Technical Note: Former Gaiety Cinema, Cardiff - Geo Environmental Desk Based Assessment

Date:	01 October 2018
Project:	195-197 City Road, Cardiff
Project Number:	A100414
Subject:	Geo-environmental Desk Based Assessment

Introduction

WYG was commissioned to carry out a preliminary geo-environmental desk study assessment at 195-197 City Road, Cardiff (hereafter referred to as 'the site') on behalf of Bonne Mares Limited.

An outline, desk-based assessment of the ground conditions is required to support a feasibility study prior to the potential acquisition of the site for development as purpose built student accommodation and associated infrastructure. The brief is to provide a concise desk study assessment for the site including a preliminary qualitative geotechnical and contamination risk assessment highlighting the key issues associated with the ground conditions at the site and the likely implications for future development.

Report Scope

The scope of this commission included:

- A historical site and area review, primarily referring to past issues of Ordnance Survey Maps;
- A discussion of the general expected ground and groundwater conditions within the topographical and area context referring to our own geological and hydrogeological maps library;
- Details from a search of readily available information from key relevant agencies, including Statutory Authorities such as Natural Resources Wales;
- A preliminary geotechnical and ground contamination assessment discussing the results of the research above not only concerning potential on-site conditions/constraints and contamination but also an overview of the potential for contaminant migration onto or off-site with respect to the surrounding neighbouring sites;
- Development of a preliminary conceptual site model; and,
- Qualitative ground contamination risk assessment (compliant with CIRIA 552 methodology).

Limitations

The recommendations and opinions expressed in this report are based on information obtained as part of the desk study or provided by others. Information provided from other sources is taken in good faith and WYG cannot guarantee its accuracy.

This report is subject to the report conditions presented in Appendix A.

The information contained in this report is intended for the use of the Bonne Mares Limited and WYG can take no responsibility for the use of this information by any third party or for uses other than that described in this report or detailed within the terms of our engagement.

Desk Top Review

Table 1 – Desk Top Review

Site Details		
The key site features which could be considered pertinent to an assessment of land quality arising from land use are discussed below.		
Location and Address	The site is located at 195-197 City Road within the Roath area of Cardiff, c. 800m north east of the Cardiff city centre. The site is located at postcode CF24 3JD.	
National Grid Reference	The centre of the site is located at National Grid reference ST187775.	
Site Access	Vehicular access to the site is from City Road immediately east of the site. Access to the site is currently restricted due to the derelict nature of the site.	
General Site Context	The site occupies an area of approximately 0.13ha and is currently a former four-storey cinema building and adjacent hardstanding car parking. The site is located within an area predominately occupied by commercial units and residential housing.	
Surrounding Land Uses	North	An unnamed access road is present immediately north of the site with a construction site for a residential development c.5m north.
	South	Commercial buildings including a funeral home, Doctors surgery and furniture shop.
	East	City Road bounds the site's eastern boundary and terraced commercial units beyond.
	West	The west of the site is bound by an unnamed access road, with residential housing from c. 10m west.
Site Description	The site comprises a derelict four-storey former cinema building in the northern portion of the site with hardstanding carparking covering the southern portion of the site. Access to the site is restricted to the public with security fencing along the eastern boundary and a wall along the west boundary. Overgrown vegetation was observed on site along the eastern and south western boundary of the site. An electrical sub-station was noted in the south west corner of the site.	
Historical Development		
The historical development of the site and surrounding area has been assessed using available extracts of historical Ordnance Survey (OS) maps. The following section identifies the key aspects of the site's development regarding potentially contaminative land-uses, facilities or features and should be read in conjunction with the map extracts presented in Appendix B.		

On Site Development	The earliest available historical OS maps (dated c.1880 at 1:500 scale and 1:2,500 scale) shows the site is occupied by residential housing. The site remains unchanged until mapping from 1919-1920 (1:2,500 scale) which shows the Gaiety cinema in the north of the site and residential housing in the south of the site. Mapping from 1940-1942 (1:2,500 scale) shows the Cinema remains in the north portion of the site, but the residential housing has been demolished and the land shown as vacant. Mapping from 1958-1987 (1:1,250 scale) indicates an electrical substation in the south west corner of the site. The site remains unchanged for the remainder of the historical mapping up to and including the most recent aerial photography in 2018.
Off Site Development	The earliest available historical OS maps from 1880 (1:500 scale) shows residential housing immediately north of the site; a roadway immediately east of the site with greenfield land beyond; undeveloped land immediately south and west of the site with residential housing c. 55m south/ south west and 75m west. A rail track is identified c.120m west of the site running broadly north to south. Historical mapping from 1901 (1:2,500 scale) shows significant development in the surrounding area with residential housing in all directions from the site. The rail line remains c. 120m west of the site identified as Rhymney Railway. A joinery works is identified c. 160m north west of the site. Mapping from 1958-1987 (1:1,250 scale) shows the surrounding land use remaining predominantly as residential within a number of schools, churches and clubs and a surgery c.10m south of the site. However, a small number of potentially contaminative land uses are identified including garages c.10m and c.105m north and c.65m, c.145m and c.200m south; the joinery works c.160m north west is now shown as a timber yard with a car breakers yard c.175m north west; and a tyre depot c.150m south of the site. Mapping up to and including aerial photography from 2018 remains largely unchanged.

