



Ground Condition Consultants

IMPERIAL WHARF, CLIFTON MARINE PARADE, GRAVESEND, DA11 0DY

GROUND CONDITION DESK TOP STUDY

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0. EXECUTIVE SUMMARY

Brief	The brief was to use the information provided in an Environmental Database Search relating to the Site to assess and report on the findings with respect to potential ground contamination and potential associated future liabilities in accordance with the Preliminary Risk Assessment procedure outlined in Land Contamination Risk Management (LCRM), published by the Environment Agency.
Current Site Status	The Site is located at the intersection of Clifton Marine Parade and The Shore, Gravesend, DA11 0DY (approx. grid ref: 563903, 174474) and is irregular in plan shape with an area of approximately 0.67ha. The Site comprises three main areas, linked by roadways.
Site History	The Site has had a long industrial use, including docklands from prior to 1866, being reclaimed from mudflats between 1923 and 1932, part of a paper mill and associated with bitumen production and storage. The historical maps indicate the historical presence of tanks in the northwest and southwest areas of the Site. The Site areas have more recently been used for material storage and car parking.
Geology	Reference to the British Geological Survey (BGS) Map extracts indicates the west of the Site to be underlain by Made Ground and Worked Ground with no superficial deposits shown in the southern area and Alluvium shown beneath the northern area. The bedrock geology beneath the whole Site comprised Seaford Chalk Formation.
Hydrogeology	The Environment Agency Groundwater Vulnerability Map extracts indicate the north of the Site to be overlying a superficial Secondary Undifferentiated Aquifer, interpreted as the Alluvium, over a bedrock Principal Aquifer, interpreted as the Seaford Chalk Formation.
Hydrology	The River Thames is located adjacent to the Site to the north
Conclusions and Recommendations	The following potential sources of contamination were identified: • Potential for asbestos containing material fragments and fibres within the Made Ground across the Site as a result of the construction and demolition of former structures; • Potential for a range of organic and inorganic contaminants present within the Made Ground across the Site from the historical industrial activities, particularly the former tank areas in the northwest and southwest, and current bitumen activities; • Potential for ground gas from Made Ground used to reclaim the north of the Site from mud flats. • Potential for a range of organic and inorganic contaminants that may have migrated from the adjacent industrial uses and bitumen storage. It should be noted that additional sources of contamination may become apparent during any future investigation and development of the Site. The risk of impact to identified receptors from the identified potential sources is generally considered to be very low to low/moderate. As such, an intrusive investigation is recommended for the development to further assess the risks to human health and controlled waters. It is also considered prudent to undertake a geotechnical investigation to inform the foundation design of the proposed development, which is likely to be piled in the area reclaimed from the mud flat of the River Thames.
<i>This sheet is intended to provide a summary only of the initial indicative assessment study of the site in relation to ground contamination. It does not provide a definitive engineering analysis for the purposes of costing or construction, and is subject to the limitation of the agreed brief.</i>	

1. INTRODUCTION

1.1 INSTRUCTION

Ground Condition Consultants Ltd. (GCC) was commissioned by PDE Consulting Ltd on behalf of FM Conway Ltd in October 2021 to undertake a Ground Condition Desk Top Study of a Site located at Imperial Wharf, Clifton Marine Parade, Gravesend, DA11 0DY.

The brief was to use the information provided in an Environmental Database Search relating to the Site to assess and report on the findings with respect to potential ground contamination and potential associated future liabilities in accordance with the Preliminary Risk Assessment procedure outlined in Land Contamination Risk Management (LCRM), published by the Environment Agency.

This report is prepared in line with the agreed brief and is subject to the report conditions shown in Appendix 1.

1.2 LEGAL CONTEXT

Part IIA of the Environmental Protection Act 1990 (inserted by Section 57 of the Environment Act 1995) provides a regime for the control of specific threats to health or the environment from land contamination. In accordance with the Act and the statutory guidance document 'The Contaminated Land (England) Regulations 2000', the definition of contaminated land is intended to embody the concept of risk assessment. Within the meaning of the Act, land is only "contaminated land" where it appears to the Regulatory Authority, by reason of substances within or under the land, that:

- Significant harm is being caused, or there is a significant possibility of such harm being caused; or
- Pollution of controlled waters is being, or is likely to be, caused."

