CONTAMINATION REPORT
DESK STUDY
Revision A

Job No. 20689

Proposed Residential Development
Land Behind Willowmere
Garden House Lane
Rickinghall
Diss

Client: Mr & Mrs Arnold

June 2016

civil • structural • environmental • surveying

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REPORT CONTROL SHEET

Client: Mr & Mrs Arnold **Job No.:** 20689

Project Name: Proposed Residential Development
Land behind Willowmere
Garden House Lane
Rickinghall
Diss
IP22 1EA

Issue		
First Issue	January 2016	
Revision A Proposal reduced from 29 dwellings to 10 dwellings	June 2016	**Report Prepared by:** T J Barker Tyler Barker Environmental Technician
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CONDITIONS OF INVESTIGATION AND REPORTING

This report and its findings should be considered in relation to the terms of the brief and objectives agreed between Plandescil Ltd and the Client.

Plandescil Ltd has made every effort to provide an accurate assessment of the ground condition of the site, within the constraints of this desk study. However it is possible that different ground conditions or contamination may exist in parts of the site which has not been identified in the desk study or the visual survey.

The conclusions within this report are professional opinions based on the interpretation of environmental and historical data which have been compiled using a standard methodology designed to provide reasonable consistency and robustness. Plandescil Ltd cannot be held responsible for any contamination subsequently identified during development of the land.

The details contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by Plandescil Ltd has not been independently verified by Plandescil Ltd, unless otherwise stated in the report.

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TABLE OF CONTENTS

1.0 INTRODUCTION

Plandescil Ltd has been commissioned by Keith Day Architects, on behalf of the applicants Mr & Mrs Arnold., to prepare a Phase 1 Contamination Report Desk Study. The report was requested by Lisa Evans, Development Management Planning Officer of Babergh and Mid Suffolk District Councils. The report includes a review of environmental and historical factual data and site walkover, to enable determination of planning application 4116/15 for the proposed erection of 10 dwellings on land behind Willowmere, Garden House Lane, Rickinghall, Diss, Suffolk, IP22 1EA. Refer to Sketch Layout Plan, Drawing No. 444-SK01 (**Drawings Appendix**).

2.0 OBJECTIVES

This Phase 1 Desk Study seeks to identify as far as reasonably practicable, the likelihood of potential environmental contamination which may affect the suitability of the site for future use as a residential development, or adversely affect the health and safety of sensitive receptors.

This will be achieved by:

- construction of a preliminary conceptual site model (CSM), to facilitate an understanding of the potential sources, pathways and receptors which may exist on site
- production of a qualitative preliminary risk assessment accounting for potential pollutant linkages
- establishing the need and scope for further investigation

3.0 SOURCES OF INFORMATION

A variety of public, published and site-specific information sources have been consulted in the compilation of this report. These sources are listed below:

[1] NHBC, Environment Agency & CIEH. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66: 2008 Volume 1

[2] Environment Agency. Model Procedures for the Management of Land Contamination. Contaminated Land Report 11. 2014

[3] British Geological Survey: Sheet 5 hydrogeological map of Southern East Anglia. 1981. Scale 1:125,000

[4] British Geological Survey. Digital Geological map of Great Britain. Scale 1:50,000

[5] Anglian Water. Information for Developers about Contaminated Land and Ground Condition Assessments

[6] Environment Agency: What's In Your Back Yard Maps (WIYBY)

[7] Environment Agency: Wild Plants: dangerous, invasive and protected species. www.gov.uk.

[8] Groundsure (2016) GeoInsight Report compiled January 2016.

[9] Groundsure (2016) EnviroInsight Report compiled January 2016.

[10] Groundsure (2016) MapInsight (All Scales) compiled January 2016.

[11] Google (2016) Google Maps.

[12] Norfolk County Council (2016) Historic Map Explorer

[13] UK Grid Reference Finder (2016) Maps.

[14] Bing (2016) Bing Maps.

[15] Natural England. Injurious weeds and invasive plants. www.naturalengland.org.uk

4.0 SITE HISTORY

4.1 Site Description

The site is situated in the village of Rickinghall, which lies approximately 6 miles south west of the town of Diss, refer to Site Location Plan, Drawing No. 20689/701 **(Drawings Appendix)**. The site is located at National Grid reference 604548E, 275163N [8], and lies at an elevation varying between 38.52m above ordnance datum (AOD) at the northern extent of the access and 44.46m AOD in the south west of the site, refer to Topographical Survey Drawings, Drawing No. 20304/001 & 20304/002 **(Drawings Appendix)**.

The site is currently utilised as a builders yard, which primarily involves material storage (aggregates, fuel, oil and other builders materials), refer Site Walkover in **Section 5.1** for further information. The materials are either stored within buildings/structures or are stockpiled in dedicated, uncovered areas on site. Evidence of the agricultural heritage of the site is also identifiable.

4.2 Historical Setting

Historical maps [10] obtained from Groundsure as part of their EnviroInsight report [9] and aerial photographs obtained from various archival sources [11, 12] are included at **Appendix C**. A summary of the information obtained from the historical maps and aerial photograph's is provided in **Table 4.1.**

Please note: The site boundary detailed within the Groundsure report identifies the approximate location of the site boundary, please refer to Drawing No. 444-SK01 (**Drawings Appendix**) for the accurate location of the proposed development.

Table 4.1 Summary of Historical Land Use

Date of Map	Scale	On Site	Off-Site (<250m)
1885	1:2,500	Undeveloped land	- Footpath approx. 0m W - Drain approx. 4m N - Structure approx. 62m NW - Gardenhouse Inn approx. 93m NW - Unspecified pit approx. 96m W
1885-1888	1:10,560	No significant change	No significant change within 250m of site
1903	1:2,500	No significant change	No significant change within 250m of site
1903-1905	1:10,560	No significant change	- Unspecified pit approx. 96m W no longer identified
12/1945	Aerial Photograph	No significant change	No significant change within 250m of site
1950 (x2)	1:10,560	No significant change	- Structure approx. 16m W
1957	1:10,560	MAP BLANK	MAP BLANK
1976	1:2,500	2 structures in north of site	- 5 structures approx. 18–40m E - 2 structures approx. 73m N - 7 structures approx. 27–104m NW
1982-1983	1:10,000	MAP BLANK	NORTH OF MAP BLANK No significant change within 250m of site
1987	1:2,500	No significant change	No significant change within 250m of site
1995	1:2,500	4 additional structures in north of site Track identified across northern half of site	- 2 structures identified as Willowmere approx. 0m E - Modification to buildings 18 – 40m E - 2 structures identified as Tralaig approx. 18m W - Elm Lodge approx. 49m W - Maven House approx. 84m W
12/1999	Aerial Photograph	Various storage identified across northern half of site	- Pond approx. 184m E
2002	1:10,000	No significant change	- Pond approx. 184m E shown as cutting
12/2005	Aerial Photograph	Additional storage on site, rows of parallel soil in south of site (understood to have been used as a worm farm)	- Pond approx. 184m E
08/2007	Aerial Photograph	No significant change	No significant change within 250m of site
07/2008	Aerial Photograph	No significant change	No significant change within 250m of site
2010	1:10,000	No significant change	- Pond/cutting approx. 184m E identified as pond
2014	1:10,000	No significant change	No significant change within 250m of site

5.0 ENVIRONMENTAL SETTING

5.1 Site Walkover

A Site Walkover was conducted on 5th January 2016, by Tyler Barker and Jemma Gooch-Boags of Plandescil Ltd. The objective of the walkover was to assess existing site activities and identify

any potential causes of contamination arising from these, including but not limited to, a robust review of the physical condition of the surface and any hardstandings present on site to attempt to identify any existing areas of contamination.

A series of photographs were taken to record the site in its current condition, and are included within the photo portfolio held at **Appendix D**.

5.1.1 On Site

The site is currently accessed by a narrow concrete road which is situated to the north of the site enabling access and egress via Garden House Lane. This access will not provide access to the proposed development. Access will instead be provided by an access road to the north west as detailed on Sketch Layout Plan, Drawing No. 444-SK01 (**Drawings Appendix**).

A number of small dilapidated buildings and containers are located to the north east and north west of the site. For ease of reference the site has been subdivided into four separate areas (Area 1 – Area 4), and are discussed in detail below. The division of the site is shown on Existing Site Layout, Drawing No 20689/702 (**Drawing Appendix**)

Area 1: Comprised a small section of the narrow concrete access road which enables access and egress to and from the site from Garden House Lane located to the north east.

A small section of the site was laid to hardstanding (refer to Existing Site Layout Drawing No. 20689/702, **Drawing Appendix**). The concrete showed evidence of wear and tear (cracks in the concrete, damage to the corners of the pads along the joints and a number of pot holes). A service trench is understood to have been located along the north eastern boundary. The trench was excavated to enable the electricity supply to be re-directed along the boundary to enable construction of an off-site dwelling located to the east of the site. The trench although back filled has yet to be resurfaced, and contained pooled surface water with an oily sheen.

A number of buildings and structures were located in this area, these are described in detail below and are referred to as Building **B1 – B12**;

B1 – Comprised an asbestos clad building utilised for storing plant and equipment associated with the builders yard.

B2 – Comprised a small steel clad storage facility.

B3 – Comprised a small wooden shed also utilised for storing plant and equipment associated with the builders yard.

B4 & B5 – Comprised dilapidated porta cabins.

B6 – B9 – Comprised a series of steel container units, different building materials were stored within each one, ranging from plastic piping (foul and surface water), to metal road signs, rolls of black membrane. Motorised plant and equipment were located within one of the containers and 5l drum of turbo diesel was located on the metal floor although no leaks or spillages were noted from the containers.

B10 & B11 – Comprised dilapidated porta cabins, with various stored materials including pedal bikes, and personal protective equipment.

B12 – Comprised a small steel container utilised as a storage facility for building equipment and materials.

Two tanks (T1 and T2) were in use on site, it is understood that these are utilised for fuelling plant and equipment associated with the builders yard. Both tanks comprised single skin mild steel, nozzles linked to each tank were locked off at the time of the site visit, no secondary containment had been provided for the tanks. Spillages from refuelling activities were evident and an oily sheen extended onto the concrete to the east. The tanks were located on plinths which were uneven, and a bulge was noted on the eastern side of tank T2, the bulge is believed to have been caused by poor weight distribution beneath the tank from the uneven plinths. A wall to the south of the tanks which had been used as a retaining wall for the aggregates storage had collapsed beneath the tanks, the wall had not impacted the supporting plinths for the oil tanks as the plinths did not extend across the entire base of the tank.

A trailer, a shredder, a number of JCB diggers and other motorised plant and equipment were located on the hardstanding within Area 1. An area of crushed concrete was located north-west of Building B3 and aggregates storage was situated to the north of B1.

A number of items of plant, equipment and building materials were stored around the edges of the concrete, and comprised anything from barrels of rainwater cement mixers, reinforcing bars, metal cladding and a multitude of other materials.

Two empty 2500l integrally bunded GRP oil storage tanks were located on the grassed areas in the west of Area 1, no evidence of leaks or spillages were identified and the tanks appeared to have been deposited with a number of other items. The grassed areas of Area 1 were scattered with plant equipment and machinery (refer to Photograph portfolio included at Appendix D).

A large storage area for wood and wood products was located south of B1, the wood was stockpiled to heights in excess of 2m and comprised wooden pallets, skirting boards, doors and other wood products such as chip board.

Area 2: Comprised an area which had been utilised as an allotment, two greenhouses were located to the east and the majority of the grassed area was overgrown. An area east of B3 is understood to have comprised a slurry pit which although has been infilled, it is understood that the structure of the slurry pit may still exist beneath the covering soil.

Two buildings / structures were located in this area, these are described in detail below and are referred to as Building B13 – B14;

B13 – Comprised an asbestos roofed building, the building was utilised for wood storage but the roof had collapsed and was supported by the wood stored within.

B14 – Comprised a small steel container utilised as a storage facility for building equipment and materials.

Area 3: Comprised an overgrown grassed area, building materials were scattered throughout this area. The client advised that this area was formerly utilised for the rearing of 400 livestock and 1000 poultry, a concrete base was identified to the north east of the area, indicating the location of the former buildings housing the livestock. The client also advised that a slurry pit had been located in this area, but no evidence was identified of this former use.

A large steel container referred to as Building B15 was located to the south west of the area, the container was utilised for the storage of building equipment and materials.

A number of items of plant and equipment including a car which had been stripped of its engine were located to the south of the area.

No obvious visible or olfactory evidence of contamination was noted in this area.

Area 4: Comprised an over grown grassed area. The client advised that a former worm farm had been located to in this area, but had ceased operation. The worms had been bred on food wastes, and were shallow dwelling to enable easy harvesting. The soil appeared dark brown and organic in this area.

A small chicken coup housing 4 chickens was also located in this area.

A large power screen understood to be utilised for screening crushed concrete and building materials was located to the west of the area. Stock piles of material to be crushed, sorted and screened were located around the screen, it is understood that the crushing process occurs in this location. A number of items of plant and equipment were located in this area. Stockpiled building materials including roof tiles, metal beams, wooden pallets, skirting board and many other materials were located here.

In general the four areas of the site were quite difficult to access and an accurate visual assessment of the ground conditions could not be undertaken due to the substantial quantity of material (building materials and wood) located on-site. Some areas were substantially overgrown, which again prohibited access.

5.2 Existing Land Use

A summary of current land uses noted during the Site Walkover and on interrogation of the Groundsure EnviroInsight Report [9] are provided at **Table 5.1**.

Table 5.1 Summary of Existing Land Use

Direction	Existing Land Use
On-site	The site comprised a number of small buildings in connection with the builder's yard.
North	The site is bound by residential properties and Garden House Lane. Ground Sure indicates the following industrial uses in this area; - Electricity Sub Station approx. 201m N - Electricity Sub Station approx. 205m NW
East	The site is bound by residential properties and greenfield land.
South	The site is bound by greenfield land.
West	The site is bound by residential properties and greenfield land.

5.3 Geology

The British Geological Survey's, Digital geological map of Great Britain 1:50,000 scale [4], identifies the Bedrock Geology to comprise Chalk Formation (undifferentiated). This is predominantly overlain by Superficial Deposits comprising Kesgrave Catchment Subgroup (Sand & Gravel). A small area in the south east corner is overlain by Superficial Deposits comprising Lowestoft Formation (Diamicton) and the north of the access road is overlain by Superficial Deposits of Head (Clay, Silt, Sand & Gravel). This is consistent with the findings of the Groundsure GeoInsight report [8] held in **Appendix B.**

Geotechnical data relating to the project sites ground conditions has been obtained from Groundsure GeoInsight (referred to in **Table 5.2** as Geo) and EnviroInsight (referred to in **Table 5.2** as Enviro) are summarised below.

Table 5.2 Geotechnical Data Summary

Ground Subsidence/ Geotechnical Information	Details
Ground Workings (Geo Section 2) and Potentially Infilled Land (Enviro Section 1)	No historic or current ground workings/potentially infilled land are identified within 250m of the site.
Artificial/Made Ground	No artificial/made ground is not identified on-site or within 500m of the site.
Natural Hazards and Mining	The site is not situated within an area, which has been mined for clay, tin, coal or other valuable materials. The site is identified to be in an area, which may have been subject to minor mining for chalk, including on site. The site local geology does not appear to contain natural cavities, and has not been subjected to brine or gypsum extraction.
Shrink-Swell Clay	Low – Negligible Ground conditions are medium–low plasticity.
Landslides	Very Low Slope instability problems are unlikely to be present.
Ground Dissolution Soluble Rocks	Low – Very Low The majority of the site is considered low and significant soluble rocks are present. There is a low possibility of subsidence occurring naturally but may be possible in adverse conditions such as high surface or subsurface water flow.
Compressible Deposits	Negligible
Collapsible Deposits	Very Low Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Running Sands	Negligible – Very Low Very low potential for running sand problems if water table rises or if sandy strata are exposed to water.
Estimated Background Soil Chemistry	Rural Soil. 16 records of background soil chemistry are located within 250m of the site. All records returned Rural Soil values (4 on-site record, and 12 off-site records, located at approx. 5m SW, 38m NE, 79m S, 84m S, 114m NW, 125m NE, 193m NW, 220m NW, 224m N, 2 x 237m N and 249m NW).

Ground Subsidence/ Geotechnical Information	Details
Railways and Tunnels	The site is not situated on, or within 250m of railway, tunnel or railway/tunnel feature (current or historical).
Groundwater Vulnerability/Soil Leaching Potential (Enviro Section 6)	Environment Agency data identifies groundwater vulnerability and soil leaching potential to be Major Aquifer/Low Leaching Potential (L) and Major Aquifer/Intermediate Leaching Potential (I1): L – Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants. I1 – Soils which can possibly transmit a wide range of pollutants.

5.4 Hydrology and Hydrogeology

The Groundsure EnviroInsight (**Appendix A**) Report identifies the project site to be situated predominantly on Superficial Deposits comprising Kesgrave Catchment Subgroup (Sand & Gravel), which is designated as Secondary A. Superficial Deposits comprising Lowestoft Formation (Diamicton) and Head (Clay, Silt, Sand & Gravel) are designated as Secondary (undifferentiated).

The Bedrock geology comprises Chalk Formation is classified as a Principal Aquifer.

The project site is not situated within a designated Source Protection Zone.

The British Geological Survey's Hydrogeological map of Northern East Anglia [3], identifies groundwater contours of the chalk water table to flow from south to north at a depth of approximately 25–30m above ordnance datum (AOD), which is a minimum depth of approximately 8.52–13.52m below ground level (bgl) (British Geological Map Extract, Drawing No. 20689/713, **Drawing Appendix**).

A tertiary river, identified as Drain, is located approx. 8m NE. This connects to a tertiary river identified approx. 203m NW. Three culverts are identified approx. 89m NW, 207m SE and 221m NW along the tertiary river. Three surface water features, likely to be part of the identified rivers/culverts, are also identified approx. 10m NE, 66m NE and 70m NW of the site. An additional surface water feature is identified approx. 175m E, likely to be a pond. Other rivers noted in the EnviroInsight are beyond 250m of the site.

5.5 Flooding

Environment Agency Flood Map for Planning (Rivers and Sea) [6] identifies the site to be situated within Flood Zone 1 (which is the preferred zone for development), and is at very low risk of being affected by flooding of rivers or sea. There is less than a 0.1% (1 in 1000) chance of flooding occurring per year.

5.6 Industrial Pollution

Industrial pollution data for those installations regulated by the Environment Agency, and the Local Authority have been consulted to identify the location of any potentially polluting activities

such as landfill sites (current and historic), permitted facilities, and discharge consents etc. The results are summarised within **Table 5.3.**

Table 5.3 Summary of Pollution Data

Data	Source	Results
Industrial Pollution	EA WIYBY [6]	No industrial pollution incidents are recorded within 250m of the site.
Air Pollution	EA WIYBY [6]	The site is situated in an area which does not have any individual sources emitting reportable levels of Carbon Dioxide (CO2), Sulphur Dioxide (SO2), and Particulates (PM10).
Historical Garage & Motor Vehicle Repairs	Groundsure EnviroInsight [9]	Three historical garages are identified. Garage feature 26G–27G located 220–221m N is dated 1976–1987. Garage feature 28 located 242m NW is dated 1976. Garage feature 29H–30H located 254m N–255m NW is dated 1976–1987. It appears to be connected to garage feature G.
Records of Part A(1) and IPPC Authorised Activities	Groundsure EnviroInsight [9]	No records of activities listed as Part A(1) or IPPC authorised activities were identified within 250m of the site.
Records of Part A(2) and Part B Listed Activities and Enforcements	Groundsure EnviroInsight [9]	No records of activities listed as Part A(2) and Part B were identified within 250m of the site.
Records of Licensed Discharge Consents	Groundsure EnviroInsight [9]	No records of Licensed Discharge Consents were identified within 250m of the site.
Water Abstraction Licences	Groundsure EnviroInsight [9]	No potable, surface or groundwater abstraction licences were identified within 250m of the site.
Landfill (Current and Historic)	EA WIYBY/Groundsure EnviroInsight [6,9]	No historic or current landfill sites are located within 500m of the site.
Services	Groundsure EnviroInsight [9]	There are no records of high pressure underground pipelines within 500m of the site.

5.7 Invasive Plant Species

No noticeable evidence of Japanese Knotweed, or Giant Hogweed, was identified during the site walkover. *"It is an offence under section 14(2) Wildlife and Countryside Act 1981 to plant or otherwise cause the plant to grow in the wild"* Natural England [15]. Should either of these species be identified during the works specialist advice should be sought to control them.

No noticeable evidence of Himalayan Balsam was identified during the site walkover, although it is noted that the presence of the above species would have been difficult to determine during the site walkover which was conducted during the winter months.

5.8 Environmentally Sensitive Areas

The project site is situated within a Surface Water Nitrate Vulnerable Zone.

The Environment Agency [2] defines an NVZ as "A Nitrate Vulnerable Zone (NVZ) is designated where land drains and contributes to the nitrate found in "polluted" waters. Polluted waters include:

- Surface or ground waters that contain at least 50mg per litre (mg/l) nitrate
- Surface or ground waters that are likely to contain at least 50mg/l nitrate if no action is taken
- Waters which are eutrophic, or are likely to become eutrophic if no action is taken

A water is eutrophic if it contains levels of nitrogen compounds that cause excessive plant growth resulting in "an undesirable disturbance to the balance of organisms present in the water and to the quality of the water".

No other environmentally sensitive areas are identified within 250m of the site.

5.9 Radon Data

The site is not situated in a Radon affected area, as defined by the Health Protection Agency, as less than 1% of properties are above the Action Level. Groundsure (**Appendix B**) [8] indicates no radon protective measures are necessary.

6.0 PRELIMINARY CONCEPTUAL SITE MODEL

6.1 Conceptual Site Model

CLR11 [2] states that "*land contamination in its broadest sense describes a general spectrum of site and soil conditions.*" To understand the level of potential contamination present on site, it is essential to understand the natural history of the site and its current and historic uses.

Robust research has been conducted to attempt to identify any area of land which may exhibit elevated levels of naturally occurring substances, but also any specific site uses which may have resulted in a legacy of contamination remaining on site from activities including those arising from waste storage and disposal.

The conceptual site model attempts to understand the existing and historic uses in combination with the existing and historic land uses associated with neighbouring sites. A robust understanding of local land use is required to attempt to identify land which has been affected by aerial deposition, accidents, incidents (including leaks/spillages) and/or migration of contamination, which could affect the condition of the project site.

The preliminary conceptual site model accounts for both on-site and off-site potential sources of contamination and their potential pathways to impact sensitive receptors. Potential sources, pathways and receptors are identified in detail at Sections 6.2 - 6.5.

6.2 Potential Sources of Contamination

Ten potential on-site sources of contamination have been identified relating to its current and historic use and includes;

S1. Metals & hydrocarbons from material storage

S2. Hydrocarbons from four tanks and various drums & containers

S3. Manure from two former slurry pits

S4. Herbicides, pesticides, insecticides & fertilisers from allotments

S5. Asbestos from buildings

S6. Ammonia, nitrates & phosphorus from former housing of livestock and non-intensive livestock

S7. Organic material from former worm farm

S8. Asbestos, metals & PAH's from crushing and screening equipment

S9. Metals, hydrocarbons & PAH's from machinery storage

S10. Asbestos, hydrocarbons & PAH's from aggregate storage

Three potential off-site contamination sources have been identified and include;

OS1. Various contaminants (Ground Gases, including Carbon Dioxide and Methane, from Decomposing Organic Matter) from historic pit and existing pond

OS2. Various contaminants (Ground Gases, including Carbon Dioxide and Methane, from Decomposing Organic Matter) from drain north of site

OS3. PCB's, hydrocarbons & asbestos from electricity sub-stations

OS4. Metals, oils & hydrocarbons from historic garages

6.3 Potential Pathways

A pathway can be defined as a route or means by which a receptor can be affected by a contaminant. The conceptual site model identifies potential pathways by which potential contaminants may migrate from source to the receptor, these include;

P1. Permeable Ground - the soil leaching potential is classified as Major Aquifer/Intermediate Leaching Potential (I1) and Major Aquifer/Low Leaching Potential (L). Soil Vulnerability Category I1, which are described as soils which can possibly transmit a wide range of pollutants. Soil Vulnerability Category L, which are described as soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.

P2. Subsurface Structures – electricity, mains water, foul & surface water drainage, and phone and internet connections may be present on site, and are likely to be installed as part of the proposed development. These structures can cause migration of contaminants via leakages, but can also provide a route for mobile contaminants

to follow in or around the structure potentially increasing the distance permissible for lateral migration of mobile contaminants.

P3. Direct Contact – dermal contact or ingestion of substances that are present at or near the surface of the land.

P4. Inhalation – of airborne particles, vapours or ground gases that may be present on the site.

P5. Flooding – The site is located within Zone 1 the preferred zone for development, and is unlikely to be at risk from river, or tidal flooding, however if flooding were to occur this may facilitate migration of contaminants off-site.

P6. Groundwater – the bedrock geology is considered a Principal Aquifer. The soil leaching potential is classified as Major Aquifer/Intermediate Leaching Potential (I1) and Major Aquifer/Low Leaching Potential (L). Soil Vulnerability Category I1, which are described as soils which can possibly transmit a wide range of pollutants. Soil Vulnerability Category L, which are described as soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.

P7. Plant Uptake – Ingestion of plants (vegetables / fruit) that contain substances that are present within the land.

6.4 Potential Receptors

CLR11 [2] defines a receptor as something, which can be adversely affected by a contaminant. The potential receptors, which may be affected by the potential presence of contaminants at or around the project site, have been identified as;

R1. Human Health (construction workers) - Exposure of construction workers to contaminants may occur during the construction process, and must be managed in accordance with applicable Health and Safety and Environmental Legislation.

R2. Human Health (future land users) – future users may be directly exposed to contaminants via dermal contact, or inhalation of dusts from potentially contaminated land, where they work in close proximity to it.

R3. Groundwater - the bedrock geology is considered a Principal Aquifer. The soil leaching potential is classified as Major Aquifer/Intermediate Leaching Potential (I1) and Major Aquifer/Low Leaching Potential (L). Soil Vulnerability Category I1, which are described as soils which can possibly transmit a wide range of pollutants. Soil Vulnerability Category L, which are described as soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.

R4. Buildings and Structures – services could be vulnerable to chemical attack if ground conditions contain contaminants.

R5. Ecological Receptors – The site is situated within a Surface Water Nitrate Vulnerable Zone.

R6. Neighbouring Sites – the neighbouring sites consist of residential properties and greenfield land.

R7. Surface Water – surface water drainage systems and features may be vulnerable if contaminants migrate into the drainage system.

6.5 Pollution Linkages

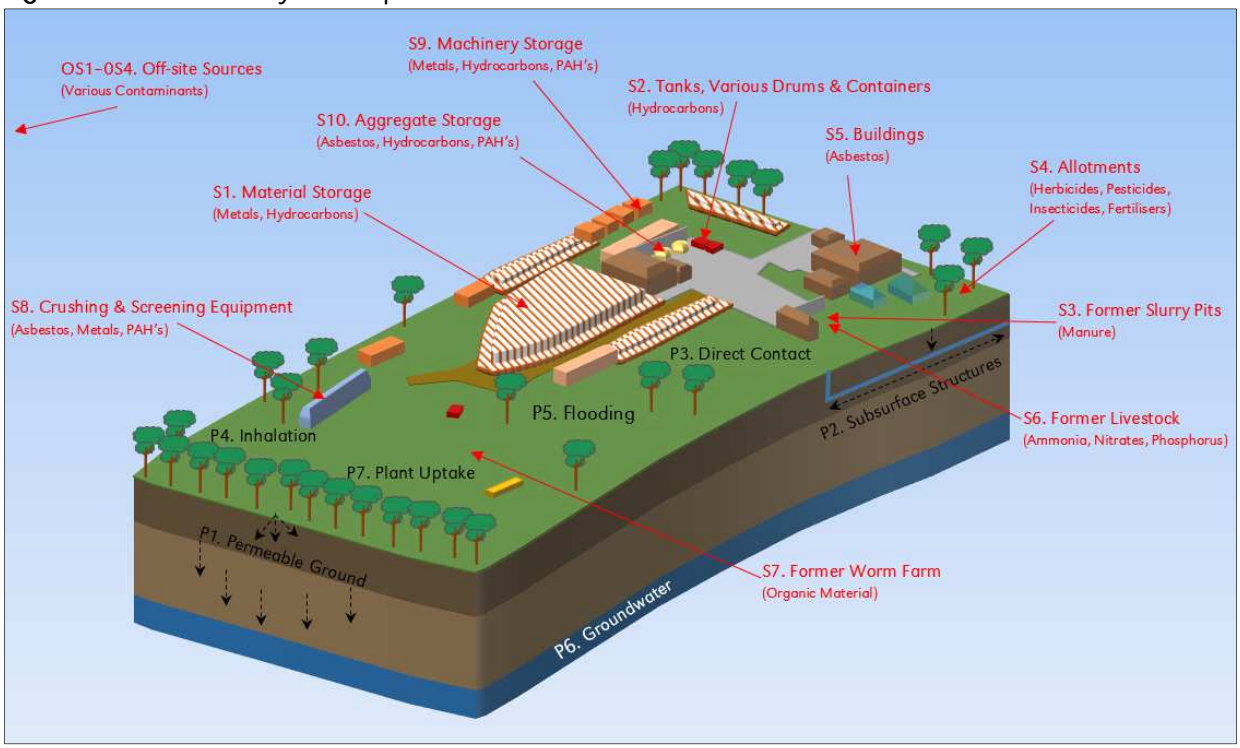
The concept of a pollutant linkage, involves a potential contaminant being able to reach a receptor via a specific pathway. It is possible for each element to exist independently but where they are linked, a pollution linkage is realised.

The pollution linkages identified for the project site, are visually summarised within the conceptual site model in **Figure 6.6**.

6.6 Illustrative Preliminary Conceptual Site Model

A preliminary conceptual site model has been prepared based upon the site survey and desk study and is included at **Figure 6.6**.

Figure 6.6: Preliminary Conceptual Site Model



7.0 RISK ASSESSMENT

7.1 Risk Categorisation and Terminology

The preliminary conceptual site model at Figure 6.6, establishes the potential source, pathway and receptor linkages, which may exist at the project site. These linkages form the baseline from which the following qualitative risk assessment has been made.

The risk for each pollutant linkage identified at Table 6.6 has been reviewed based on both the likelihood and consequence of potential contamination impacting on each receptor identified within the Conceptual Site Model.

Risk categorization terminology and description has been adopted from Environment Agency and NHBC guidance [1], and is summarised in Tables 7.1 – 7.2.

Table 7.1 Categorisation of Risk

Probability (Likelihood)		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
	High Likelihood	Very High Risk	High Risk	Moderate Risk	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

Source: R&D66:2008 Volume 1 [1]

Table 7.2 Description of Risk Levels

Term	Description
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard at the site without appropriate remediation action.
Moderate Risk	It is possible that without appropriate remediation action harm could arise to a designated receptor. It is relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely that such harm would be relatively mild.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard. It is likely that, at worst if any harm was realised any effects would be mild.
Very Low Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

Source: R&D66:2008 Volume 1 [1]

7.2 Preliminary Risk Assessment

Utilising the terminology set out in Tables 7.1 – 7.2, in combination with the review of current and historical environmental information, and the preliminary conceptual site model, the following risks have been established for the project site in Table 7.3.

Table 7.3 Contamination Risk Assessment

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
R1 Human Health - Construction Workers	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides, Insecticides, Fertilisers (S4) Asbestos (S5) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9)	Likely/Mild	Moderate/ Low	**Risk:** The risk to human health (construction workers) from potential contamination is considered **Moderate/Low.** **Justification:** S1 – Various material storage was identified on the site, including but not limited to, wood for recycling, building materials, plant & equipment, and a stripped vehicle. The majority of material was stored directly on unprotected land. No evidence of any leaks or spillages were identified on unprotected areas, however any contaminants produced from the storage is likely to enter the shallow soils. To safeguard the identified receptor, **Recommendations 1 – 3** should be adhered to. ***Recommendation 1*** *Construction workers may be exposed to potentially contaminative materials. This risk should be mitigated by the correct use of personal protective equipment, and compliance with relevant health and safety legislation. If unusual materials/ground conditions are encountered these should be treated in accordance with applicable health and safety and environmental legislation and reported to a competent person for further investigation.* ***Recommendation 2*** *A site 'clear up' should be undertaken prior to any construction works beginning on-site. All material storage should be removed prior to any ground investigation.* ***Recommendation 3*** *An Intrusive Investigation should be carried out to confirm ground conditions and samples should be obtained to determine the presence of specific contaminants. A general suite of determinands should be analysed including but not limited to Asbestos, Organic Matter, Metals, PAH's, TPH. Ammonia, Nitrates and Phosphorus should also be analysed in trial pits excavated in the area of the former livestock. Trial pits should be to a minimum depth of 2–3m to confirm ground conditions. If groundwater is encountered, water samples should be obtained.*

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Asbestos, Hydrocarbons, PAH's (S10) Carbon Dioxide, Methane (OS1, OS2) PCB's, Asbestos, Hydrocarbons (OS3) Metals, Oils, Hydrocarbons (OS4)			S2 – Two empty oil tanks with a 2,500L capacity and two diesel tanks (T1 & T2) at approx. 1,500–2,500L capacity and a number of drums/25L & 5L containers were identified on site. No visible or olfactory evidence of leaking or spillages were identified surrounding the empty tanks, drum and container. The two 1,500–2,500L diesel tanks (T1 & T2) comprised single skin, mild steel. Evidence of structural failure was noted on one of the tanks; the tank wall had bowed out which was caused by an uneven siting which did not provide sufficient support, causing uneven weight distribution. Fill nozzles were locked off, however no secondary containment was provided. Evidence of spillages during fuelling was noted on the concrete hardstanding below both tanks. To safeguard the identified receptor, **Recommendations 1 & 3** should be adhered to. S3 – The client advised during the site walkover that two slurry pits were historically located on the site. A small pit was visible in one area, however no evidence of the second was identified. Manure will have been present and is likely to be buried within the area of the former pit. A trial pit should be excavated in the area of each former pit to identify the infill material and ground conditions, **Recommendation 3**. S4 – Allotments were identified to the north east of the site. Although no crops had been planted at the time of the walkover, the client advised that vegetables were planted annually in this area for personal use. Herbicides, pesticides, insecticides and fertilisers may have been used in this area. A trial pit should be excavated in this area to identify if an elevated level of metals is present in the shallow soils, **Recommendation 3**. S5 – Buildings utilised for storage were located on site and appeared to comprise possible Asbestos Containing Materials (ACM's). To safeguard the identified receptor, **Recommendation 4** should be adhered to. *Recommendation 4* *Asbestos containing materials should be carefully removed and managed in accordance with applicable Health and Safety and Environmental Legislation to prevent release of fibres to air during removal.*

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
				S6 – During the site walkover, the client advised that cattle had historically been housed on site and also two poultry sheds had been located to the north east of the site. The site has housed livestock in the recent years (except for <10 chickens). One trial pit in this area should obtain samples to be tested for key contaminants from intensive/non-intensive livestock including but not limited to ammonia, nitrates, phosphorus to safeguard the identified receptor, **Recommendation 3**. S7 – During the site walkover, the client advised that the south of the site had historically been utilised as a worm farm and were regularly fed waste food products. Although the site has not been utilised for this activity recently, the waste food may have caused an elevated organic matter level in the shallow soils, potentially increasing the risk of gas production within the soil. A trial pit should be excavated in this area to confirm the level of organic matter, **Recommendation 3**. S8 – Crushing and screening equipment, including but not limited to a power screen, was identified on site. The client advised that various materials brought onto site were screened, crushed and sorted. This process was undertaken on unprotected land and can cause the release of asbestos fibres and potential metals and PAH's into the soils. A trial pit should be excavated in this area to identify the presence of any contaminants related to this activity, **Recommendation 3**. S9 – Various machinery, including but not limited to mobile generators, vibration plate and other mechanical equipment, were identified on site. Some of these were stored within storage unit containers, however some were stored directly onto unprotected land. To safeguard the identified receptor, **Recommendations 1 & 3** should be adhered to. S10 – Various aggregates of sand and gravels were stored on the site. Due to the crushing and screening process they undertake, various contaminants including asbestos, hydrocarbons and PAH's may be present within these materials. To safeguard the identified receptor, **Recommendation 3** should be adhered to.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
				OS1 – A historic pit approx. 96m W was identified on the 1885 historic map but no longer identified in the 1903-1905 map. The pit may have been infilled, however the infill material would be >100 years and unlikely to omit any gas. A pond is identified approx. 184m E in the 1999 aerial photograph and, however historic maps identify the pond as a cutting in 2002. The 2010 map identifies the feature as a pond. Any gas produced from the pond is unlikely to migrate this distance to site. **OS2** – A drain is identified approx. 4m N of the site. Any gas produced from decomposing vegetation within the drain is likely to migrate through the easiest path, being the water and disperse into the air. This is unlikely to affect the identified receptor on site. **OS3** – Two electricity sub-stations are identified approx. 201m N and 205m NW. Any contamination produced is unlikely to migrate this distance to site and affect the identified receptor. **OS4** – Historic garages are identified between 220 – 255m N/NW dated between1976 – 1987. Any contamination produced from the activities within the historic garages are unlikely to migrate this distance to site and affect the identified receptor.
R2 Human Health - future land users	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides,	Likely/Mild	Moderate/ Low Risk	**Risk:** The risk to human health (future land users) from potential contamination is considered **Moderate/Low.** **Justification:** **S5** – The risk to future land users from the possible ACM's on site should be minimal providing **Recommendation 4** is adhered to. However given the range of materials stored on site it is recommended that all samples obtained are tested for Asbestos, **Recommendation 3**. Refer to R1 for justification of S1, S2, S3, S4, S6, S7, S8, S9, S10, OS1, OS2, OS3, OS4 and **Recommendations 3 & 4**.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Insecticides, Fertilisers (S4) Asbestos (S5) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9) Asbestos, Hydrocarbons, PAH's (S10) Carbon Dioxide, Methane (OS1, OS2) PCB's, Asbestos, Hydrocarbons (OS3)			

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Metals, Oils, Hydrocarbons (OS4)			
R3 Groundwater	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides, Insecticides, Fertilisers (S4) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9)	Low/Mild	Low Risk	**Risk:** The risk to groundwater from potential contamination is considered **Low.** **Groundwater Designation:** The Aquifer within the Superficial Deposits of Kesgrave Catchment Subgroup (Sand & Gravel) is designated as Secondary A Aquifer. The Aquifer within the Superficial Deposits of Lowestoft Formation (Diamicton) and Head (Clay, Silt, Sand & Gravel) is designated as Secondary (undifferentiated). The Aquifer within the Bedrock Geology comprising Chalk Formation is considered a Principal Aquifer. The site is not situated in a Source Protection Zone. Soil leaching potential and Groundwater vulnerability are designated as I1 and L. Soils designated as I1 can possibly transmit a wide range of pollutants. Soils designated as L are described as soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants. **Justification:** The Hydrogeological Map of Southern East Anglia (Drawing No 20689/713, **Drawing Appendix**) identifies groundwater flow from south to north at a minimum depth of approx. 8.52 – 13.52m bgl. Refer to R1 for justification of S1, S2, S3, S4, S6, S7, S8, S9 and S10.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Asbestos, Hydrocarbons, PAH's (S10)			
R4 Buildings and Structures	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides, Insecticides, Fertilisers (S4) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9)	Likely/Minor	Low Risk	**Risk:** The risk to buildings and structures from potential contamination is considered **Low.** **Justification:** A low – negligible hazard rating of shrink-swell clays and a low – very low hazard rating of ground dissolution of soluble rocks are located on-site. **Recommendations 5 & 6,** should be adhered to, to mitigate any risk to buildings. ***Recommendation 5*** *Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE).* ***Recommendation 6*** *Implications should be considered for stability when changes to drainage or new construction are planned. For new build, site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution.* **S6** – Due to the former use of the site for livestock, there is potential for ammonia salts to exist in the soil. Sulphates should be analysed within the soil in the location where cattle has been historically housed, refer to **Recommendation 3**. Refer to R1 for justification of S1, S2, S3, S4, S7, S8, S9, S10, OS3, OS4 and **Recommendation 3**.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Asbestos, Hydrocarbons, PAH's (S10) PCB's, Asbestos, Hydrocarbons (OS3) Metals, Oils, Hydrocarbons (OS4)			
R5 Ecological Receptors	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides, Insecticides, Fertilisers (S4) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7)	Unlikely/Mild	Very Low Risk	**Risk:** The risk to ecological receptors from potential contamination is **Very Low**. **Ecological Receptor:** A Surface Water Nitrate Vulnerable Zone is located on site. **Justification:** Refer to R1 for justification of S1, S2. S3, S4, S6, S7, S8, S9, S10, OS3 and OS4.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9) Asbestos, Hydrocarbons, PAH's (S10) PCB's, Asbestos, Hydrocarbons (OS3) Metals, Oils, Hydrocarbons (OS4)			
R6 Neighbouring Sites	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides, Insecticides, Fertilisers (S4)	Low/Mild	Low Risk	**Risk:** The risk to neighbouring sites from potential contamination is **Low**. **Justification:** **S2** – To minimise the risk to the surrounding residents, **Recommendation 4** should be adhered to. Refer to R1 and R2 for justification of S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 and **Recommendation 4**.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Asbestos (S5) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9) Asbestos, Hydrocarbons, PAH's (S10)			
R7 Surface Water	Metals, Hydrocarbons (S1) Hydrocarbons (S2) Manure (S3) Herbicides, Pesticides,	Low/Mild	Low Risk	**Risk:** The risk to surface water from potential contamination is **Low**. **Justification:** The site is situated in Flood Zone 1, and shown not to be at risk of fluvial and tidal flooding. A tertiary river (Drain) is identified at 8m NE and connects to a tertiary river identified at 203m NW. Various culverts for the tertiary river were identified. A pond was identified approx. 175m E of site. Other rivers and culverts are beyond 250m of the site.

Receptor	Contaminant(s)	Probability / Consequence	Risk	Comments / Justification / Linkage
	Insecticides, Fertilisers (S4) Ammonia, Nitrates, Phosphorus (S6) Organic Material (S7) Asbestos, Metals, PAH's (S8) Metals, Hydrocarbons, PAH's (S9) Asbestos, Hydrocarbons, PAH's (S10)			Refer to R1 for justification of S1, S2, S3, S4, S6, S7, S8, S9 and S10.

8.0 CONCLUSION & RECOMMENDATIONS

8.1 Risk Summary

The site conceptual model indicates that there are several potential pollutant linkages on site, and the perceived risk to receptors is summarised at **Table 8.1**.

To safeguard receptors the recommendations and notes detailed in **Table 8.1** should be addressed.

Table 8.1 Receptor Risk Summary

Receptor	Notes	Risk
R1 Construction Workers	Receptor R1 is classified as **Moderate/Low Risk.** To reduce the risk to Construction Workers the following recommendations should be addressed; ***Recommendation 1*** *Construction workers may be exposed to potentially contaminative materials. This risk should be mitigated by the correct use of personal protective equipment, and compliance with relevant health and safety legislation. If unusual materials/ground conditions are encountered these should be treated in accordance with applicable health and safety and environmental legislation and reported to a competent person for further investigation.* ***Recommendation 2*** *A site 'clear up' should be undertaken prior to any construction works beginning on-site. All material storage should be removed prior to any ground investigation.* ***Recommendation 3*** *An Intrusive Investigation should be carried out to confirm ground conditions and samples should be obtained to determine the presence of specific contaminants. A general suite of determinands should be analysed including but not limited to Asbestos, Organic Matter, Metals, PAH's, TPH. Ammonia, Nitrates and Phosphorus should also be analysed in trial pits excavated in the area of the former livestock. Similarly, sulphates should be analysed in trial pits excavated in the location cattle was historically housed. Trial pits should be to a minimum depth of 2–3m to confirm ground conditions. If groundwater is encountered, water samples should be obtained.* ***Recommendation 4*** *Asbestos containing materials should be carefully removed and managed in accordance with applicable*	**Moderate/Low Risk**

Receptor	Notes	Risk
	Health and Safety and Environmental Legislation to prevent release of fibres to air during removal.	
R2 Future Land Users	Receptor R2 is classified as **Moderate/Low Risk**. To reduce the risk to future land users **Recommendation 4** should be adhered to.	**Moderate/Low Risk**
R3 Groundwater	Receptor R3 is classified as **Low Risk**	**Low Risk**
R4 Buildings and Structures	Receptor R4 is classified as **Low Risk**. To reduce the risk to Buildings & Structures the following recommendations and **Recommendation 3** should be addressed; ***Recommendation 5*** *Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE).* ***Recommendation 6*** *Implications should be considered for stability when changes to drainage or new construction are planned. For new build, site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution.*	**Low Risk**
R5 Ecological Receptors	Receptor R5 is classified as **Very Low Risk**.	**Very Low Risk**
R5 Neighbouring Sites	Receptor R6 is classified as **Low Risk**	**Low Risk**
R7 Surface Water	Receptor R7 is classified as **Low Risk**	**Low Risk**

8.2 Conclusion

The basic requirements for land development in the UK is that the land should be suitable for use. The information reviewed in the preparation of this Phase 1 Contamination Report Desk Study identifies existing and historical on-site sources of contamination which may affect the identified receptors, therefore **Recommendations 1 – 6** in **Table 8.1** should be adhered to before the site is suitable for development for residential use.

When developing the site, it is possible that differing ground conditions and higher concentrations of contaminants exist than have been identified by this report, in the event that differing ground conditions are encountered, further assessment/investigation should be undertaken by a competent person(s).