Geology, Hydrogeology, Hydrology and Radon		
The geology of the site is covered by British Geological Survey (BGS) Solid & Drift 1:50,000 maps Cardiff (Sheet No. 263).		
Geology	Made Ground	Made Ground is not recorded on the available BGS GeoIndex but is likely to be present associated with previous development of the site.
	Superficial Deposits	The BGS GeoIndex indicates that superficial deposits are present beneath the site comprising Glaciofluvial Sheet Deposits (Devensian) of Sand and Gravel.
	Solid Geology	The BGS GeoIndex indicates that the site is underlain by the solid geology of the Mercia Mudstone Group. This formation is described as dominantly red, less commonly green-grey, mudstones and sub-ordinate siltstones with thick halite bearing units in some basinal areas. Thin beds of gypsum/ anhydrite are widespread, and sandstones are also present. The Mercia Mudstone is shown to have a regional thickness exceeding 1,350m.
Hydrogeology	The Mercia Mudstone Group is classified as a Secondary B Aquifer. 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. A review of the EA Groundwater Vulnerability Maps have revealed the site is situated in an area of High Vulnerability for groundwater within the Mercia Mudstone Group Formation. These are areas which have the potential to transmit pollution to groundwater and are characterised by high leaching soils and the absence of low permeability superficial deposits. This results in a high overall pollution risk to groundwater from surface activities. Construction operations or activities in these areas are likely to require appropriate pollution prevention measures to ensure that groundwater is not impacted. The superficial Glaciofluvial Sheet Deposits are classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. A review of the BGS GeoIndex viewer shows a number of boreholes within 250m of the site the closest located c.40m east of the site (ST17NE526). The borehole records show hard packed gravel to 1.52m overlying very dense clayey sand and gravel to 7.62m with no water strikes noted. A further borehole is identified c.90m north of the site (ST17 NE527) which shows fill to 1.98m overlying dense sandy gravel to 3.96m overlying weathered marl to 9.37m. A water strike was observed at 5.49m. There are no BGS GeoIndex records for groundwater abstraction boreholes within 500m of the site.
Hydrology	There are no surface water features currently shown to be present on site. The nearest surface water features to the site are shown to be Roath Brook c.800m north west of the site, and an unnamed stream located c.850m south west of the site. The National Resource Wales (NRW) flood risk mapping shows the site is not located within an area at risk from flooding from Rivers or Seas. The east and west boundary of the site are shown to be at a low risk from surface water flooding.
Radon	BRE document 211[1] mapping coverage for the site area was consulted and indicates that the site is located within an area where basic radon protection measures are **not** required for new developments.
Environmental Database Search	
A search of readily available environmental information was undertaken and is summarised in the following section. The following summary is generally limited to locations within 500m of the site boundaries unless it is considered that installations or activities beyond that range could potentially have an impact on the site or be affected by the redevelopment of the site.	
Water abstractions	There are no water abstraction licences within 500m of the site.
Discharge Consents	There are no discharge consents within 500m of the site.

[1] BRE 211. Radon: Guidance on protective measures for new buildings. Chris Scivyer MCIOB. 2015 edition.

Landfill sites	There are no recorded historical or current landfills shown to be located within 1km of the site.
BGS recorded mineral sites	There are no BGS recorded mineral sites within 500m of the site.
Sensitive Land Uses	The site is not shown to be situated within an area of sensitive land use.

Preliminary Geotechnical Hazard Assessment

Based on the information identified in the preceding sections, the following table summarises the anticipated ground conditions and associated geotechnical hazard assessment for the site.

