and remediation phases of the works on site. The plan stipulated that the remediation strategy was linked to the future development site masterplan and addressed the elimination of risk from the underlying legacy landfill material; allowing the reuse potential of the site to be maximised.

Extensive environmental monitoring and validation was carried out throughout each of the phases of works on site. The success of the CRAMP was confirmed through a validation sampling process in order to demonstrate that no potential residual impacts of the IGB operations remained at the site. This validation sampling formed part of the Site Specific Quantitative Risk Assessment, which is described below.

Site Specific Quantitative Risk Assessment

The CRAMP specified the development of a site specific quantitative risk assessment for the site in terms of the end use scenarios. These end use scenarios comprised of:

- the current remediated site in its interim condition ready for site development.
- future construction and development plans for the site (as based on the understanding of the masterplan at the time)

The contaminants present and potential pathways for exposure were considered for both end use scenarios.

The CRAMP also recognised that future development at the site would require additional site specific risk assessments.

Validation Sampling

Validation sampling was carried out throughout the remediation works to:

- confirm that all vestiges of the IGB glass manufacturing operations had been removed from the site,
- determine the quality of the residual material in the underlying domestic landfill, and;
- validate the protection measures for the external environment and future site users.

The validation sampling process was also intended to provide data for any future risk assessments required under the statutory planning process, for the design of building protection measures in the future site development.

Site Specific Target Levels (SSTLs) were developed based on the understanding of the redevelopment masterplan in place at the time. Site-Specific Target Levels (SSTLs) are “clean-up” standards, calculated on the basis of site-specific information and parameters. SSTLs represent the mean concentration, in soil or groundwater that will prevent unsafe exposure to human or environmental receptors.

The derived SSTLs were compared to the contaminant concentrations detected on site to assess the need for response action. If the concentrations of a contaminant were found to be above the SSTL then an action plan would be developed to address this.

The laboratory analyses received for the validation sampling were compared to the Site Specific Target Levels (SSTLs) for both the current interim site status and required protection measures for the proposed future development.

This data demonstrated acceptable results for the specific design stipulations and no additional remediation was required.

2. Section 7 of EIS for Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme – Geotechnical, Soils & Ground Conditions Malone O'Regan, 2009

7.0 Effect on the Environment: Geotechnical, Soils & Ground Conditions.

7.1 Introduction.

7.1.1 This chapter has been prepared by Malone O'Regan and discusses the existing soils, geology and general ground conditions as well as providing an overview of existing contamination of the Draft Planning Scheme Area. The chapter also addresses the potential impacts of the Draft Planning Scheme at Poolbeg Peninsula on the soils and geology and the mitigation measures that may be employed to reduce/ eliminate potential impacts where necessary. Furthermore, this chapter identifies contaminants that have the potential to impact on human health or the environment.

7.2 Assessment Methodology.

7.2.1 A desk-based study of the Draft Planning Scheme Area was conducted which involved reviewing available geotechnical information held by the Geological Society of Ireland (GSI) and others on the area. The following sources were identified and reviewed during this assessment:

- Published Ordnance Survey mapping to assess the surface topography and landforms.
- Soils maps of Ireland.
- The *Dublin Docklands Area Strategic Environmental Assessment* of the *2008 Draft Docklands Master Plan.*
- Depth to bedrock data and other quaternary information obtained from the Geological Survey of Ireland (GSI) Geotechnical Map viewer from previous ground investigations.
- Geology of Kildare-Wicklow – GSI Publication.
- Existing geotechnical reports prepared for sites within and adjacent to the Draft Planning Scheme Area were also reviewed including available reports from the Dublin Waste to Energy Project, Fabrizia and Irish Glass Bottle development sites (See Section 7.7 References).

7.3 The Receiving Environment.

7.3.1 *The Draft Planning Scheme Area - Historical Background and Uses.*

7.3.1.1 The eastern edge of the Draft Planning Scheme Area was first used in 1903 to generate electricity in Pigeon House. Land further to the east was subsequently reclaimed where Poolbeg Power Station, powered by oil, was opened in 1971.

7.3.1.2 Lands to the west were historically used by Dublin City Council as a landfill. The Irishtown Tip Head, which was reported to have commenced operation in 1948, was closed and capped in 1978. It is reported that the landfill was worked in a sequential fashion, with landfilling activities moving in an easterly direction over time (AWN, 2004). Following capping of the former landfill area around 1978, lands to the west of the overall development lands were leased to Irish Glass Bottlers (IGB) Ltd. until 2004. The IGB plant was also built on part of this landfill.

7.3.1.3 The central area of the site was and is currently used for the tank storage of molasses and oil. Other areas of the site were used by Dublin Port for storage and other associated port-related activities.

7.3.1.4 Currently a redundant and overgrown pitch and putt course is located within ESB lands while a rowing clubhouse is also situated in the centre of the scheme area. Three concrete production facilities and a scrap metal works also currently operate in the Scheme area.