Inherent in this definition is the requirement for contamination risk assessment to be undertaken on a site specific basis, as the potential for harm is determined by the Site's end use and its specific environmental setting.

The guidance defines "risk" as the combination of:

- The probability, or frequency, of occurrence of a defined hazard (for example, exposure of a property to a substance with the potential to cause harm); and
- The magnitude (including the seriousness) of the consequences.

While Part IIA of the Environmental Protection Act provides a risk based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment, the regime does not take into account future uses. New developments are therefore controlled by the planning regime, with reference to the National Planning Policy Framework (NPPF), rather than directly by Part IIA of the Environmental Protection Act.

The NPPF is based on the principal that the site should be suitable for its new use, taking account of ground conditions, including from natural hazards or former activities and states that “Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner”. The NPPF also links the planning and Part IIA regimes by stating that “after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990”. Key components of the Part IIA regime, such as the definition of Contaminated Land and the associated risk based assessment approach, are therefore considered to also be applicable to the planning regime.

1.3 METHODOLOGY

This report has been prepared in accordance with published Environment Agency guidance (‘Land Contamination Risk Management (LCRM)’). LCRM provides the technical framework for structured decision making about land contamination and builds on previous work carried out under the Contaminated Land Research Programme (of the former Department of the Environment) and the Model Procedures for the Management of Land Contamination – Contaminated Land Report (CLR) 11. LCRM has adopted and refined the well recognised methodology and terminology that has been used in contaminated land risk assessment for a number of years.

1.3.1. Pollutant linkage concept

In the context of land contamination, there are three essential elements to any risk:

- A **contaminant source** – a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters.
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body.
- A **pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage.

1.3.2. Conceptual model

An important thread throughout the overall process of risk assessment is the need to formulate and develop a **conceptual model** for the Site, which supports the identification and assessment of pollutant linkages. A conceptual model represents the characteristics of the Site in diagrammatic or written form that shows the possible relationships between contaminants, pathways and receptors (pollutant linkages).

1.3.3. Risk assessment

LCRM advocates a phased approach to risk assessment comprising the following in order, as necessary:

Preliminary Risk Assessment – a desk study consisting of a review of documentary, anecdotal and site walk over evidence.

Generic Quantitative Risk Assessment (GQRA) - comparison of contaminant concentrations obtained from site investigation with generic assessment criteria.

Detailed Quantitative Risk Assessment (DQRA) - comparison of contaminant concentrations obtained from site investigation with site-specific assessment criteria.

This document constitutes a Preliminary Risk Assessment.

1.4 PROPOSED USE

It is currently understood that two additional bitumen tanks, load out gantry, installation of a bitumen emulsion plant and alternative car parking are to be developed at the Site. parking, located to the south of Clifton Marine Parade.

The two additional bitumen storage tanks will be located on an area of land currently used for car parking. The emulsion plant will be located adjacent to the east of the Technology Centre, contained within the matrix of the already built development, with the load out gantry located to the west of The White House. Alternative car parking provision will be made on land to the west of the proposed bitumen storage tanks, on the opposite side of Clifton Marine Parade. New dedicated HGV parking is also proposed on land immediately west of the proposed bitumen storage tanks and on land to the west of the new load out gantry.

A change in the Site use from that currently proposed may result in the need for re-assessment of risk criteria and the conclusions and recommendations resulting from the risk assessment could therefore significantly change.

1.5 REPORT SCOPE AND LIMITATIONS

This report is based upon a review of readily available historical and current information, geological and hydrogeological maps and information from an environmental database search. The assessment is based on the proposed use stated in Section 1.4 and the outcomes of this assessment could change if the end uses change.

The information contained in this report is intended for the use of FM Conway Ltd. GCC can take no responsibility for the use of this information by any other party or for uses other than that described in this report.

2. PRELIMINARY RISK ASSESSMENT

2.1 SITE LOCATION AND DESCRIPTION

The Site is located at the intersection of Clifton Marine Parade and The Shore, Gravesend, DA11 0DY (approx. grid ref: 563903, 174474) and is irregular in plan shape with an area of approximately 0.67ha. The Site comprises three main areas (northern Site area, southeast Site area and southwest Site area), linked by roadways.

The northern Site area is located between the River Thames, which forms the northern Site boundary, and The Shore, which forms the southern boundary of this area. At the time of the walkover survey, this area was in use for some general material storage and parking. An office building, The White House, and the Conway Technology Centre are located adjacent to the southeast of this area.

The southeast area of the Site is located between Clifton Marine Parade, which forms the northern and western boundaries, and the Imperial Business Park, which forms the southern and western boundaries. At the time of the walkover survey, this area was in use as car parking in the east and a concrete covered storage yard in the west.

The southwest area of the Site is located between Clifton Marine Parade, which forms the eastern boundary, and the Imperial Business Park, which forms the southern and western boundaries. At the time of the walkover survey, this area comprised an unoccupied gravel covered storage yard.

2.2 SITE HISTORY

2.2.1. Study Site

The historical map extracts from 1866 to 2021 show the Site to have been in industrial use since at least 1866. The earliest available map extracts show parts of the north of the Site to be in use as quays with the remainder of the north of the Site comprising of tidal mud flats associated with the River Thames. Rail tracks crossed both the northern and southern areas of the Site with parts of the southern area of the Site also occupied by a public house and parts of what appears to be a large residential property (Bycliffes).

Between 1923 and 1932, the north of the Site was infilled between the quays to form a continuous wharf extending to the east of the Site. This wharf is noted to have had a series of traveling cranes and a jetty extending into the Thames to the north. During this period, the southwest section of the Site had been redeveloped from being part of the former Bycliffes plot to being part of two larger industrial units, linked with Imperial Paper Mills, which is identified to the southeast of the Site on the 1932 map. The southeast area of the Site had been redeveloped with a replacement public house. Rail lines are still shown crossing the centre of the Site.

While the 1952 map extract does not show much change within the Site boundary, other than a tank identified in the centre of the southwest area, large parts of the industrial buildings to the south and southeast are identified as ruins, suggesting bomb damage during World War 2.

The northwest area of the Site was redeveloped in the late 1960s/early 1970s with two large circular tanks and an adjacent building, identified as a hopper. These tanks and hopper were removed by the mid 1980s. This area appears to have remained undeveloped and has been used for material storage and car parking.

The industrial buildings on the southwest area of the Site appear to have been demolished in the late 1980s and appears to have remained undeveloped since then and used for material storage.

The public house and other small industrial buildings in the southeast area of the Site appears to have been demolished in the late 1990s/early 2000s and has remained undeveloped since then. This area has more recently been used for car parking and material storage.

2.2.2. Surrounding Area

As discussed above, the 1866 map extract shows a large residential building (Bycliffe) adjacent to the southeast of the Site with the associated gardens extending to the south. To the west of Bycliffe were a series of terraced houses. To the east of the Site was an apparent row of commercial and possibly residential units along Clifton Marine Parade, fronting the River Thames. To the southeast of the Site was a lime works and associated kilns, linked to quays on Site by tramways.

Bycliffe, the commercial units along Clifton Marine Parade and the lime works were redeveloped between 1923 and 1932 with the Imperial Paper Mills, which incorporated the Site and surrounding area. Between 1963 and 1972, two large tanks were constructed adjacent to the northeast of the Site with additional tanks added to the east between 1993 and 2003. These tanks remain to the present day and it is understood that these are bitumen storage tanks.

The Imperial Paper Mill buildings to the south and southeast of the Site were demolished in the late 1980s and early 1990s and were replaced with the Imperial Business Park by 1999.

2.3 DOCUMENTATED GROUND CONDITIONS

Ground conditions recorded in readily available sources are summarised below.

2.3.1. Geology

Reference to the British Geological Survey (BGS) Map extracts (see Appendix 2) indicates the west of the Site to be underlain by Made Ground and Worked Ground with no superficial deposits shown in the southern area and Alluvium shown beneath the northern area. The bedrock geology beneath the whole Site comprised Seaford Chalk Formation.

2.3.2. Hydrogeology

The Environment Agency Groundwater Vulnerability Map extracts (see Appendix 2) indicate the north of the Site to be overlying a superficial Secondary Undifferentiated Aquifer, interpreted as the Alluvium, over a bedrock Principal Aquifer, interpreted as the Seaford Chalk Formation.

Secondary Undifferentiated Aquifers are assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

Principal Aquifers are geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers.

The Site is not located within a Groundwater Source Protection Zone.

2.3.3. Hydrology

The River Thames is located adjacent to the Site to the north (forming the northern Site boundary).

2.3.4. Radon

Radon is a naturally occurring radioactive gas which may be harmful to human health. Radon is generally released into the atmosphere in areas underlain by granite and limestone. Harmful concentrations of radon may build up if it becomes trapped in an enclosed space such as a building.

BGS/Public Health England data presented within the Groundsure Report indicates that the percentage of houses exceeding the Action Levels for Radon is less than 1% for the Site. Therefore, the property is not in a Radon Affected Area, as defined by the Health Protection Agency (HPA), and radon protection measures are not necessary in new dwellings or extensions.

2.4 ENVIRONMENTAL DATA SEARCH

A search of an environmental database was undertaken together with information from various other organisations as part of the desk study and is summarised in the following sections. The following summary is generally limited to locations within 250m 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.

Table 2.1. Data search results

Discharge consents	There is 1no recorded active discharge consent within 250m of the Site. It relates to discharge of surface water from the Imperial Business Park into the River Thames.
Pollution incidents	There is 1no. recorded pollution incident with 250m of the Site. 189m southeast, 16/05/2002 – Diesel. The impact to air was classified as Category 4 – No Impact. The impact to water and land was classified as Category 3 – Minor.
Water abstractions	There are no recorded water abstractions within 500m of the Site.
Fuel Stations	There are no recorded fuel stations within 250m of the Site.
Landfill Sites	An inert waste landfill, dating to 1972, is located 232m to the southeast of the Site. The north of the Site is also known to have been reclaimed from the mud flats of the River Thames, although this is not recorded as a landfill.

2.5 MINING AND NATURAL GROUND HAZARDS

2.5.1. Mining

Sporadic underground Chalk mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered. Chalk is known to have been mined for lime to the southeast of the Site.

2.5.2. Natural Ground Hazards

The following ground hazards were identified:

Compressible ground stability hazards – Negligible and Very Low hazard

BGS Notes: (Negligible hazard associated with the majority of the Site) Compressible strata are not thought to occur.

BGS Notes: (Very Low hazard associated with the northern periphery of the Site) Compressibility and uneven settlement problems are not likely to be significant on the site for most land uses.

Collapsible ground stability hazards – Very Low hazard

BGS Notes: (Negligible hazard associated with the northern periphery of the Site) Deposits with potential to collapse when loaded and saturated are believed not to be present..

BGS Notes: (Very Low hazard associated with the majority of the Site) Deposits with potential to collapse when loaded and saturated are unlikely to be present.

Ground dissolution stability hazards – Very Low hazard

BGS Notes: Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.

Landslide ground stability hazard – Very Low to Negligible hazard

BGS Notes: (Very Low hazard associated with the northern periphery of the Site) Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.

BGS Notes: (Negligible hazard associated with the majority of the Site) Slope instability problems are not thought to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.

Shrinking or swelling clay ground stability hazard – Negligible and Low hazard

BGS Notes: (Negligible hazard associated with the majority of the Site) Ground conditions predominantly non-plastic.

BGS Notes: (Low hazard associated with the northern periphery of the Site) Ground conditions predominantly medium plasticity.

Running sand ground stability hazards – Negligible to Very Low hazard

BGS Notes: (Negligible hazard associated with the majority of the Site) Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.

BGS Notes: (Very Low hazard associated with the northern periphery of the Site) Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.

2.6 DEPARTMENT OF ENVIRONMENT – INDUSTRY PROFILES

The Department of the Environment Industry Profile for Dockyards and docklands, Railway land and Bulk storage of petroleum products have been reviewed in relation to the past and current uses of the Site.

As a result of this use, the following potential contaminants have a significant potential to be present:

- Metals
- Asbestos
- Inorganic chemicals
- Organic chemicals including oil and fuel hydrocarbons

2.7 UNEXPLODED ORDNANCE

A Preliminary Unexploded Ordnance (UXO) Risk Assessment has not been commissioned as part of this assessment. However, it is noted from the historical maps that suspected bomb damage was evident to the building to the south and southeast of the Site but not to the structures within the Site boundary.

3. CONCEPTUAL SITE MODEL

3.1 SOURCES

The conceptual model, based on information obtained as part of the preliminary risk assessment, identified the following potential contaminant sources:

3.1.1. On-Site – Historic and Current

- Potential for asbestos containing material fragments and fibres within the Made Ground across the Site as a result of the construction and demolition of former structures;
- Potential for a range of organic and inorganic contaminants present within the Made Ground across the Site from the historical industrial activities, particularly the former tank areas in the northwest and southwest, and current bitumen activities;
- Potential for ground gas from Made Ground used to reclaim the north of the Site from mud flats.

It should be noted that additional sources of contamination may become apparent during any future investigation and development of the Site.

3.1.2. Off-Site – Historic and Current

- Potential for a range of organic and inorganic contaminants that may have migrated from the adjacent industrial uses and bitumen storage.

3.2 PATHWAYS

The key environmental pathways and exposure routes by which potentially toxic substances can reach the identified potential receptors are considered to be:

3.2.1. Indirect

- Vertical migration leading to accumulation of gases in enclosed spaces,

3.2.2. Direct

- Direct contact,
- Ingestion,
- Inhalation of dust,
- Inhalation of ground gas.

3.3 RECEPTORS

Receptors that may be affected by the potential contamination are:

3.3.1. Human

- Future Site users

Construction workers have been excluded from this assessment on the basis that they are subject to health and safety at work regulations and are expected to use appropriate personal protective equipment (PPE).

3.3.2. Environmental

- New buried services and construction materials
- Principal Aquifer (Chalk)
- Adjacent River Thames

4. RISK ASSESSMENT

4.1 RISK ASSESSMENT PROCEDURE

By considering the sources, pathways and receptors (pollutant linkages), an assessment of the human health/ environmental risks is made with reference to the significance and degree of the risk. This assessment is based on consideration of whether the source contamination can reach a receptor and hence whether it is of major or minor significance.

The risk assessment has been undertaken with reference to BS10175 and CIRIA Document C552: Contaminated Land Risk assessment 'A Guide to Good Practice'. The risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential magnitude of the hazard and the sensitivity of the target, based on the categories given overleaf.

Table 4.1. Sensitivity of receptor

Category	Examples
High	Residential with gardens/Groundwater Source Protection Zone
Medium	Residential without gardens/Principal (Major) Aquifer/sensitive watercourse
Low	Commercial and industrial use/Secondary (Minor) Aquifer
Very Low	Construction and maintenance workers/non-sensitive watercourse

Table 4.2. Magnitude of impact

Category	Examples
Gross Impact	Heavily contaminated gasworks or industrial site, hazardous waste landfill
Moderate Impact	Major leaks and spills from fuel infrastructure (e.g. petrol stations), domestic waste landfill
Slight Impact	Minor leaks and spills from fuel infrastructure, 'inert' waste landfills
No Impact	No identified or suspected contamination

Table 4.3. Level of severity for potential hazard

	Sensitivity of receptor			
Magnitude of Impact	High	Medium	Low	Very Low
Gross Impact	Severe	Medium	Mild	Minor
Moderate Impact	Medium	Mild	Minor	Minor
Slight Impact	Mild	Minor	Minor	Minor
No Impact	Minor	Minor	Minor	Minor

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Table 4.4. Probability of risk definition

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

Table 4.5. Level of risk for potential hazard definition

Probability of risk	Potential severity			
	Severe	Medium	Mild	Minor
High Likelihood	Very high	High	Moderate	Low/ Moderate
Likely	High	Moderate	Low/ Moderate	Low
Low likelihood	Moderate	Low/ Moderate	Low	Very low
Unlikely	Low/ Moderate	Low	Very low	Very low

The assessment is discussed below in terms of plausible pollutant linkages. A complete assessment of the pollutant linkages is presented in Table 4.6 overleaf.

A description of these risk classifications and likely action required are given in CIRIA 552 as:

Very high risk – High probability that severe harm could arise to a designated receptor from an identified hazard OR there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.

High risk – Harm is likely to arise to a designated receptor from an identified hazard. This risk, if realised, is likely to result in substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.

Moderate risk – It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation is normally required to clarify risks and to determine potential liability. Some remedial works may be required in the long term.

Low risk – It is possible that harm could arise to a designated receptor from an identified hazard but it is likely that this harm, if realised, would at worst normally be mild.

Very low risk – It is a low possibility that harm could arise to a designated receptor. In the event of such harm being realised it is not likely to be severe.

4.2 POLLUTANT LINKAGE ASSESSMENT

Table 4.6. Pollutant Linkage Assessment

Source	Pathway	Receptor	Severity	Likelihood	Risk Level
Potential for a range of organic and inorganic contaminants present within the Made Ground and natural strata from the current and former Site uses	Direct Contact Ingestion Inhalation	Future Users	Minor	Low Likelihood	Very Low
	Vertical and lateral migration leading to direct contact	River Thames	Mild	Low Likelihood	Low
	Vertical migration leading to direct contact	Principal Aquifers	Mild	Likely	Low/ Moderate
	Direct Contact	New services and building materials	Minor	Likely	Low
Potential contamination from off-site industrial uses and bitumen storage	Direct Contact Ingestion Inhalation	Future Users	Minor	Unlikely	Very Low
Potential for asbestos containing material fragments within the soil	Inhalation	Future Users	Medium	Unlikely	Low
Ground-gas from on-site Made Ground	Vertical migration of ground gas leading to accumulation in confined spaces and inhalation	Future Users	Mild	Low Likelihood	Very Low

4.2.1. Range of contaminants present in the Made Ground

The Site has had a long industrial use, including being reclaimed from mudflats, part of a paper mill and associated with bitumen production and storage. It is therefore considered possible that a variety of organic and inorganic contaminants are present in the ground and groundwater at concentrations that could present a significant risk to human health and controlled waters.

Given the low sensitivity of the proposed use and the likely predominance of hard standing in the completed development, the risks to the health of the future users are considered to be very low.

The adjacent River Thames to the north of the Site and the underlying Principal Aquifer on the Site are also considered to be potential receptors for impacts from the Site. The risks to these receptors have therefore been assessed to be low/moderate.

Intrusive investigation of the potential pollutant linkages is recommended to confirm this assessment. In particular, such an investigation should target the former tank locations in the northwest and southwest of the Site.

4.2.2. Asbestos containing materials and fibres

The potential exists for the Made Ground beneath the Site to contain asbestos from the former structures. It is likely that much of the Site will be covered by hard standing following completion of the proposed development so the primary exposure routes are during the development process and in any areas of proposed soft landscaping that will form part of the completed development. Given the proposed commercial/industrial use of the Site is a relatively low sensitivity end use, the risk to the future Site users have been assessed to be low/moderate.

It is therefore recommended that an intrusive investigation is undertaken to further assess this potential risk. However, it should be noted that the discrete nature of asbestos contamination in soil means that a potential for asbestos to be present will remain even if the investigation does not identify such material.

The risks to construction workers will need to be managed separately during the development, subject to the findings of the recommended intrusive investigation.

4.2.3. Ground gas (methane and carbon dioxide)

The reclaimed land in the north of the Site is a potential source of ground gas generation, although it is recognised that much of the degradable matter in this material is likely to have already degraded since the material was placed. Intrusive investigation and ground gas monitoring of the Site is recommended and it is possible that ground gas protection measures will be required for any enclosed buildings built on the ground in the proposed development to mitigate any residual risk.

4.2.4. Adjacent industrial uses and bitumen tanks

The area surrounding the Site has had an extensive industrial history with a range of potential contaminants in the ground surrounding the Site to could migrate onto Site. However, the risks to the users of the Site are not likely to be increased significantly by such contamination. Although, there is a potential for contaminated groundwater migration from these sources to contribute to the groundwater contamination on Site and may therefore influence the controlled waters risks. The risk has therefore been assessed to be very low with regard to human health of the future users.

Gravesham Borough Council

5. CONCLUSIONS AND RECOMMENDATIONS

The following potential sources of contamination were identified:

- Potential for asbestos containing material fragments and fibres within the Made Ground across the Site as a result of the construction and demolition of former structures;
- Potential for a range of organic and inorganic contaminants present within the Made Ground across the Site from the historical industrial activities, particularly the former tank areas in the northwest and southwest, and current bitumen activities;
- Potential for ground gas from Made Ground used to reclaim the north of the Site from mud flats.
- Potential for a range of organic and inorganic contaminants that may have migrated from the adjacent industrial uses and bitumen storage.

It should be noted that additional sources of contamination may become apparent during any future investigation and development of the Site.

The risk of impact to identified receptors from the identified potential sources is generally considered to be **very low to low/moderate**. As such, an intrusive investigation is recommended for the development to further assess the risks to human health and controlled waters. It is also considered prudent to undertake a geotechnical investigation to inform the foundation design of the proposed development, which is likely to be piled in the area reclaimed from the mud flat of the River Thames.

While construction workers have been excluded from this assessment on the basis that they are subject to health and safety at work regulations and are expected to use appropriate personal protective equipment (PPE), any ground works contractors working on the Site, including installing new underground services, should be made aware of the potential for contamination to be present within the ground underlying the Site surfacing.

FIGURE 1: LOCATION PLAN



Ground Condition Consultants Ltd
10 Waldegrave Close Southampton SO19 9RY
Telephone 07971 450113
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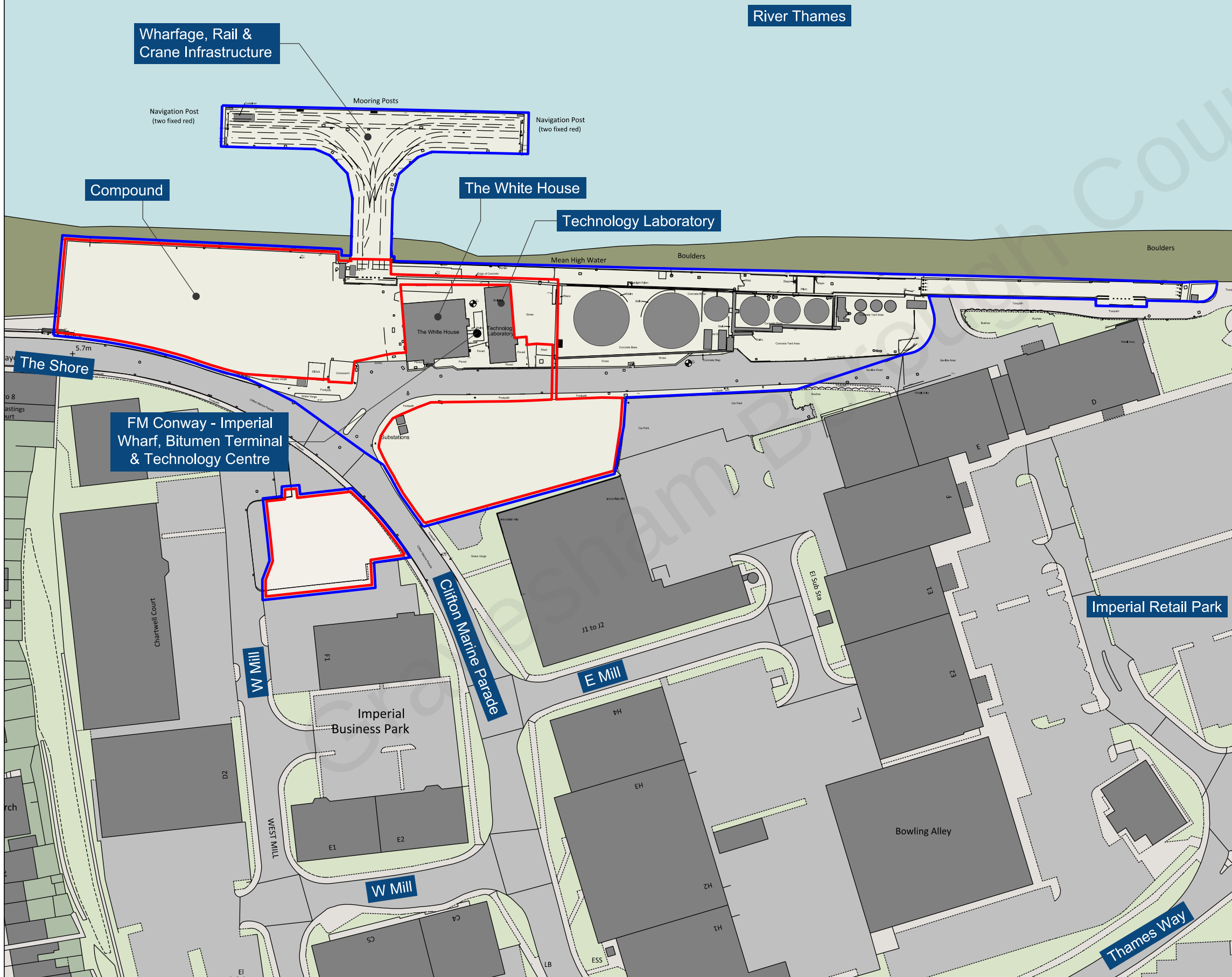
client	FM CONWAY LTD
site	IMPERIAL WHARF, GRAVESEND
title	SITE LOCATION PLAN

scale	NTS	drawn by	AP	checked by	RP
date	23 NOV 2021		job no	J21-044	
drawing number					rev.
FIGURE 1					-

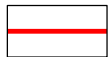
FIGURE 2: LAYOUT PLAN

Imperial Wharf

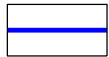
Current Situation / Immediate Site Context



Legend



Planning Application Boundary



Land Under the Control of the Applicant



Existing Buildings & Infrastructure within and surrounding the Site



PROJECT

Imperial Wharf

DRAWING TITLE

Current Situation / Immediate Site Context

DATE _____

November 2021

SCALE

1:1,250 @ A3

DRAWING No.

KD.IMP.D.003

DRAWING STATUS

FINAL



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APPENDIX 1: REPORT CONDITIONS

This report is produced solely for the benefit of **FM Conway Ltd** 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 visual Site inspection, study of readily accessible referenced historical records, information supplied by those parties noted in the text and preliminary discussions with local and Statutory Authorities. Some of the opinions are based on unconfirmed data and information and are presented in good faith without exhaustive clarification. Where ground contamination is suspected 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. The possibility of the presence of contaminants, not revealed by this research cannot be discounted.

Whilst confident in the findings detailed within this report because there are no exact UK definitions of these matters, being subject to risk analysis, 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 Ground Condition Consultants Ltd. In time improved practices or amended legislation may necessitate a re-assessment.

The report is necessarily limited to those aspects of land contamination specifically reported on and no liability is accepted for any other aspect especially concerning gradual or sudden pollution incidents that may occur. 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. If migrating pollution or contamination (past or present) exists this can only practically be better assessed following extensive on and off Site intrusive investigations and monitoring.