Table 2 - Geotechnical Hazard Assessment

Geotechnical Aspect	Site Specific Information	Hazard Potential	Comments
Ground Conditions	Unknown thickness, composition and physical characteristics of possible Made Ground beneath the site.	Low to Medium	Ground investigation is required to assess and verify underlying ground conditions including the extent of likely Made Ground deposits and depth to the solid geology. Geotechnical testing will also be required to confirm suitable foundation design.
Foundations and Pavement Design	Unknown thickness, composition and physical characteristics (Density/Competency and chemical characteristics) of possible Made Ground and bedrock deposits. A range of foundation solutions may be required.	Low to medium	Ground investigation required to assess underlying ground conditions for foundation design.
Topography	The topography of the site is generally flat. In the wider area there is a slight slope from north to south.	Low	Significant cut and fill is not anticipated.
Vegetation	Overgrown vegetation was observed, associated with the derelict nature of the site. Mature trees along southern boundary of the site.	Low	Clearance works to be undertaken prior to development.

Geotechnical Aspect	Site Specific Information	Hazard Potential	Comments
Drainage	Superficial deposits recorded on site of sand and gravels. Unknown thickness of deposits and depth to bedrock. The site is situated within an area of High Vulnerability for groundwater in the Mercia Mudstone Group.	Low to medium	Ground investigation required to assess underlying drainage and groundwater conditions of the site including the potential for soakaways. High vulnerability is assigned for groundwater resources. The EA may require specific control measures during construction.
Previous use	The site is shown to have been utilised for residential use prior to the redevelopment of the site for as a cinema with associated car parking.	Low to medium	Made Ground is likely to be present beneath the site from the demolition of former buildings. Potential for in ground obstructions associated with former foundations.

Site Conceptual Model and Preliminary Ground Contamination Assessment

Overview

In general, ground contamination can occur through several causes, particularly from historical operations and activities. Contamination can result from either on site sources or from on-site migration from off-site sources, leading to long term liabilities under recent legislation for any site owner.

The Environmental Protection Act 1990 (Part 2A) makes provisions for a risk-based framework for the identification, assessment, management and redevelopment of contaminated land within the UK. The provisions of the Act came into effect in England in April 2000 and is aimed at ensuring that actions taken with respect to contaminated land are directed by a technically well-founded assessment of risk.

The process of risk assessment is an evaluation of the probability of harm, and comprises the identification of sources of contamination, receptors that may be affected by the contamination and pathways by which the receptors may be harmed.

Conceptual site model

The following table provides a synopsis of the conceptual model for the site, based upon the findings of the desk study assessment and subsequent fieldwork:

Table 3 – Preliminary Conceptual Site Model

Sources
The site has historically been utilised for residential housing prior to the redevelopment as the Gaeity Cinema with associated car parking. An electrical substation is shown to have been present in the south west corner of the site since 1958-1987 which represents a minor potential source of contamination. However, there is the potential for made ground to be present within the subsurface which has the potential to contain a range of organic and inorganic contaminants. Historical mapping indicates that the land adjacent to the site has been largely utilised for residential housing from 1901-present. However, a garage is identified c.10m north of the site in mapping dated 1958-1987 to 1992. This presents a potential source of contamination to site. The following potential sources of contamination have been identified in association with the site and its surroundings: • On-site: Made Ground associated with the former redevelopment of the site including the potential for asbestos and ground gas; • On-site: Electrical Sub-Station (Polychlorinated Biphenyl – PCBs). • Off-site: Former garage c.10m north of the site (hydrocarbons including BTEX)
Pathways
Based on a future land use of the site for residential use (without plant uptake) the potential pathways by which receptors may be exposed to contamination are:

- Dermal contact, inhalation of particles and ingestion of soil/dust (i.e. human interaction with sub-surface materials);
- Leaching of contaminants from Made Ground and subsequent vertical and lateral migration of dissolved phase contamination;
- Lateral and vertical migration of groundwater through permeable sub-surface materials and/or preferential pathways;
- The migration and accumulation of ground gases or vapours through permeable sub-surface materials and / or preferential pathways.

Receptors

Potential receptors are as follows:

- Construction workers;
- Future site users – assuming a re-development to residential properties (student accommodation) with amenity and landscaped areas;
- Groundwater
- Building infrastructure.

Current site users are not considered below, due to the derelict nature of the site and restricted access. No regular access is permitted.

Ground contamination risk assessment

The source, pathway, receptor linkages identified in the previous section are outlined and a qualitative risk assessment shown in the following tables.