7.3.2 *Ground Conditions – General.*

7.3.2.1 The general ground conditions and geology are outlined in the Dublin Docklands Area *Strategic Environmental Assessment* of the *2008 Draft Docklands Master Plan.* Much of the subsoil in the Draft Planning Scheme Area is made up of made ground overlying recent marine deposits of mixed silts or clays and fine sands and glacial and fluvio glacial deposits of sands and gravels with some cobbles and boulders in places. This is underlain by glacio-marine deposits of sandy clays with some silt and sand layers overlying weathered rock of boulders, cobbles, gravels, clays and silts on strong, dark grey, mostly thinly bedded, fine grained carboniferous limestone bedrock (Arup, 2006).

7.3.3 *Made Ground/ Fill Material*.

7.3.3.1 The made ground within the Draft Planning Scheme Area consists of distinct types of material which include the municipal waste filled as part of the Irishtown Tip Head (1945-1978) and general construction and demolition (C&D) waste. It is also reported that hydraulic fill material was used to reclaim distinct areas of the site (Arup, 2006).

7.3.3.2 Mott MacDonald Pettit (2008) report that site investigations in the Poolbeg area have previously logged made ground as being 1.6 to 5.6m in thickness. The Mott McDonald Pettit Report (2008) is contained in Appendix 7.1. Typically, builder's rubble and similar dry fill were used to construct roads at locations to the west of the peninsula; landfill material was then tipped on either side of the roads.

7.3.3.3 Historically, the Fabrizia and IGB sites were constructed upon part of a Dublin Corporation landfill. It is understood that the general public also dumped refuse in this area during this period. The domestic and other waste beneath this site is expected to have been in the ground for somewhere in the region of 30 to 50 years. No soil gas venting or collection systems were installed on these sites during operation or after closure. Therefore landfill gas could potentially be still present (see further comment under Section 7.3.7).

7.3.3.4 There are no records available as to the exact types and quantities of materials which were dumped at the different sites across the Draft Scheme Area. However, from an examination of the trial pit logs and boreholes from site investigations carried out on the Fabrizia and IGB sites and from a review of a geotechnical assessment report produced by Mott MacDonald Pettit (2008) it would appear that much of the fill comprised of domestic and Construction and Demolition (C&D) waste. The composition varied greatly but commonly consist of a mixture of gravels, sands, silts, clays, rubble, bricks, concrete, glass, timber, concrete slabs, cabling, piping, rags, metal household containers and cinders (non-exhaustive list).

7.3.4 *Quaternary Deposits.*

7.3.4.1 Superficial soils have been well mapped in the Poolbeg area from the quantity of site investigations that have been undertaken. A review of the Geological Survey of Ireland (GSI) Geotechnical Map viewer and available geotechnical reports provided information on the thickness of superficial sediments and their composition within the Draft Planning Scheme Area.

7.3.4.2 According to the Geotechnical Report for the Poolbeg Peninsula Planning Scheme (Mott MacDonald Pettit, 2008), the soil overlying the limestone bedrock consists of a relatively thin layer of brown slightly silty or clayey gravel, with cobbles and/or boulders. This is overlain by over 20m of material consisting of stiff dark grey or black slightly sandy clay with layers and laminations of silt and silty sand overlain by silt with sand laminations. Above this is a layer over 10m deep of sands and gravels with occasional cobbles and boulders. This layer is occasionally silty in nature. Overlying the drift geology, the next layer consists of marine or seabed deposits up to 2.5m thick. There is also evidence of riverine deposits from the Liffey and Dodder. This layer generally includes soft or loose to medium dense sandy silt and slightly clayey/ silty fine sand including shell fragments and some fine gravel. Some silty clays are also encountered at this level but these are less common.

7.3.5 Bedrock.

7.3.5.1 The Geological Survey of Ireland (GSI) has published maps (at a scale of 1:100,000) and memoirs of the bedrock geology, Sheet 16 of which covers the Poolbeg Peninsula in which the Draft Planning Scheme Area is located. The sheets show the rock formations which are interpreted to be present below the surface drift deposits. The bedrock geology of Dublin is dominated by rocks of carboniferous age, and the scheme area is underlain by Calp Limestone (Dinantian Upper Impure Limestones). There are a number of faults in the Calp limestone however studies show that the area under review is unfaulted.

7.3.5.2 The geological map indicates that the Calp Limestone itself is comprised of dark grey to black limestone with shales. While the top 1m or so layer of rock is weathered, the overall mechanical strength is described as strong to very strong (Mott MacDonald Pettit, 2008).

7.3.5.3 Bedrock on the Peninsula lies between 30 and 50m below ground level. The deepest rock is in the central area with slightly shallower rock at the tip of the Peninsula and around Sean Moore Park and the IGB/ Fabrizia sites.

7.3.6 Landfill Gas.

7.3.6.1 As discussed in Section 7.3.1, part of the Poolbeg Peninsula was formerly used for the disposal of significant quantities of municipal solid waste, a portion of which is biodegradable and which biodegraded anaerobically to form methane gas and carbon dioxide and small quantities of hydrogen sulphide. Landfill gas production levels generally peak between 5 and 20 years after closure of a landfill and decline thereafter. However, landfills may continue to produce landfill gas for up to 50 years after closure. Landfill gases can pose a risk to human health and the environment at specific concentrations and depending on the site use if the necessary mitigation measures are not imposed including the requirement for a detailed risk assessment.

7.3.6.2 Landfill gas surveys completed in 2004 indicate that some areas on the Peninsula (e.g. south of the Fabrizia site) are continuing to produce methane gas. However, overall methane gas production levels are quite low, and have declined between 1999 and 2004. While flow from an active landfill can be as high as 50 litres/hour, gas flows of up to 0.8 litres per hour were recorded in some boreholes during an investigation of the Fabrizia site in 1999, which decreased to 0.1 litres per hour in 2004 indicating that gas production had declined (AWN, 2004).

7.3.6.3 The Department of the Environment (DOE) published guidelines in 2004 titled *'Protection of New Buildings and Occupants from Landfill Gas*'. The guidance document specifies limits of 1.5% v/v methane and 0.5% v/v carbon dioxide. Specialist engineering design must be used when constructing buildings on lands in excess of these limits. The DDDA will ensure that

landfill gas risk assessments and mitigation measures are taken into account for any development where the presence of landfill gas is suspected.

7.3.7 *Contamination.*

7.3.7.1 In recent years a number of site investigations were undertaken within the Poolbeg Peninsula area that involved the installation of boreholes and trial pits and associated soil sampling (both within and outside of the Draft Planning Scheme Area). The results showed concentrations of contaminants at elevated levels reflecting the filling activities and industrial history of the area. Reports from sites within the boundary of the Draft Planning Scheme Area and adjacent to it have been briefly reviewed in terms of contamination found and a factual summary of the findings presented in the reports are outlined in Sections 7.3.8 – 7.3.10 below.

7.3.8 *Fabrizia Site.*

7.3.8.1 AWN Consulting completed the soil and geology assessment of the Environmental Impact Statement (EIS) which accompanied the 2004 mixed use office, residential and supportive retail facilities proposal on the Fabrizia site. Reports indicate that there is 3.0-3.5m of domestic refuse and builders rubbles beneath 1m of topsoil (landfill cap) consistent with reports that the Irishtown Tip Head is located within that area. The waste identified included timber, bricks, concrete slabs, cabling, piping, rag and metal household product containers.

7.3.8.2 According to Appendix 14 of the Fabrizia EIS, in addition to the main site investigation (which was not available for review as part of this assessment), a site investigation was also carried out at the Fabrizia site in 1999 due to a suspected oil leak. The report identified the presence of gasworks waste as well as elevated concentrations of Polycyclic Aromatic Hydrocarbons (PAHs). Appendix 14 of the Fabrizia EIS is contained as Appendix 7.2.

7.3.8.3 Trial pits excavated at the Fabrizia site also highlighted some localised hydrocarbon contamination, notably in the north east corner. Some additional isolated contaminated areas (mainly metal contamination) were also identified at the site and some asbestos fibres noted in some of the trial pits. In general, asbestos fibres pose a risk if they become airborne. These potential risks may be mitigated against by a construction management plan, appropriate risk assessments and the implementation of any required remedial measures.

7.3.8.4 Landfill gas investigations also determined that landfill gas was still being produced at the site (AWN, 2004) and reported maximum concentrations of methane and carbon dioxide detected of 23.1% and 29.2%, respectively. It is clear from the limits detailed in Section 7.3.6.3 above that the levels recorded in 2004 exceed the DOE limits for methane and carbon dioxide of 1.5 % and 0.5 %, respectively; therefore further assessment of landfill gas production and remedial engineering design measures would be required prior to development based on those concentrations.

7.3.9 *IGB Site.*

7.3.9.1 A number of investigations and assessments were carried out at this site in 1996 (K.T. Cullen & Co.), 2005 (GES) and 2007 (Arup Consulting Engineers). The report produced by K.T. Cullen & Co. Ltd. (1996) was available for review. Consistent with general information for the Poolbeg Peninsula area, the site investigation indicated that the entire site had been constructed on a former landfill. It is reported that the overburden profile consists of up to 7.0m of backfill material consisting of rubble, plastic, timber, rocks, bricks, glass jars, paper, clay, sand and hardcore.

7.3.9.2 Analytical results were compared against the Dutch Intervention Values (RIVM, 2000). These intervention values represent the level of contamination above which there is a serious case of soil contamination. If the Intervention values are exceeded, clean up should be considered (unless and subsequent site specific risk assessment proves others) (Arup, 2006). Analytical results indicated that the material beneath the site was contaminated with varying levels of hydrocarbon, arsenic, lead, mercury and PAHs in excess of the Dutch I values (K.T. Cullen & Co., 1996).

7.3.9.3 There were no reports on landfill gas available for review with regards to the possible presence of landfill gas at this site.

7.3.10 *Proposed Waste-to-Energy Site.*

7.3.10.1 Arup Consulting Engineers carried out a desk based review (2006) of the site investigations that were undertaken at the proposed Dublin Waste to Energy Site in 2003 (Geotech Specialists Limited) and 2005 (RPS). This site is outside the Draft Planning Scheme Area, however the report gives further details on the general fill and contamination within the area and contains details on adjacent sites within the Draft Planning Scheme. The site investigations determined that in general made ground was 1.6m to 5.6 m thick across the site and consisted of a mixture of gravels, sands, silts, clays, rubble, bricks, concrete, glass, timber and cinder.

7.3.10.2 Analytical results were compared against the Dutch Intervention Values (RIVM, 2000). The results showed that the fill materials across the site showed evidence of hydrocarbon contamination, lead, copper and zinc at varying concentrations.

7.3.10.3 Landfill Gas: Elevated landfill gas concentrations at the adjacent site (south of the proposed Waste to Energy site and west of the nature reserve) were reported from monitoring carried out in 1997. Methane concentrations of 27-59% and carbon dioxide concentrations of 22-32% were reported. It is clear from the limits detailed in Section 7.3.6.3 that the levels recorded in 1997 exceed the DOE limits for methane and carbon dioxide of 1.5 % and 0.5 %, respectively; therefore further assessment of landfill gas production and remedial engineering design measures would be required prior to development based on those concentrations.

7.4 Relevant Characteristics of the Draft Planning Scheme.

7.4.1 *Construction Phase.*

7.4.1.1 The earthworks and construction phase will at a minimum involve contaminated soil disturbance and may potentially involve contaminated soil removal for design purposes (i.e. the construction of basements) or for risk assessment purposes (i.e. removal of contaminated material that exceeds a human health and environmental risk assessment) pending further site investigation and/or risk assessment.

7.4.1.2 A full geotechnical assessment will be required for each potential development site before detailed foundation design can be carried out. It is considered that conditions may not be favourable for conventional strip or raft foundations and therefore, it is likely that extensive piling will be required for significant building (Mott MacDonald, 2008).

7.4.1.3 There is a possibility that parts of the Peninsula might be filled in order to raise the levels. If this does happen, it may be possible to use soil stabilisation techniques as an alternative to deeper piles (Mott MacDonald, 2008). However, a full geotechnical assessment would need to be carried out before this could be considered further.

7.4.2 Operational Phase.

7.4.2.1 Given the nature of the development, the impact on existing soils arising from the Draft Planning Scheme in the long term is not expected to be significant. Heating will be via district or gas heating systems and therefore the potential for further soil contamination is limited.

7.5 Likely Impacts of the Draft Planning Scheme.

7.5.1 The potential impacts of the Draft Planning Scheme on soils and geology during the construction and operational phases are outlined below. The potential impact of contaminated land on groundwater and surface water is identified in Chapter 8.0 which deals with this topic. The potential impact of the presence of contaminated soil on human beings is identified below.

7.5.2 *Construction Phase.*

7.5.2.1 The bedrock on Poolbeg Peninsula is too deep to be impacted by the proposed Planning Scheme during the construction phase, even if piling operations are required.

7.5.2.2 As with all construction sites, there is the potential for contamination of soils by waste oil, fuel, chemical spillages etc. used during the construction stage. Mitigation measures are described below to address these potential concerns.

7.5.2.3 In case of excavation in areas where contaminated soil is present on site there is a risk of exposure and mobilisation of contaminants into clean soil.

7.5.2.4 Landfill gases and contaminated soils encountered during excavation works have also the potential to represent a risk for site workers and surrounding areas.

7.5.2.5 The potential impacts will be mitigated as described under Section 7.6 below.

7.5.4 Operational Phase.

7.5.4.1 In the long term, there is the potential for further contamination of existing soil as a result of run-off from surface and underground car parking areas and other paved areas across the site. Mitigation measures are outlined below to address this particular issue.

7.5.4.2 In addition, leakage from sewage pipelines could potentially contribute to heavy metal and bacterial contamination of subsoils which could then impact on the adjacent water bodies. Impacts on water are discussed in Chapter 8.0 – Water of this EIS.

7.5.4.3 Contaminated soil present could potentially affect future occupiers if pathways from the source of the contamination to the receptors (future occupiers) are present. Mitigation measures are described under Section 7.6 to prevent this occurrence.

7.5.4.4 Landfill gas could potentially migrate from undeveloped to developed areas. Mitigation measures to prevent this occurrence are described below.

'Do Nothing' Scenario.

7.5.4.5 The 'Do Nothing' scenario would not realise the potential to remediate areas of Poolbeg Peninsula compared to the 'Do Something' Scenario or the Draft Planning Scheme proceeding.

7.6 Mitigation.

7.6.1 Suitable remedial and mitigation measures which should be put in place during both the construction and operational phases are outlined below.

- Further site specific investigations and contaminated land risk assessments for construction and future users should be conducted in accordance with the standards for site investigation notably BS5930: 1999 'Code of Practice for Site Investigations' and

BS10175: 2001 'Investigations of Potentially Contaminated Sites – Code of Practice'. Specialist risk assessment practitioners should be employed to evaluate all potential risks to human beings or the environment prior to construction commencing.

- Contamination that is encountered within the Draft Scheme Area should be assessed against remedial targets derived from a site specific risk assessment and may require some form of intervention depending on the levels of contamination encountered and the recommendations derived from the risk assessment carried out at each site. This should be undertaken prior to any development works taking place.
- Furthermore, the *Dublin City Development Plan 2005-2011* indicates that where the previous history of a site suggests that contamination may have occurred, then developers will be responsible for undertaking a detailed site survey and analysis to establish whether contamination has occurred, as well as providing a detailed written report of the survey and assessment with recommendations for treating the affected ground.
- The DDDA will prohibit development until it is satisfied that the affected ground and any associated risks have been satisfactorily remediated.
- Remediation measures involving the excavation, removal or disposal of contaminated soil, where required, will be completed in accordance with the requirements of the *Waste Management Act 1996* and all subsequent regulations and standards that are current at the time the work is carried out.
- Design of all commercial and residential buildings will comply with current and relevant Building Regulations and any subsequent regulations, amendments and standards that are current at the time the work is carried out.
- Landfill gas emissions where observed on site will require suitable engineering design for gas mitigation and control at design stage. Soil gas barrier systems may be required to protect new buildings from adjoining undisturbed landfill areas.
- In order to minimise the potential for spillages to drains and possibly further to subsoils, all roadways will be effectively sealed with surface water discharges draining to sealed surface water drains. Similarly any run-off collecting in subterranean basement car parking areas – including run-off from oil, leaks, spillages or other sources – will also be collected in a sealed foul drainage system (see also Chapter 8.0 – Water for other related mitigation features).
- Developers will be required to draw up Construction Management Plans detailing protection measures for human health and the environment during construction including measures for waste management, soil handling, water run-off etc.

7.7 References.

Dublin Docklands Area Strategic Environmental Assessment of the Draft Master Plan, 2008.

Dublin Waste to Energy Project, Ringsend, Dublin, Chapter 11, Appendix 11.1 Geo-Environmental Engineering Assessment, Arup Consulting Engineers, Elsam, June 2006.

Mixed Use Office and Residential and Supporting Retail Facilities Development at South Bank Road, Ringsend, Dublin 24 for Fabrizia Developments, Environmental Impact Statement, Reid Associates, 2004.

Geology of Kildare - Wicklow: A Geological Description, with accompanying Bedrock Geology 1:100,000 scale map, Sheet 16, Kildare – Wicklow, McConnell and Philcox, 1994.

Poolbeg Peninsula Planning Scheme Geotechnical Report, Mott MacDonald Pettit, May 2008.

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Proposed Development at Irish Glass Bottle Company Ltd. South Bank Road, Ringsend, Dublin for Becbay Ltd., Ground Investigation – Factual Report, Arup Consulting Engineers, August 2008.

Soil & Groundwater Quality Investigation, Irish Glass Bottle Ltd. Dublin 4 for Irish Glass Bottle Ltd. South Bank Road Irishtown Dublin 4 – KT Cullen & Co. Ltd, July 1996.

7.8 Appendices.

Appendix 7.1 Mott MacDonald Pettit Geotechnical Report for Poolbeg Peninsula Planning Scheme, May 2008.

Appendix 7.2 Appendix 14 "*Investigation of Possible Oil Leak at South bank Road, Ringsend, Dublin*" from the 2004 EIS for the Fabrizia Mixed Use Proposal.

3. Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme Geotechnical Report *Mott MacDonald Pettit May 2008*

Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme Geotechnical Report

1. Introduction

Mott MacDonald Pettit has been appointed by Dublin Docklands Development Authority as Infrastructure Consultant for the Poolbeg Peninsula Planning Scheme. Part of the remit is to provide a preliminary, desk based Geotechnical/ Contaminated Land assessment. This is required to provide geotechnical and environmental advice in relation to ground conditions and potential contamination and to identify measures that may be necessary to support development proposals. It should be noted that a more detailed contaminated land assessment will be undertaken as part of the Environmental Impact Statement for the Planning Scheme. This document does not propose to duplicate that process but to highlight key contamination issues and the engineering implications of these. It also sets out to give a brief overview of geotechnical conditions on site and the effects these will have on buildings/ foundations etc. Finally, this report will make recommendations as to future studies that may be required during the detailed design process. This report is intended as a desktop overview only and should not be relied upon for foundation design or even planning stage assessment. Any development proposed in this area will require a detailed geotechnical assessment, including a full site investigation, before design can commence.

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2. General

The proposed redevelopment site located at Poolbeg Peninsula is an area which consists mainly of reclaimed land. Soils in this area show the influence of glaciers, the sea and Liffey and Dodder Rivers. Up until the 1900's much of this area was in fact part of the foreshore before a series of reclamation projects gradually began filling the area. Fill consisted of both inert material, including material dredged from the seabed, and domestic waste. In particular, much of the Peninsula was used as a domestic landfill up until 1978. Analysis of soil samples suggests that the primary use of the landfill was domestic rather than industrial but the possibility of some industrial materials having been dumped there cannot be ruled out. Ashes from the power stations and by products from the nearby town gas manufacturing plant have also been encountered. This history of the site raises both geotechnical and contamination issues. The area is surrounded on three sides by the sea, meaning that high ground water levels are likely. The nature of soil conditions in the area means that detailed site specific information will be required for foundation design.

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3 Existing Conditions

3.1 Bedrock Geology

This is the geology of the solid rock which underlies the ground surface and overlying soils on the Peninsula. The Geological Survey of Ireland has produced a 1:100,000 Bedrock Geology series of maps for the country, Sheet 16 of which (Geology of Kildare – Wicklow) covers the Poolbeg Peninsula. Bedrock on the Peninsula lies between 30 and 50m below ground level. The deepest rock is in the central area with slightly shallower rock at the tip of the Peninsula and around Sean Moore Park and the IGB/ Fabrizia sites. The bedrock in this region consists of sedimentary rocks that are assigned to the Calp Formation of the Carboniferous era (also referred to as Dinantian Upper Impure Limestones). The geological map indicates that the rock in this area is comprised of dark grey fine grained limestones with

interbedded shales. While the top 1m or so layer of rock is weathered, the overall mechanical strength is described as strong to very strong. Given the depth of this rock, it is unlikely to have a direct effect on construction being too deep to require excavation and also too deep for either piles or traditional foundations to bear on it.

3.2 Drift Geology

This is the geology of all mineral material (clay, sand, silt, boulders) transported by a glacier and deposited directly by or from the ice, or by the flow of melt water from the glacier. The drift geology of the Poolbeg area consists mainly of deposits from the last glaciation period. Typically, these materials would have been deposited either beneath an advancing glacier or along its side as a moraine. As glaciers melted, further deposits were laid down by melt waters discharging from the front of the glacier. There is evidence that materials in this area have been modified by the typical marine processes of erosion and deposition prior to the recent period of reclamation. Drift deposits are overlain in places by marine materials which were deposited near the coastal fringes. The soil overlaying the limestone bedrock consists of a relatively thin layer of brown slightly silty or clayey gravel, with cobbles and/or boulders. This is overlain by over 20m of material consisting of stiff dark grey or black slightly sandy clay with layers and laminations of silt and silty sand overlain by silt with sand laminations. Above this is a layer over 10m deep of sands and gravels with occasional cobbles and boulders. This layer is occasionally silty in nature.

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3.3 Marine Deposits

Overlying the drift geology, the next layer consists of marine or seabed deposits up to 2.5m thick. There is also evidence of riverine deposits from the Liffey and Dodder. This layer generally includes soft or loose to medium dense sandy silt and slightly clayey/ silty fine sand including shell fragments and some fine gravel. Some silty clays are also encountered at this level but these are less common.

3.4 Made Ground

There are different types of made ground in the proposed redevelopment area. Inert fill essentially builders rubble or similar, has been placed either as part of the construction and development of the area or has been placed as part of the reclamation project from the sea. Dredged material from the seabed has also been used as fill. Site investigations in the Poolbeg area have previously logged made ground as being between 1.6m and 5.6m in thickness The composition of the made ground in the area is highly variable but commonly consists of a mixture of gravels, sands, silts and clays, including rubble, bricks, concrete, glass, timber and cinders from the Powerstation. The presence of made ground and the frequent industrial usage of land in the Poolbeg area means that hotspots of soil contamination are quite likely to be encountered. Hydrocarbon contamination has been encountered throughout the Peninsula and the history of local sites will give strong indications as to the kind of other contaminants that may be encountered there. In addition to areas being filled with rubble, large parts of the Peninsula have previously been used as a domestic land fill meaning that contamination associated with domestic wastes is certain in these areas. As stated previously, this area is not believed to have been commonly used for disposal of toxic industrial wastes though the possibility of this having occurred cannot be ruled out. Exact records of areas that were landfilled do not exist but it is known that the western part of the Peninsula was used and that the landfill may have extended as far as the Poolbeg Powerstation. The landfill practices at the time would not comply with modern standards for disposal of domestic waste.

3.5 Surface Material

There is a variety of different surface materials on the Peninsula from topsoil layers up to 1m deep to concrete or tarmacadam finishes. The Peninsula would have a relatively high impermeable area at this time. A lot of the surface water generated at the moment is likely to be discharging directly to the sea.
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3.6 Groundwater

Groundwater movement in the region is likely to move principally in the drift layers rather than the hard limestone bedrock. The flow will also be restricted mainly to the sand and gravel drift layers since the stiff clay layers are less permeable. Given that the Peninsula is surrounded three sides by the sea and that no part of the Peninsula is more than 500m from the sea, tide levels will have a significant influence on groundwater. Previous studies suggest that groundwater is likely to be encountered at depths of 2m to 4m below ground level – i.e. tying in with high tide levels. It has been suggested that this may be a perched aquifer with a deeper bedrock aquifer below this. This seems unlikely but a more detailed hydrogeological assessment would be required to confirm this. The effect of the sea is also seen in groundwater quality. Saline intrusion is likely meaning that the water is likely to be brackish. The shallow depths of soil cover over the groundwater table means the groundwater in the area would be classified as highly vulnerable. This combined with the industrial history of the area means that much of the groundwater in the area is likely to be polluted. Previous studies have confirmed this. The Final Characterisation Report of the Eastern River Basin District says that the Dublin City water body is one of only two groundwater bodies in the entire Eastern River Basin District that is classified as being "At Risk of not reaching good status". In the Poolbeg Peninsula area, the abstraction of groundwater for drinking water or other purposes is unlikely to happen in the foreseeable future. However under the EU's Groundwater Directive, there is a requirement to improve groundwater quality regardless of whether or not it is ever intended to use it. Remediation measures associated with the proposed works may lead to some improvement in groundwater quality but should certainly lead to no reduction in quality.
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4. Implications

4.1 Bedrock Geology

Bedrock on the Peninsula is between 30m and 50m deep. This means that it will have little direct affect on construction. The rock is too deep for it to affect excavations, even if particularly deep excavations were to be required. It is also too deep for either direct foundations or even most conventional piles to bear directly onto the rock.

4.2 Soil Types

The soil type in the area is very mixed and we must be very cautious in trying to make general comments. Full geotechnical assessment will be required for each potential development site before detailed foundation design can be carried out. This will include full site investigations and soil testing. It is known to date that a variety of soil types may be encountered on the Peninsula. These include gravel layers with cobbles and/or boulders and either stiff or sandy clays with laminations of silt/ sand. The upper layers consist of sands and gravels with occasional cobbles and boulders. Many of these layers would include silts and would generally include soft or loose materials. In addition to this there is a substantial amount of made ground. Geotechnical conditions in these areas could be very variable. While the stiff clays would appear to be favourable for construction, these are relatively deep and the presence of laminations means that the prediction of their behaviour should be carefully assessed. Layers close to the surface are likely to contain some softer material. The relatively high groundwater table, and the presence of permeable material, means that groundwater issues could be critical in

construction. This will be particularly relevant in the case of tunnels or deep excavations. The result of this is that conditions may not be favourable for conventional strip or even raft foundations. It is highly likely that any significant building anywhere on the Peninsula will require extensive piling. This is technically feasible but will impose costs on developers in the area. Some piling techniques involve the removal of material from deep underground. The use of these techniques may lead to an increased risk of encountering contaminated soil. Non piled solutions may well be used for roads/ pavements and the like. Where shallow foundations exist beside piled foundations, the risk of differential settlement should be considered. It is instructive to note that the buildings on the former IGB site were piled while surrounding pavements were not. This has lead to very obvious differential settlement on that site. There is a possibility that parts of the Peninsula might be filled in order to raise their levels. If this does happen, it may be possible to use soil stabilisation techniques as an alternative to deeper piles. There are a number of techniques available including the use of soil compaction, soil stabilisation using lime or other cementitious materials or the use of geogrids or geotextiles. A full geotechnical assessment would need to be carried out before this could be considered further.
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4.3 Contaminated Ground

Detailed assessments will need to be carried out on every site in the area to assess whether or not the soil and groundwater at that particular site is considered to be contaminated. In the absence of previous site investigations, these assessments are likely to include soil testing and interpretation. Indications at this stage are that some level of contamination can be expected in most areas of the Peninsula. This is due to the previous history of landfilling and reclamation and the many heavy industrial uses that have been in place on the Peninsula. The extent of contamination is likely to vary widely and there are a number of options for dealing with contaminants, depending on how serious the problem is at any particular location. The worst case scenario will be that soil may need to be removed from site and treated/disposed of elsewhere. Low level contamination can be dealt with in Ireland depending on the soil's classification in the European Waste Catalogue. Material could only be transported from the site by a specialist firm who hold a collection permit under the Waste Management (Collection Permit) Regulations 2007. The material would have to be transported to a licenced facility relevant to that waste type. There is no facility in Ireland capable of dealing with seriously contaminated/ hazardous soil any such waste encountered would have to be exported. The removal of this waste would have to comply with the Waste Management (Shipment of Wastes) Regulations 2007. Any removal of contaminated material will have to be done in conjunction with the Environmental Protection Agency and Dublin City Council. Landfill gases are likely to be encountered at some sites with significant methane concentrations having been noted in previous studies. Provision may be required for either trapping or venting these gases. Any site investigation carried out on the Peninsula should include a requirement for gas monitoring. This will have health and Safety implications during the construction phase as there is a possibility of poisonous, explosive or asphyxiating gases filling trenches or other excavations. For less serious contamination, it may be possible to trap the contaminants using material such as dense, impermeable clays. Provision for venting of gases may still be required. It should be noted that this approach is only really practical if deep or extensive excavations are not required. There is considerable evidence of low level contamination with hydrocarbons across the entire Docklands area, including the Poolbeg Peninsula. These include total Petroleum Hydrocarbons and Polynuclear Aromatic Hydrocarbons (PAHs). These can come from oil or tar or from burnt tires or domestic waste. In some area, this material is in concentrations above intervention limits and may need to be removed off site or treated. In many areas it will not be sufficiently contaminated to require that level of treatment. However, hydrocarbons can have very significant impacts on water pipes particularly the modern High Performance Polyethylene (HPPE) pipes which are now commonly used. Hydrocarbons can migrate

through the walls of these pipes causing drinking water contamination. For this reason, pollutant resistant pipes are frequently specified in the Dockland areas. These would include, for example, aluminium lined HPPE pipes which are resistant to hydrocarbon ingress. These cost six times more than conventional HPPE but there is no impact on laying/ backfill costs so the overall cost difference is not that significant. There is a possibility that phenolic compounds and cyanide compounds associated with the manufacture of town gas could be encountered. Phenolic compounds are a particular concern as they can cause tainting of water in plastic pipes. There have been reports of high sulphate levels in parts of the Docklands including the Poolbeg Peninsula, meaning that Sulphate Resisting Cement may need to be considered on some sites. Volatile Organic Compounds have been detected in previous studies. These would include benzene which is a proven carcinogen, as well as xylene, toluene and ethylbenzene. Toxic metal including arsenic have been found in concentrations above intervention limits. Other heavy metals encountered included barium, chromium, mercury, nickel, lead and tin.
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4.4 Groundwater
Groundwater on the Peninsula is likely to be high in all areas. This will have impacts for construction as de-watering is likely to be required in any area where significant excavation is required. It should be noted that any groundwater that is encountered may need to be treated as contaminated water – i.e. direct discharge to the sea is unlikely to be an option. Thus, groundwater is likely to be pumped to the foul sewer network, subject to local authority permission, or be pre treated prior to discharge to the sea. In either case, an IPPC licence may be required from the EPA. The use of infiltration techniques for stormwater drainage may not be possible due to the high ground water table and to concerns about the possible mobilisation of subsoil contaminants. Soil conditions suggest that contaminants could move vertically downwards before being trapped by clay or silt layers. The possibility of mobilised contaminants reaching the sea would have to be considered. The possibility of contaminated groundwater infiltrating into new or existing stormwater pipes and hence flowing to the sea would also need to be considered. As groundwater in the area is tidally affected, the impact of climate change will include an increase in groundwater levels and this should be considered in carrying out geotechnical design on the Peninsula.
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5. Conclusions
The Poolbeg Peninsula is an area which consists mainly of reclaimed land. Up until the 1900's much of this area was in fact part of the foreshore before a serious of reclamation projects gradually began filling the area. Fill consisted of both inert material including material dredged from the seabed, and domestic waste. In particular, much of the Peninsula was used as a domestic landfill up until 1978. The area is surrounded on three sides by the sea, meaning that high ground water levels are likely. The nature of soil conditions in the area means that foundation design will not be straightforward. Soil conditions are likely to be very variable with soft material in the upper layers and high ground water tables. Rock is not likely to be encountered within 30m of the surface. Detailed site investigation will be required at design stage but it is likely that significant piling will be required for any new structures. De-watering could be a serious issue on many sites particularly if deep excavations are required. It is almost certain that some level of ground contamination will be encountered throughout the Peninsula. This is due to the previous history of landfilling and reclamation and the many heavy industrial uses that have been in place on the Peninsula. Detailed assessments will need to be carried out on potential development site in the area to assess whether or not the soil and groundwater at that particular site is considered to be contaminated. These assessments are likely to include soil testing and interpretation and detailed hydrogeological studies. The extent of contamination is likely to vary widely and there are a number of options for

dealing with contaminants, depending on how serious the problem is at any particular location. The worst case scenario will be that soil may need to be removed from site and treated/disposed of elsewhere. Low level contamination can be dealt with in Ireland but seriously contaminated/ hazardous soil any such waste encountered would have to be exported. Any removal of contaminated material will have to be done in conjunction with the Environmental Protection Agency and Dublin City Council. There do not appear to be any geotechnical or contamination constraints that would prevent development taking place on the Peninsula but this will need to be confirmed by detailed investigations. Geotechnical and soil contamination issues do raise serious concerns that will have to be fully explored at detailed design stage. Dealing with soil conditions in this area is likely to impose additional costs on developers.