

**LAND AT CHANNEL VIEW, GRANGETOWN
CARDIFF**

ENVIRONMENTAL STATEMENT

**VOLUME 2
CHAPTER 9: CONTAMINATION**

INTRODUCTION

- 9.1 This chapter of the ES has been prepared by Cambria Consulting to assess the ground conditions and potential contamination of the proposed development of the land east of Channel View Road, Cardiff.
- 9.2 This chapter has been compiled by Ben Whyman, a Senior Associate at Cambria Consulting. Ben holds a MEng (Hons) in Civil Engineering from the Cardiff University, is a Graduate Member of the Institute of Civil Engineering (GMICE) and member of the Chartered Institute of Highways & Transportation (MCIHT). Ben has over 14 years' experience in the Civil Engineering consultancy sector.
- 9.3 This Chapter describes the baseline conditions currently existing at the Site; the mitigation measures required to prevent, reduce or offset any significant negative impacts; and the likely residual impacts after these measures have been adopted. This chapter refers to a Geotechnical and Geo Environmental report (Appendix 9.1). This study was based on the principles of the scheme as it stood at the time and is included in this chapter appendix.

LEGISLATIVE AND POLICY CONTEXT

9.4 Environmental legislation which is relevant to land contamination is summarised below.

Legislation

9.5 The relevant legislation is as follows:

- **Environmental Protection Act 1990** and **Environment Act 1995**: provides fundamental structure and authority for waste management and control of emissions into the environment.
- **Groundwater Daughter Directive (GWDD) 2006/118/EC**: establishes specific in order to prevent and control groundwater pollution.
- The **Environmental Permitting Regulations 2016**: implement EU Directive which requires the prevention or limitation of certain substances into groundwater.
- **Water Resources Act 1991**: regulates water resources, water quality and pollution, and flood defence.
- **Environmental Risks and Pollution**: provide guidance on the preparation and content of development plans and advice on development control decisions and appeals.
- **Contaminated Land Regulations 2006**: Sets out provisions for the identification and remediation of contaminated land.
- **Model procedures for the management of contaminated land, CLR11, Environment Agency**; provides the technical framework for applying a risk management process when dealing with land affected by contamination.
- **Contaminated Land Risk Assessment**, A guide to good practice, CIRIA 552, 2001.

National Planning Policy

9.6 Relevant national planning policy is as follows:

- **Future Wales: The National Plan 2040**
- **Planning Policy Wales, Edition 11**: provides guidance on the preparation and content of development plans and advice on development control decisions and appeals.

Local Planning Policy

9.7 Local planning policy in relation to water resources is set out in the Local Development Plan (LDP) adopted in January 2016. It is based on the following relevant Key Policies:

- **KP5: Good quality and sustainable design** – Promoting the efficient use of land, developing at highest practicable densities and where appropriate achieving the remediation of

contaminated land. Ensuring no undue effect on the amenity of neighbouring occupiers and connecting positively to surrounding communities.

- **KP11: Minerals and aggregates** – Cardiff will contribute to regional aggregate supplies by: Promoting and supporting the efficient use of minerals and use of alternatives to naturally occurring minerals including the re-use of secondary aggregates.
- **KP18: Natural Resources** – In the interests of the long-term sustainable development of Cardiff, development proposals must take full account of the need to minimise impacts on the city’s natural resources and minimise pollution, in particular the following elements: Protecting the quality and quantity of water resources, including underground surface and coastal waters. Remediating contaminated land through the redevelopment of contaminated sites.

9.8 In relation to ground conditions the following relevant detailed policies have been proposed within the LDP:

- **EN4: River Valleys** - The Natural Heritage, character and other key features of Cardiff’s river corridors will be protected, promoted and enhanced, together with facilitating sustainable access and recreation.
- **EN5: Local nature reserves and non-statutory sites of nature conservation and geological importance** - Development proposals that would affect locally designated sites of nature conservation and geological importance should maintain or enhance the nature conservation and/or geological importance of the designation. Where this is not the case and the need for the development outweighs the nature conservation importance of the site, it should be demonstrated that there is no satisfactory alternative location for the development which avoids nature conservation impacts, and compensation measures designed to ensure that there is no reduction in the overall nature conservation value of the area or feature.
- **EN11: Protection of Water Resource** – Development will not be permitted that would cause unacceptable harm to the quality or quantity of underground, surface or coastal waters.
- **EN13: Air, noise, light pollution and contaminated land** - Development will not be permitted where it would cause or result in unacceptable harm to health, local amenity, the character and quality of the countryside, or interests of nature conservation, landscape or built heritage importance because of air, noise, light pollution or the presence of unacceptable levels of land contamination.

ASSESSMENT METHODOLOGY

9.9 The assessment has been carried out using qualitative analysis and is based on the test results obtained, statutory guidance, approved methods of practice and professional judgement. The methodology includes the following:

- A review of the relevant legislation
- A desk study to identify existing information
- A review of the published geological maps and memoirs
- A review of existing ground investigation information
- A review of current and historical land use information
- A review of aerial photography
- A review of pollution incidents and landfill records
- A detailed review of the ground investigations data
- Consultation with the local authority
- Assessment of the likely impact on the ground conditions arising from both construction and operation
- An Assessment of the likely significance of those impacts and the identification of mitigation measures
- An Assessment of any residual impact

Significance Criteria

9.10 The effects of ground contamination have been assessed following the pollutant's linkage methodology. The pollutants linkage consists of source, pathway and receptor and takes account of contaminant as they enter at source and travel to an outlet. For a pollutant linkage to cause impact and thus be a potential for a risk of a significant harm to human health or water resources, all three components need to be present. All components of the pollutant linkage have been reviewed and the significance of impacts has been derived based on potential linkage presence. An indication of impact duration has also been made. The significance of an environmental impact is determined by the classification of impact (Table 9.1), interaction of the sensitivity of the receptor (Table 9.2) and the magnitude of the impact, whereby the impact can be beneficial or adverse. The overall significance of effects of the development are assessed based on Table 9.3.

Table 9.1 Classification of impact

1	Substantial beneficial	The proposals would remove/replace all elements or features that are inconsistent or lead to contamination of existing, surrounding areas.
2	Moderate beneficial	The proposals would remove/replace some elements or features that are inconsistent or lead to contamination of existing, surrounding areas.
3	Minor beneficial	The proposals would remove/replace minor elements or features that are inconsistent or lead to contamination of existing, surrounding areas.
4	Neutral/negligible	No apparent effect

5	Minor adverse	Pollution of non-sensitive water resources. Significant damage to buildings/structures and crops (“significant harm” as defined in the Circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures or the environment. slight, very short or highly localised effects.
6	Moderate adverse	Chronic damage to Human Health and pollution of sensitive water. A significant change in a particular ecosystem, or organism forming part of such ecosystem. (note: the definitions of ecological systems within Circular on Contaminated Land, DETR, 2000). Limited effects which may be considered significant.
7	Substantial adverse	Short term (acute) risk to human health likely to result in “significant harm” as defined by the Environment Protection Act 1990. Short term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. Short term risk to a particular ecosystem, or organism forming part of such ecosystem. considerable effects (by extent, duration or magnitude) or of more than local significance or breaching identified standards or policy

Table 9.2 Classification of Sensitivity of Receptors

Significance	Definition
Substantial	The receptor is generally, but not exclusively, sites of national importance and resource/features which are unique and if lost cannot be replaced or relocated.
Moderate	The receptor is an important at a regional or district scale.
Minor	The receptor is an important at a local scale.
Negligible	The receptor is not designated or protected and is not important at a local scale.

Table 9.3 – Overall Significance of the effects

Sensitivity of Receptor	Magnitude of Impact			
	Substantial	Moderate	Minor	Negligible
Substantial	Substantial	Substantial	Moderate	Minor
Moderate	Substantial	Moderate	Minor	Negligible
Minor	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

Consultation

- 9.11 A scoping opinion for the development was provided by Cardiff Council on the 6th January 2020. This confirmed the requirement of a Contamination Chapter to be included within the ES.
- 9.12 A pre application response was provided by Cardiff Council, reference PA/20/00054/MJR, dated the 6th of July 2020. The response in relation to Contamination and the Site Investigation Report confirms that available records show that part of the site is an historic landfill/raise. In addition, former landfill/raise sites have been identified within 250m of the proposed development. Cardiff Council confirm a contamination and ground gas assessment of the site, in line with current guidance, is required.

Assumptions and Limitations

- 9.13 It is assumed that standard pollution control measures based on best working practices will be implemented during construction. Soil and groundwater testing together with ground gas monitoring results obtained from the ground investigations within the site and surrounding area have been used, together with desk-based studies, to establish baseline conditions. The ground investigations were undertaken prior to the demolition of the buildings and therefore limited to areas outside building footprints, roadways and housing. The subsurface geological profiles, any contamination and other plots are generalised by necessity and have been based on the information found at the locations of the exploratory holes and depths sampled and tested and as such not be taken as homogenous or uniform throughout the entirety site.
- 9.13 Distances described when reviewing historic mapping data are approximate. Any changes to the site in between historical mapping records may not be recorded.

BASELINE CONDITIONS

Existing Conditions

- 9.14 Cardiff County Council has requested that a Geo-Environmental Site Assessment (GSA) and Geotechnical Investigation (GI) be performed in order to determine the baseline conditions, i.e. establish if contamination is present beneath the site. These results have been presented in entirety in Appendix 9.1.
- 9.15 The development is located mainly on a brownfield site accessed off Channel View Road in Cardiff. The site boundary consists of the Marl to north, the Taff Trail & Cardiff Bay to the east, residential properties fronting Channel View road to the west and residential dwellings to the south. The site boundary extends to South Clive Street to the south west and Ferry Road Park and Beecher Avenue to the north west. The site centres on an approximate National Grid Reference of 318010 174030 occupying a plan area of approximately 6.01 Hectares and is irregular in shape. The site is generally level with an elevation of 7-8mAOD. The northern and central sections of Channel View Road are relatively flat and are between 9.5m AOD – 9.8m AOD.
- 9.16 Historical maps of the site have been obtained in an Envirocheck Report, provided by Landmark Information and the most relevant changes to the site are summarised below in Table 9.4. Distances are approximate, and any changes in-between map editions may not be recorded.

Table 9.4 Historical use of proposed development land

Date	Key features on site	Key features off site
1880	The north and east of the site an area of salt marshland and the west of the site being an empty field.	The site is surrounded by marshland and to the south west at within 100m is the Taff Vale Railway.
1901	The east of the site is found to be a floodplain indicated by the salting and mud banks.	To the northeast within 150m away there is a sewerage tank. To the northwest within 250m there is a Gas works. The railway is still present at within 150m west.
1922	A spring is recorded on site to the northeast. The site is still occupied to the east by the River Taff's floodplain indicted by the mud bank and salting.	Oil tanks are located within 250m to the west. Clay pits are located within 200m to the southwest and a stadium has been constructed to within 50m to the northwest of the site boundary.
1938	No significant change, Envirocheck data sheet records The Marl landfill present on site to be operational from 31/12/1936.	The stadium located within 50m northwest has been demolished.
1947-1951	The site has been subject to filling. The salting and mud banks are no longer recorded as being on site.	The west side of the site boundary has now been established by small residential dwellings. The Sewage works to the northeast and gas works to the northwest are still present.

1965	The site appears to have been used as a landfill site (The Marl) with the addition of trees surrounding the north and west boarder.	There are land drains recorded within 50m south of the site boundary. The sewage works are no longer recorded and has been replaced by a sand and gravel yard.
1969-1974	To the south west construction of Channel View flats has been completed.	There is a transport depot within 50m to the south.
1982	There are houses along the west boundary of the site.	No significant change.
1984-1986	The housing development to the west and south of the site is now established and occupies a significant proportion of the site.	No significant change.
1991-1996	No significant change.	The construction of the A4232 within 250m to the southwest, south and southeast is completed.
1999-2020	No significant change	No significant change

Geology

- 9.17 Geological maps of the Cardiff and the local area and the publication 'Urban Geology of Cardiff Centre and the Bay Region' were consulted. The site is underlain by rocks of the Mercia Mudstone Group, which are Triassic in age. These rocks generally comprise structureless red mudstones, stiff clays, siltstones and sandstones. Estuarine/marine alluvium is shown to overlie the solid geology. In this area of Cardiff superficial fluvio-glacial (undifferentiated) terrace deposits are recorded to be present between the alluvium and Mercia Mudstone. The fluvio-glacial gravel terrace was deposited from an historical melt-water fan. The alluvium was deposited above the gravel as the sea level rose, post-glacially. The alluvial deposits consist of a sequence of clays with sub-ordinate silts, sands and gravels. Peat horizons within the alluvium are also often found. Made ground associated with the reclamation of land from the sea may be present. Reclamation took place in this area of Cardiff by 1810 and any fill materials are likely to be highly variable. There are buried channels within the Mercia Mudstone beneath Cardiff. The Cardiff Borehole Contour Map shows a buried channel running along the south boundary of this site.
- 9.18 No faults are recorded on site. The site lies in a lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). Cardiff Bay Wetlands and Hamadryad Park is located 163m northeast and classed as sensitive land. The Hamadryad Park is formed from dredged alluvial deposits from the construction of the PDR bridge. The proposed development is not considered likely to impact these sensitive receptors and this will not be addressed again in this chapter.

Hydrology/Hydrogeology

- 9.19 The nearest surface water feature is located on the eastern boundary of the site. This feature is the River Taff. The River Taff is designated a Site of Importance for Nature Conservation (SINC) and is important for migratory fish, otters, wildfowl and its bankside vegetation acts as a major wildlife corridor.
- 9.20 Generally, the topography of the site is level, however, surface water runoff is likely to be in an easterly direction. Deeper groundwater flow within the underlying bedrock will be controlled by the strata dip and any fractures or bedding planes within the rock units. The hydraulic gradient will be at its steepest during periods of heavy rainfall and aquifer recharge. The bedrock deposits beneath the site have an aquifer designation of 'Secondary B'. These are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. The superficial deposits beneath the site have an aquifer designation of 'Secondary Undifferentiated'. This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- 9.21 There is a recorded historical landfill site called The Marl situated within the site boundary and multiple landfill sites named; the Northern Old Clay Pit situated 153m to the north of the site boundary, British Gas Corporation situated 159m southwest, Hamadryad No 2 169m northeast and Southern Old Clay at Ferry Road 232m southwest. There are no currently active landfill sites within, or within 250m of the site boundary. There is a licensed waste management facilities or registered waste transfer site within, or within 250m of the site boundary. This is the Butetown Link Landfill, located 147m northeast.

Pollution

- 9.22 The Envirocheck Reports records one pollution incident to controlled waters within 250m of site. The incident occurred on 21/03/1997 at Ferry Road, 167m southeast of the site. Pollutant was mud clay and soil run-off; it is classed as a category 3 – minor incident. The Envirocheck report also indicates a substantial pollution incident register within 250m of the site. The incident occurred on 08/05/2008 the position of which was located by the supplier to be within 10m of the incident. It is classed as a category 2 – significant incident to water. There is a recorded pollution prevention and controls recorded within 250m of site. This is by ASDA stores Ltd and is dated 23/12/1998 located at Cardiff Bay Retail Park some 248m northwest of the site boundary.

Potential Contamination

- 9.23 The potential contamination beneath the site, whether in the matrix of soil or groundwater is related to the sites past use. The historical data reviewed shows the site to have had past industrial or commercial use as a Landfill (The Marl) and deposited waste included inert, industrial, commercial, household and special waste. There is likely, therefore, to be a Medium to High risk of contamination

relating to past industrial use of the site as a landfill. The risk of contamination would be determined by testing for a general suite of contaminants including asbestos. No other potential on-site sources of contamination have been identified during the desk study.

Ground Conditions

9.24 There were two groundwater strikes encountered during the investigation work. The first was encountered within the gravels at 11.80m in CP01, 12.00m CP02 and 11.30m in CP03. The second was encountered within the mudstone bedrock at 22.20m in CP02 and 22.40m in CP03. The River Taff is nearest surface water feature and is located on the eastern boundary of the site. The River Taff is identified as a potential receptor to groundwater within the fluvio-glacial gravels and bedrock. The river is located on the eastern boundary of the site. The site is, therefore, a risk to controlled waters. Investigation results show the site is generally comprised by Made Ground comprised of the following layers:

- Grass over firm brown slightly gravelly CLAY to depth of 0.45m
- Medium dense black gravelly SAND to maximum depth of 5.3m
- Soft grey laminated silty CLAY with occasional cobble to maximum depth of 11.80m
- Loose grey clayey sandy GRAVEL to a maximum depth of 12.5m
- Medium dense to dense becoming very dense brown sandy GRAVEL with medium cobble content and low boulder content to a maximum depth of 19.60m
- Hard weathered brown occasionally mottled grey sandy MUDSTONE depth of 28m

Contaminants of Concern

9.25 All samples contained one or more contaminants which were above the residential with plant uptake threshold. The contaminants of concern are highlighted in Table 9.5 below. All samples contained one or number of leachable contaminants which were above the guidelines. The contaminants of concern are highlighted in Table 9.5 below. All samples contained one or number of leachable contaminants which were above the guidelines. The contaminants of concern are highlighted in the Tables 9.5 – 9.7 below.

Table 9.5 - Contaminants of Concern

Sample	Depth (m)	Contaminant	Concentration (mg/kg)	Threshold (mg/kg)	Comments
CP01	1.00	Chromium (trivalent)	16	11	Made ground
CP01	2.50	Arsenic	43	37	Made ground
		Lead,	570	200	
		Chromium (trivalent),	27	11	
		Naphthalene,	5.1	2.3	
		Benzo[b]fluoranthene,	3.2	2.6	
		Benzo[a]pyrene,	3.1	2.2	
		Dibenz(a,h)Anthracene	0.91	0.24	

CP02	3.00	Cyanide Arsenic Lead Chromium (Trivalent) Dibenz(a,h)Anthracene	38 53 2200 240 0.50	8 37 200 11 0.24	Made ground
CP02	4.50	Cyanide Lead Chromium (Trivalent)	18 660 62	8 200 11	In-situ deposits just below made ground
CP03	2.00	Arsenic Beryllium Lead Chromium (Trivalent) Dibenz(a,h)Anthracene	38 1.8 1200 58 0.28	37 1.7 200 11 0.24	Made ground
WS01	3.00	Lead Chromium (Trivalent)	62 23	200 11	Made ground
WS02	0.50	Chromium (Trivalent) Benzo[b]fluoranthene Benzo[a]pyrene Dibenz(a,h)Anthracene	23 3.3 3.2 0.77	11 2.6 2.2 0.24	Made ground
WS02	1.50	Chromium (Trivalent) Benzo[b]fluoranthene Benzo[a]pyrene Dibenz(a,h)Anthracene	15 6.6 4.5 0.89	11 2.6 2.2 0.24	Made ground
WS03	0.30	Lead Chromium (Trivalent) Aromatic TPH >C21-C35 Pyrene Benzo[b]fluoranthene Benzo[a]pyrene Dibenz(a,h)Anthracene	500 47 1200 13 13 12 2.0	200 11 1100 7.2 2.6 2.2 0.24	Made ground
WS04	1.80	Beryllium Lead Chromium (Trivalent) Dibenz(a,h)Anthracene	1.8 280 22 0.71	1.7 200 11 0.24	Made ground

Table 9.6 Leachable contaminants of Concern

Sample	Depth (m)	Contaminant	Concentration (mg/kg)	Threshold (mg/kg)	Comments
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CP01	2.50	Copper (Dissolved)	1.5	1.0	Made ground
CP02	3.00	Copper (Dissolved)	1.9	1.0	Made ground
		Zinc (Dissolved)	110	10.9	
		Cadmium (Dissolved)	0.12	0.08	
		Lead (Dissolved)	5.8	1.2	
		Nickle (Dissolved)	7.1	4.0	
CP03	2.00	Copper (Dissolved)	2.5	1.0	Made ground
		Zinc (Dissolved)	21	1.09	
		Chromium (Dissolved)	5.4	4.7	

Table 9.7 Groundwater Contaminants of Concern

Sample	Contaminant	Concentration (mg/kg)	Threshold (mg/kg)	Comments
CP01	Copper (Dissolved) Chromium (Dissolved)	3.6 & 2.0 12.0	1.0 4.7	Made ground
CP02	Copper (Dissolved) Chromium (Dissolved)	3.6 9.7	1.0 4.7	Made ground
CP03	Copper (Dissolved) Chromium (Dissolved)	2.0 5.1	1.0 4.7	Made ground

9.26 Copper and Chromium (dissolved) have been found above respective guideline values as described above. Defra guidance (Environmental Protection Act 1990: Part 2A) “seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which:

- i. may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems.
- ii. which may result in damage to material property.
- iii. or which may impair or interfere with amenities and other legitimate uses of the environment.”

9.27 Part 2A also defines that the following types of pollution (Points 1 to 4) should be considered to constitute significant pollution of controlled waters:

1. Pollution equivalent to “environmental damage” to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations. The contamination identified in the waters on the site are highly unlikely to equate to environmental damage. Envirocheck data indicates that no Sensitive Land Uses are present near the site. The closest sensitive land use is the Cardiff Bay Wetlands and Hamadryad Park, a local nature reserve, located 163m northeast,

on the east bank of the River Taff. In addition, the Cardiff Bay Wetlands and Hamadryad Park is located up stream of the site. Due to the distance from the site of this location there is unlikely to be any imminent threat of damage to protected species, habitats, surface/ground water and land.

2. Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in future, for human consumption such that additional treatment would be required to enable that use. There are no groundwater abstraction points within 250m of the site. Given that the groundwater beneath the site has a aquifer designation of Secondary B and Secondary undifferentiated it is considered that future abstractions would be very unlikely.
3. A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway. The guideline values for waters are very low and in reality, are difficult to achieve. It is highly unlikely that impacted waters on the site would produce exceedances in the adjacent surface water bodies as given the concentrations encountered on site are moderate and inconsistent across the site. The impact of any contamination would be rendered insignificant given the massive dilution upon reaching the River Taff.
4. Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)5).

9.28 The contaminants of concern within the water are copper and Chromium (dissolved). These have most likely leached out the made ground beneath the site relating to the Marl landfill. Envirocheck data states the last input at the landfill to be 31st December 1945. As activity relating to the source of the contaminated has ceased for a considerable amount of time, there should not be a sustained upward trend in the concentration of contamination in the groundwater.

9.29 For the above reasons it is considered that the site falls into the 'lesser level of pollution and that the risk to the aquatic environment from waters and soils under the site is low.

Gas Monitoring

9.30 The installations were tested for carbon dioxide, methane, oxygen and hydrogen sulphide using a Gas Analyser GA2000. At the time of writing this report only two round of gas monitoring has been completed, an updated letter report will be issued after the six rounds of monitoring have been completed. Methane was only detected in CP01, levels varied between 0.00% and 10.4%. Carbon dioxide levels varied between 0.5% and 5.0%. Oxygen concentrations varied between 14.2% and 20.7%. The gas flow rate from the boreholes was also assessed. A flow rate of 0.8 l/hr was detected in CP01, no other flow rate was detected. When these results are compared with Table 8.5 of CIRIA report C665, the site is classified as 'Gas Characteristic Situation 2' (CS2), which require no gas protection measures. When all rounds of gas monitoring are completed, an updated recommendation will be provided with the updated results.

Future Baseline

- 9.31 Should the proposed development not progress the site would remain a combination of existing housing and open field (The Marl) with the levels of contamination and risks associated continuing to be present.
- 9.32 Rainwater infiltration into the made ground could result in increased leaching of contaminants and migration into underlying aquifers. This perched water may build up over time, with potential for off-site or cross site run-off, particularly to the east. This may pose a long-term risk to the quality of aquifers and existing watercourses.

POTENTIAL IMPACTS

During Construction

- 9.33 The potential impacts during construction are listed below in Table 9.8. The piling works as part of the construction of the proposed high-rise building will involve the excavation of predominantly made ground materials and as such hazardous materials are likely to be disturbed during construction. During the proposed development construction workers are likely to come into direct contact with the site soils. The exposure period for these receptors is short term (acute) since they will only be exposed during the construction phase via the following pathways. Construction workers will be subject to short term exposure of potential contaminants only. The impact is considered to be **moderate adverse**.
- 9.34 Development of the site has the potential to disturb and mobilise contamination present within the made ground and groundwater. Site works may introduce preferential pathways for contamination to migrate particularly during any excavations works whether temporary or permanent. During the construction works there is a risk of contaminants mobilisation and downward migration in an event of increased rainwater infiltration in the eastern/south-eastern area. Construction of the piled foundation will require core excavation of the made ground layer or contaminant migration along the shaft of the auger. These are likely to have a temporary and localised impact. The sensitivity of the groundwater resources is considered to be moderate due to the classification of aquifers contained within the bedrock and superficial deposits underlying the site as Secondary Aquifers. Due to localised works of foundations, probability of a consequence occurring is likely to be Low Likelihood and therefore the impact **moderate adverse**.
- 9.35 Groundwater contained within the bedrock and gravels underlying the site may be at risk of pollution as a result of the construction activities. These may include contamination resulting from accidental spillages of oil, fuel or chemicals, refuelling activities or leaks in hydraulic systems, cement and/or concrete particularly in areas which may have pathways to the River Taff. There is a risk of encountering unexpected, localised contamination during the construction works even in areas previously covered by intrusive investigations, particularly within the made ground. The impact of these is minor adverse however due to previous site use as landfill there is a highly likely probability of unexpected contamination, therefore the risk is **moderate adverse**.

During Operation

- 9.36 The potential impacts during operation are listed below in Table 9.8. Upon development of the site, use will have changed and the primary human receptors to contamination in site soils will be residents of the new housing and visitors, as well as any maintenance contractors (e.g. gardeners, utility technicians). All future site users could be exposed to contaminants through dermal contact, ingestion and inhalation of soil/soil dust, or the inhalation of asbestos fibres. Future site residents (any their visitors) may similarly be at risk from consumption of vegetables/fruit grown in

contaminated soils and through ingestion of potable water distributed on site through plastic pipes. The consequence of this has been assessed as **moderate adverse**.

- 9.37 Based on the assessment of risk posed at baseline conditions, there is an unlikely likelihood of probability of exposure to subsurface contamination due to proposed barrier and capping of existing made ground, limiting contact and dust inhalation of soil contaminants. the site is classified as 'Gas Characteristic Situation 2' (CS2), which require no gas protection measures and therefore there is **negligible** impact of gas contamination, however there is a moderate-low risk of exposure to ground contamination.

Table 9.8 - Health and Environmental Risk Assessment

Potential Source	Potential Pathway	Potential Target	Preliminary Risk Assessment	Classification of Impact (pre mitigation)	Primary receptor & Sensitivity
DURING CONSTRUCTION					
Site Soil	Dermal contact with soil, ingestion of soil/soil dust, inhalation of soil dust/asbestos fibres	Construction workers	Moderate Risk. COSHH assessment and good level of PPE/hygiene by site workers/ staff; dust suppression measures if required. Potential made ground including asbestos	Moderate Adverse	Human Health Moderate Sensitivity
Site Soil	Dermal contact with soil, ingestion of soil/soil dust, inhalation of soil dust/asbestos fibres	Passers - by/neighbouring site users	Moderate Risk. Potential, made ground including asbestos	Moderate Adverse	Human Health Moderate Sensitivity
Landfill gas	Migration through superficial deposits and bedrock and accumulation indoors	Construction workers/site neighbours	Moderate risk. Historic Landfill with incomplete gas monitoring.	Moderate Adverse	Human Health Moderate Sensitivity

Site Soil	Surface runoff and leaching of contamination into the perched groundwater	Perched groundwater beneath the site Secondary B Aquifer. River Taff	Moderate - Low risk Potential made ground	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer) Moderate Sensitivity
Site Soil	Contamination from construction plant/materials.	Perched groundwater beneath the site Secondary B Aquifer.	Moderate risk, COSHH assessments and RAMS required.	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer) Moderate Sensitivity
Site Soils	Groundwater transport	Nearest significant western site boundary. Secondary B aquifer	Moderate - Low risk Potential made ground	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer) Moderate Sensitivity
DURING OPERATION					
Site Soils	Surface runoff and leaching of contamination into the perched groundwater	Perched groundwater beneath the site	Moderate - Low risk, made ground capped.	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer) Moderate Sensitivity
Site Soils / Surface Water Runoff	Leaching of contaminants into Surface water runoff from the site	River Taff	Moderate - Low to moderate risk, made ground capped.	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer) Moderate Sensitivity
Site Soils	Groundwater transport	Nearest significant western site boundary.	Moderate - Low risk, made ground capped.	Moderate Adverse	Aquatic Environment (River Taff SINC & Secondary B Aquifer)

		Secondary aquifer B			Moderate Sensitivity
Site Soils	Uptake of phytotoxic contaminants	Vegetation	Moderate - Low risk, made ground capped.	Minor Adverse	Human Health Moderate Sensitivity
Site Soils	Damage of building materials	New buildings	Low Risk Correct class of concrete to be chosen. Potential made ground and Sulphates.	Minor Adverse	Design life of structures Minor Sensitivity
Ground gas	Direct from any made ground/buried organic matter on site and accumulation indoors	Site End Users – Residents and visitors.	Very Low Risk capping layer and no dig barrier, CS2 gas zone.	Negligible	Human Health Moderate Sensitivity
Vapours	Migration into indoor air	Site End Users – Residents and visitors.	Very Low Risk, capping layer and no dig barrier proposed.	Negligible	Human Health Moderate Sensitivity
Site Soils	Permeation of drinking water pipes	Site End Users – Residents and visitors.	Moderate-Low Risk, made ground from landfill	Minor Adverse	Human Health Moderate Sensitivity

MITIGATION AND MONITORING

During Construction

- 9.38 As good practise construction workers should adhere to good site management, COSHH, good standards of hygiene and appropriate health & safety on site, with personal protection equipment (PPE) and dust suppression where appropriate. Neighbouring site occupants and passers-by can be protected by site screening and dust suppression measures if necessary.
- 9.39 Any imported soils should be tested and validated as suitable prior to use in accordance with 'Requirements for the Chemical Testing of Imported Materials for Various End Uses and Validation Cover Systems' published by the Welsh Contaminated Land Working Group.
- 9.40 If during development works any unexpected ground conditions or evidence of additional contamination is found, inspection by a geo-environmental engineer should be made, and any required testing or investigation carried out prior to continuation of works.
- 9.41 For proposed new water supply pipes, the UK Water Industry Research publication 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (Report 10/WM/03/21)' should be consulted.
- 9.42 During the construction period, there is a risk to the environment/adjacent sites from dewatering, digging foundations, moving contaminated soil, drainage misconnections, discharges to local surface waters or the ground, runoff from construction materials and/or exposed ground, wheel washings and oil or chemical spills. The risk is considered to be negligible as any adverse effects will be easily preventable by due diligence to good construction practise and housekeeping in preventing surface runoff and the spillage of materials.
- 9.43 The basic measures that should be taken are as follows:
- Prepare a drainage plan and mark the manholes to prevent pollutants accidentally reaching the surface water sewers.
 - Carry out any activities that could cause pollution in a designated, bunded area, away from rivers or foundation excavations. Where possible it should drain to the foul sewer.
 - Use settlement ponds to remove silty water
 - Store all oils and chemicals in a fully bunded area to prevent leaks or spills.
 - Get advice on whether you need an environmental permit and apply in good time
 - Ensure all surface water drainage infrastructure is suitably
- 9.44 During the construction phase care should be taken to minimise the amount of additional water allowed to infiltrate into the river gravels. Any perched groundwater pumped from excavations should be disposed of in a suitably manor. Prior to works commencing a full asbestos survey of all buildings to be demolished should be carried out. All deleterious materials should then be removed

to a licensed waste facility prior to demolition. The houses should then be demolished including all foundations and removed from site. All trees and scrub vegetation including all roots should be stripped and removed from beneath the proposed buildings and areas of hard standing. Any hard standings and buried obstructions should also be excavated and removed. Contingencies should be made for the protection/diversion any underground/overhead services present beneath/above the site brought about as a result of the proposed works. Allowances should also be made for the excavation of any soft spots/areas and their replacement with well compacted imported granular materials as previously described. Any reduced levels should be brought up to the required levels with suitable inert mainly granular materials. Department of Transport type 2 sub-base or similar should be used and should be compacted in layers to the requirements of the Specification for Highway works. In accordance with EC Regulation 1272/2008 and Environment Agency Guidance WM3 soils and other materials destined for off-site disposal should be classified on the basis of their hazard phrases prior to disposal. Soils are classified as a mirror entry waste and should be classified on the basis of their specific chemical properties.

During Operation

- 9.45 At the time of writing this report only two round of gas monitoring has been completed. A further 4 rounds of monitoring and an updated letter report will be issued after the six rounds of monitoring have been completed to determine the long-term impacts of gas within the ground strata. The initial readings indicate no ground gas protection is required.
- 9.46 Remedial measures will be required with regards to site soils which have been found to contain elevated levels of arsenic, lead, Chromium (trivalent), Naphthalene, Benzo[b]fluoranthene, Benzo[a]pyrene, Dibenz(a,h)Anthracene, Aromatic TPH >C21-C35, Pyrene, Cyanide and Amosite asbestos. The affected soils are the made ground and in-situ materials just below the made ground that is present over of the whole site. Various levels of contamination in all samples is present and it is considered that there is a risk to human receptors at the site in the areas of contamination. Due to the level and depth of the contamination at the site it is likely to be a continued risk to end users. Capping will therefore be required in landscaped and garden areas.
- 9.47 The capping is to consist of the proposed buildings, hard standing and in garden and landscaped areas 600mm of suitable clean imported subsoil/topsoil material to BS:3882. At the base of the capping layer, a double no dig barrier should be placed to provide a barrier between the clean imported soils and contaminated made ground soils. The double no dig barrier should consist of a hi-visibility geotextile with a structural geo grid positioned on top of the geotextile. Any imported soils should be tested at source to confirm that the soils are clean and suitable for use. The soils should also be tested in-situ whilst confirming the capping thickness and presence of the no dig barrier. The remainder of the site will be capped by buildings and hard standings.

9.48 All surface water drainage, SUDS features, will be lined with an impermeable membrane to prevent surface water runoff infiltrating into the made ground material below the site and upon SAB approval and project handover surface water drainage will be adopted by the Local statutory body.

RESIDUAL EFFECTS

During Construction

- 9.49 Following the application of appropriate mitigation measures all residual effects during the construction phase of the development will **negligible**. All mitigation measures will be approved by the regulatory authorities and once construction is complete the identified potential effects will be considered to have been mitigated.

During Operation

- 9.50 Following the application of appropriate mitigation measures all residual effects during the operational phase of the development as all risks have been designed for during construction/ as part of operational maintenance with **negligible** residual effects – see table 9.9.

SUMMARY AND CONCLUSIONS

- 9.51 The impact of the development on ground conditions during the construction phase of development is summarised in table 9.9 below. Without the suggested mitigation measures the impacts during construction and operation have the potential to be **moderately adverse**.
- 9.52 Following incorporation of the proposed mitigation measures, the impact of the residual risk of the proposed development during the construction is considered to be **negligible**. No residual effects are expected during the operational phase.

Table 9.9 – Summary of mitigation measures

Receptor	Impact	Overall Significance (pre mitigation)	Mitigation	Residual Effect
DURING CONSTRUCTION				
Construction workers Human Health Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Health and Safety measures on site, CEMP, dust suppression and PPE	Negligible
Site neighbours/general public Human Health Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Health and Safety measures on site, CEMP, dust suppression, temporary hoarding	Negligible
Underlying bedrock: Secondary B Aquifer Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Pumping where required, CEMP, Best practise, use of liners in water retaining structures	Negligible
Perched Groundwater Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Pumping where required, CEMP, Best practise, use of liners in water retaining structures	Negligible
Unexpected contamination Human health /groundwater Moderate Sensitivity	Moderate Adverse	Moderate Adverse	CEMP	Negligible

Exposure of contaminated soil Human health / groundwater / land Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Hazardous waste procedures, waste management plan, CEMP, hazardous material zone.	Negligible
Accidental spillages and fuel leaks Human health / groundwater Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Best Practice, COSHH Assessments if required	Negligible
Potential impact on soil/groundwater due to piling Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Foundation Risk Assessment, Best Practice, CEMP	Negligible
Impact on River Taff and Cardiff Bay Moderate Sensitivity	Moderate Adverse	Moderate Adverse	All SUDs features to be lined. All runoff to be treated by a SUDS treatment prior to discharge into the River Taff.	Negligible
Exposure to /release of ground gas. Human health Moderate Sensitivity	Moderate Adverse	Moderate Adverse	6 gas monitoring test to be carried out, results initially indicate CS2 gas zone	Negligible
DURING OPERATION				
Exposure of contaminated soil. Human health / groundwater / land Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Capping layer and no dig barrier to be provided	Negligible
Impact on River Taff and Cardiff Bay Moderate Sensitivity	Moderate Adverse	Moderate Adverse	Drainage systems to be regular maintained by adopting authority.	Negligible
Exposure to /release of ground gas. Human health Moderate Sensitivity	Minor Adverse	Minor Adverse	4 further gas monitoring tests to be carried out.	Negligible

Abbreviations and definitions

DETR – Department of the Environment Transport and the Regions

LDP – Local Development Plan

NRW – Natural Resources Wales

OD – Ordnance Datum

OS – Ordnance Survey

SPZ - Source Protection Zone

CEMP – Construction Environmental Management Plan

SUDS – Sustainable Drainage System