The risk assessment considers the site within an area context and assesses potential risks to identified receptors in relation to the existing site setting and the proposed development. CIRIA C552 has been used to define the risk rating presented in the Qualitative Risk Assessment matrix, the methodology for which is presented in Appendix C.

Table 4 - CIRIA C552 Qualitative Risk Assessment

This matrix is based on CIRIA C552 risk evaluation methodology, definitions for risk ratings is presented in Appendix C						
Source	**Pathway**	**Receptor**	**Consequence of risk being realised**	**Probability of risk being realised**	**Risk Classification**	**Potential risk management requirements**
Made Ground deposits associated with the demolition of former buildings and redevelopment as a cinema c. 1912.	Direct dermal contact or ingestion of soils, or inhalation of dust	Future Site Users	Mild	Low Likelihood *(due to proposed site use and cover)*	**Low Risk**	There is a potential for Made Ground to be present on and surrounding the site. However, this should be confirmed as part of subsequent intrusive investigation. Any made ground materials encountered during ground investigation or construction works should be tested to ensure no significant contamination is present. Workers on site should use appropriate PPE and good hygiene to limit potential risk.
		Site Construction Workers	Mild	Likely *(due to interaction and disturbance of the Made Ground during construction)*	**Moderate / Low Risk**	
	Leaching and lateral/vertical migration	Groundwater	Medium	Low Likelihood *(assuming limited thickness of Made Ground)*	**Moderate / Low Risk**	Should significant depths of Made Ground be encountered during ground investigation, analysis of materials should be undertaken to include leachate testing. The site is situated within an area of High Vulnerability to underlying groundwater resources. Construction activities could potentially require additional measures over and above good (standard) practice pollution prevention measures.
		Surface Waters	Medium	Unlikely *(due to distance to nearest surface waterbody >800m)*	**Low Risk**	
		Building Infrastructure	Mild	Unlikely *(assuming limited thickness of Made Ground)*	**Low Risk**	

Asbestos associated with Made Ground	Inhalation	Future Site Users	Medium	Low Likelihood *(due to proposed site use and cover)*	**Moderate/ Low Risk**	Given the age of the Cinema, and prior residential housing there is the potential for asbestos in soils associated with the redevelopment of site. Risks to construction workers can be managed through appropriate on-site management systems. It is recommended that construction workers are made aware of the potential for asbestos within the Made Ground prior to the commencement of any ground disturbance and that a reactive strategy is developed for when groundworks commence.
		Site Construction Workers		Likely *(due to interaction and disturbance of the Made Ground during construction)*	**Moderate**	
On-site electrical sub-station	Direct dermal contact or ingestion of soils, or inhalation of dust	Future Site Users	Medium	Unlikely *(due to proposed site use and cover)*	**Low Risk**	The sub-station is constructed upon hardstanding limiting the potential for contact within underlying soils. No specific mitigation measures are proposed at this stage.
		Site Construction Workers	Medium	Low Likelihood *(based on limited potential contamination)*	**Moderate / Low Risk**	
	Leaching and horizontal or vertical migration	Groundwater	Medium	Low Likelihood *(based on limited potential contamination)*	**Moderate / Low Risk**	
		Surface Waters	Medium	Unlikely *(due to distance to nearest surface waterbody >800m)*	**Low Risk**	
		Building Infrastructure	Medium	Unlikely *(due to low mobility of potential contaminants)*	**Low Risk**	

Ground gas potential associated with made ground	The migration and accumulation of gases or vapours through permeable subs-surface materials and / or preferential pathways	Future Site Users	Severe	Unlikely *(assuming limited thickness of Made Ground and ground gas potential)*	**Moderate/Low Risk**	In the event that significant depths of made ground be encountered during site investigation then ground gas monitoring should be undertaken and a ground gas risk assessment undertaken in accordance with BS8485/CIRIA C665 guidance in order to assess whether gas protection measures are required for the proposed development.
Contamination associated with historic garage c.10m north of the site migrating through shallow groundwater to site	Direct dermal contact or ingestion of soils, or inhalation of dust / vapours	Future Site Users	Mild	Unlikely *(due to proposed site use and cover)*	**Very Low Risk**	No specific mitigation measures are proposed at this stage.
		Site Construction Workers	Mild	Low Likelihood *(based on limited potential contamination)*	**Low Risk**	

Conclusions and Recommendations

Ground Contamination

Based on the historical data available, the site has not been subject to uses that are likely to have resulted in significant ground contamination, although ground contamination could be associated with the potential presence of made ground and presence of an electrical sub-station.

The overall risk of ground contamination beneath the site is considered to be of moderate to low order of magnitude for construction workers during the redevelopment phase, risks to future site users are considered to be low due to the presence of hardstanding and limited potential interaction with sub-surface materials.

The risk to the underlying groundwater is considered to be moderate/low due to the location of the site in an EA defined High Vulnerability area. These are high priority groundwater resource areas that have very limited natural protection. The potential risk to the underlying groundwater from Made Ground soils should be assessed during ground investigation. The risk to the surface water features are low based on the distance to the nearest feature (>800m).

Consideration should also be given to the potential for ground gas generation if significant made ground is present. A CIRIA C665 compliant ground gas assessment may be required to assess the potential effect of ground gas on building design.

Geotechnical

Ground investigation will be required to confirm ground conditions on site including an assessment of the thickness and extent of superficial deposits and potential presence of made ground. The results of the ground investigation can be used to inform the detailed design phase with regards to foundation requirements.

Utility information will need to be obtained prior to any intrusive site works on site.

Recommendations

Ground investigation is likely to be required as part of any imposed conditions associated with a future planning application for development of the site.

The objectives of this work should be to:

- Confirm the presence, extent and nature of Made Ground materials;
- Assess the potential presence of contamination within the Made Ground;
- Should significant depths of made ground be encountered it may be appropriate to undertake an updated CIRIA C552 compliant risk assessment with respect to ground contamination within the context of a residential end use;
- Confirm ground conditions and assess geotechnical properties of the ground to aid foundation design;

- Should significant depths of made ground be encountered it may be appropriate to install ground gas and groundwater monitoring wells to facilitate a BS8485 / CIRIA C665 compliant risk assessment and assess groundwater conditions on site;
- Undertake CBR tests (Pavement Design); and
- Confirm the current hydrogeological conditions that exist beneath the site (depth to groundwater / quality).

References

1. BRE 211. Radon: Guidance on protective measures for new buildings. Chris Scivyer MCIOB. 2015 edition.
2. Construction Industry Research and Information Association (CIRIA) Publication C552. Contaminated Land Risk Assessment: A guide to good practice. D J Rudland, R M Lancefield and P N Mayell, January 2001. Section 6.3 Risk Evaluation.
3. Construction Industry Research and Information Association (CIRIA) Publication C665 Assessing risks posed by hazardous ground gases to buildings. S Wilson, S Oliver, H Mallett, H Hutchings, G Card. December 2007.

APPENDIX A: REPORT CONDITIONS

APPENDIX A - REPORT CONDITIONS
GEO-ENVIRONMENTAL DESK TOP REVIEW

This report is produced solely for the benefit of Bonnes Mares Limited and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the site.

This report is based on a study of readily accessible referenced historical records. Some of the opinions are based on unconfirmed data and information and are presented in good faith without exhaustive clarification. Where ground conditions are discussed but no physical site test results are available to confirm this, the report must be regarded as initial advice only, and further assessment should be undertaken prior to detailed activities related to the site. Where test results undertaken by others have been made available these can only be regarded as a limited sample.

Whilst confident in the findings detailed within this report because there are no exact UK definitions of these matters, we are unable to give categorical assurances that they will be accepted by Authorities or Funds etc. without question, as such bodies may have unpublished, often more stringent objectives. This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to WYG. In time improved practices or amended guidance may necessitate a re-assessment. The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous use and abuse of the site and adjacent sites. The report concentrates on the site as defined in the report and provides an opinion on surrounding sites.

APPENDIX B: HISTORICAL MAPS

APPENDIX C: CIRIA C552 RISK ASSESSMENT METHODOLOGY

The following tables are derived from CIRIA C552 and have been used to define the risk rating presented in the Qualitative Risk Assessment matrix.

Classification of consequence

Classification	Definition
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of pollution (note; Water Resources Act contains no scope for considering significant pollution) of sensitive water resource. Catastrophic damage to building/property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem. (Note the definitions of ecological systems within the Draft Circular on Contaminated Land DETR, 2000).
Medium	Chronic damage to human health ('significant harm', as defined in DEFRA, 2006). Pollution of sensitive water resources (note; Water Resources Act contains no scope for considering significant pollution). A significant change in a particular ecosystem, or an organism forming part of such an ecosystem. (Note the definitions of ecological systems within the Circular on Contaminated Land DEFRA, 2006).
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm', as defined in DEFRA, 2006). Damage to sensitive buildings/structures/services or the environment.
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.

Classification of probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place, and is even less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Matrix of consequence against probability to gain a risk classification

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk