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Consulting Geo-Environmental Engineers

PRELIMINARY
GEO-
ENVIRONMENTAL
INVESTIGATION
Of land at
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Client

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—	February 2011	

Executive Summary

Background

Speke Business Park Limited is considering the re-development of land at Goodlass Road, Speke as the site of a proposed commercial development.

PWA Geo-Environmental Brief and Objective

Speke Business Park Limited appointed PWAG to undertake an environmental review of the site to support a planning application and to inform their decision to acquire the land. The overall objective of the review was to determine the presence and likely extent of any potential environmental liabilities associated with the current and past uses of the site. This Phase 1 report is primarily a review of existing data and preliminary environmental risk assessment with proposals for intrusive investigation works.

Site History

The site was previously occupied by a varnish and colour works / paint factory which operated for about 40 years. The site is now disused and the former buildings mostly demolished.

Preliminary Risk Assessment

Existing documentary data was sourced and compiled to establish the likely ground conditions, site history and the sites environmental sensitivity. Public domain information was obtained regarding records of regulatory intervention. Potential sources of contamination associated with the land use were identified, as well as potential environmental receptors. The data was evaluated in the context of a new development with a commercial end use.

Conclusions and Recommendations

The preliminary risk assessment identified potential soil and groundwater contamination associated with the site operations. No information has been provided to indicate whether contamination is actually present, or if any remedial works have been carried out on site.

On the basis of the information reviewed it is considered likely that contaminants may be present that could impact the proposed development. Therefore, in order to fulfil the objective it will be necessary to carry out more detailed risk analysis based on site specific data.

It is recommended that Speke Business Park Limited proceed with completion of a Phase 2 intrusive investigation designed to:

- Adequately characterise the nature, degree and extent of potential contamination;
- Confirm whether potential pollutant linkages are actually present;
- Determine the severity of the impact of identified pollutant linkages on future redevelopment; and
- Evaluate the engineering properties of the underlying soils.

The Phase 2 data will then be used as the basis of an environmental risk assessment in accordance with current good practice as described in CLR11 and identify the need for, and scope of, any further investigations/ monitoring and / or remediation to allow redevelopment to proceed.

A summary is provided in the table below.

Subject	Remarks
Former uses	Undeveloped to about 1930s; Sports Ground to about 1950; Varnish and Colour Works / Paint Factory to about 1990s.
Potential Contamination	<p>Metals, asbestos and inorganics associated with fly-tipping and within made ground.</p> <p>Localised congealed pools of clear resin/gel-like substance of unknown composition.</p> <p>Possible impact by unknown contaminants migrating onto site from above ground fuel tanks within operational site to north.</p> <p>Pigments (e.g. cadmium, antimony, zinc, lead and chromium compounds), binders (e.g. phenol formaldehyde, hydrocarbon resins and alkydes), solvents (e.g. BTEX, styrene, naphthalene, white spirit, dichloromethane, methanol and acetone), plasticisers, catalysts surfactants etc used in varnish and paint manufacturing.</p> <p>Possible ground gas from degradation of former process chemicals spills (resin) and from possible organic material in made ground.</p>
Anticipated Ground Conditions	<p>Variable made ground across site associated with upfill to create terrace, and construction and subsequent demolition of former buildings.</p> <p>Glacial till overlying Chester Pebble Bed Formation sandstones.</p>
Mining & Quarrying	The site is not located in a coalfield area or in close proximity to active mineral extraction sites.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

Flooding & Drainage	The site is not in an area requiring flood defences.
Preparatory Works	Demolition of remaining building, break-out of concrete hard standings and access roads. Removal of fly-tipped waste, grubbing up of old foundations, drains, pipes and tanks.
Anticipated Foundation Solutions	Likely to be reinforced strip and pad footings or piles, depending on the ground conditions encountered which are indicated to vary across the site.
Recommendations for Ground Investigation	Consultation with adjacent site operator concerning condition and contents of ASTs close to northern site boundary. Work should include; sampling of old drains, targeted and random intrusive investigation by trial pits and boreholes to determine the nature, stability and depth of the made ground and existence of below ground structures. Sampling for chemical testing. Boreholes and window samples to establish geological structure and to retrieve geotechnical data and chemical samples from depth, and installation of gas/groundwater monitoring wells.

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

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APPENDICES

Appendix A – Legal Framework

Appendix B - General Notes

01	Environmental Setting
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Appendix C – Drawings

Drawing No.	Title
11029/G/150	Site Location Plan
11029/G/151	Preliminary Conceptual Site Model

Appendix D- Site Reconnaissance Photographs

Appendix E - Search Responses & Other Correspondence

From	To	Date	Content
Landmark Group	PWA Geo Environmental	17/02/2011	EnviroCheck Report

Appendix F - Historical OS Plans

FOREWORD (Geo-environmental Investigation Report)

This report has been prepared for the sole use and reliance of the Client named above and cannot be relied upon by any other parties without the express written authorisation of PWA Geo-Environmental Ltd. Any unauthorized third party relies on this report at their own risk and the authors owe them no duty of care.

The report presents observations and factual data obtained during our site investigation, and provides an assessment of geo-environmental issues with respect to information provided by the Client regarding the proposed development. Further advice should be sought from PWA Geo-Environmental Ltd prior to significant revision of the development proposals.

The report should be read in its entirety, including all associated drawings and appendices. PWA Geo-Environmental Ltd cannot be held responsible for any misinterpretations arising from the use of extracts that are taken out of context.

The findings and opinions conveyed in any Desk Study section of the report (including review of any third party reports) are based on information obtained from the sources listed, which PWA Geo-Environmental Ltd understands are reliable. All reasonable skill, care and diligence has been applied in examining the information obtained. However, PWA Geo-Environmental Ltd accepts no responsibility for inaccuracies in the data supplied or for opinions based on any such inaccurate data.

Where the report refers to the potential presence of invasive weeds such as Japanese Knotweed, or the presence of asbestos containing materials, it should be noted that the observations are for information only and should be verified by a suitably qualified expert.

PWA Geo-Environmental Ltd reserves the right to amend their conclusions and recommendations in the light of further information that may become available.

1. INTRODUCTION

PWA Geo-Environmental Ltd (PWAG), were commissioned by Speke Business Park Limited to carry out a Phase 1 preliminary investigation of land at Goodlass Road, Speke. The site comprises a disused former paint and varnish factory which has been mostly demolished. The study comprises:

- an assessment of the land use history
- determination of the site's environmental setting
- assessment of anticipated ground conditions, including potential contaminants
- assessment of anticipated foundation and engineering issues associated with redevelopment
- provision of recommendations for an appropriate Phase 2 investigation.

It is understood that consideration is being given to redevelopment of the site for commercial premises.

The preliminary investigation will inform Speke Business Park Limited on their decision to acquire the land, and also support a planning application. This Phase 1 report primarily reviews existing data to support a preliminary environmental risk assessment with proposals for intrusive investigation works.

Our overall objectives of this environmental review are to:

- Carry out an environmental risk assessment in accordance with current good practice as described in CLR11 (Ref. 1) and EA / NHBC (Ref.2);
- Identify the need for, and scope of, any further investigations/ monitoring and / or remediation to allow redevelopment to proceed.

General notes and limitations relevant to all PWA Geo-Environmental Ltd preliminary investigations are described in the Foreword and in Appendix A. These should be read in conjunction with this report. The text of the report draws specific attention to any modification to these procedures and to any other special techniques employed.

Standard definitions, procedures and guidance are contained within Appendix B, which includes background, generic information on assessment of the site's environmental setting.

1.1. Phase 1 Methodology

The Phase 1 review comprised a desk-based study in conjunction with a site reconnaissance. The key aspects are summarised as follows:

- Review of current activities and the current condition of the site based on information made available by the client, regulatory data relating to the site and the results of the site walkover survey;
- Review of the history of the site and surrounding area from historical Ordnance Survey maps and any anecdotal information available;
- Assessment of the environmental setting of the site from a review of published geological, hydro geological and hydrological information, and regulatory data;
- Development of a conceptual site model identifying potential contamination sources, pathways and receptors and the inter-relationship between them, followed by completion of a qualitative risk assessment to identify potential pollutant linkages; and
- Assessment of possible environmental liabilities associated with the site and the need for any further investigations.

This review relied on published information and information provided by the client and other parties, including anecdotal information, during the given time period. Regulatory data from the public register and historical OS maps were obtained from an Envirocheck report prepared by Landmark Information Group Limited.

2. SITE PROFILE

2.1 Site Location

2.1.1 The site location is shown on Drawing No. 11029/G/150 presented in Appendix C to this report. Site details are summarised in Table 1 below.

Detail	Remarks
Location	Approximately 2km north west of Speke town centre
NGR	NGR 341960 384450
Area	1.44Ha
Known services	Underground sewers, drainage, telecoms, electricity, gas and water likely.

2.2 Site Reconnaissance

A site reconnaissance was undertaken on 21st February 2011 and observations are summarised in Table 2 and below. In addition, site photographs are provided in Appendix D.

The site is located off Goodlass Road in a mixed industrial and commercial area. A railway line runs on an embankment parallel to the southern site boundary fence. A new office block is situated close to the eastern boundary and older factory buildings are located to the north and west. The latter comprises the premises of Eleco Timber Frame Ltd to which access is gained across the southern part of the site under consideration. A perimeter fence with gate is present along the north and east.

The ground profile is mainly level in the north, comprising weathered concrete former building floors and hard standings. There is a step change down in the western and south western areas associated with former access roads.

A small disused building containing waste material and several large mounds of apparently fly-tipped waste are present in the west. The waste comprises crushed concrete and bricks, aggregate, metal, polythene, wood, and plastic.

In addition, several large surface accumulations of a clear gel/resin-like substance were observed in the vicinity. These are present overlying the mounds of fly-tipped waste and also present as congealed pools on the hard standing in this area, and have a pungent odour.

A concrete bund with drain is present at the northern site boundary close to several large above ground storage tanks located in the adjacent factory premises.

A void was noted in the reinforced concrete hard standing towards the centre-east of the site. Several underground pipes were exposed, close to a steel plate manhole cover.

Evidence of paint was observed at two locations where bright blue and green colouration of the ground was visible.

Standing water was observed towards the southern site boundary.

Table 2 – Site Reconnaissance Findings

Feature	Remarks
Current Access	Via gate in perimeter fence off Goodlass Road, Speke
Topography	Level with step change down to west and south west
Approximate Areas	Waste ground – 0.2Ha (approximately) Concrete hard standing, floors and access road– 1.2Ha (approximately)
Surrounding land uses	North –Operational Factory South – Railway embankment West – Eleco Timber Frame factory East – New office block

2.3 Site Regulatory and Environmental Data

Information regarding potential hazards associated with environmental regulatory controls is summarised in Table 3. This information is taken from the data provided by Landmark, a copy of which is provided in Appendix E.

Table 3

Data Source	On/off site?	Details	Potential for Impact on-site?
Landfill Sites, Waste Management Facilities & Waste Transfer Sites	Off site and on site	None in site vicinity	Minimal – considered too far from the study area to have had any environmental impact.
Trade directory entries	Off site	Numerous entries including chemical industries, manufacturers, car dealers, and engineers.	Possible off-site source of contamination that could impact site.
LAPPC / COMAH	Off site	Two within 250m of site for Powder Coating Processes at Inver UK and Beckers Industrial Coatings	Possible sources of contamination that could impact the site.
Planning Hazardous Substance Consent	Off site	Croda Resin Ltd, 1999. Position 70m north of site.	Possible off-site source of contamination that could impact site.
Discharge consents	Off site		Minimal – too far from the study area to have had any environmental impact.
Water abstractions	Off site	Nearest is 550m east of site	n/a
Recorded pollution incidents to controlled waters	Off site	None associated with site. Two incidents 300m north of site relating to chemical spills at Triumph Trading Estate and Barrett Chemicals in 1998 and 1997.	Not considered to have had any impact on the study area.
Radon	N/A		

IPC = Integrated Pollution Control; IPPC = Integrated Pollution Prevention & Control; LAPPC = Local Authority Pollution Prevention & Controls; APC = Air Pollution Control; COMAH = Control of Major Accident Hazards

2.4 Site History

The site history has been determined from a review of OS historical maps. The text below describes significant historical activities on the site and surrounding area. The on-site history focuses on the 1:1,056 and 1:2,500 scale maps, with the off-site history concentrating on the 1:10,560 scale maps. All the scale maps have been used in some instances to describe relevant features. Table 4 summarises salient points relating to site history, and Table 5 indicates potential contaminative uses of the site and surrounding land. The maps are included in Appendix F.

The First Edition map of 1849 shows the site to be undeveloped within a rural setting. A stream flowing from east to west was present some 50m north of the site, and two small ponds were present off-site immediately next to the eastern boundary. A railway line was present running parallel with the southern site boundary.

The map of 1894 shows extensive railway sidings to the south of the site which steadily increased by the time of the 1928 map edition.

The 1936 map shows significant development of the site and surrounding area. Speke Hall Road and Goodlass Road had been constructed and a 'Varnish and Colour Works' built to the north of the site, close to the boundary. The site is shown as a 'Sports Ground' at this time.

Further development within the site is shown on the 1952 map. This shows buildings associated with the Varnish and Colour Works now located in the western and eastern site areas, and the former ponds to the east are no longer present. A tank is shown close to the south east corner of the building.

Further development of the Varnish and Colour Works is shown on the 1968 map, which had increased in plan area across the centre of the site.

The 1973 map indicates the site to be a 'Paint Factory' present also on the 1981 and 1993 maps.

The map editions of 1999 and 2006 do not show any buildings on site, and the latest edition of 2010 shows the current configuration of buildings adjacent to the site.

The following map extracts taken from the Landmark Group EnviroCheck report illustrate the site development history prior to demolition. The maps are provided in Appendix F.

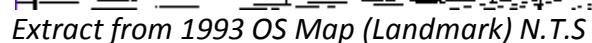


Table 4 Site History Summary

Date(s)	On –Site	Surrounding Land
1849	The site is shown as undeveloped land.	Railway to south. Ponds to east.
1894	No significant changes.	Railway sidings to south.
1928	No significant changes.	Further development of sidings.
1936	Sports Ground.	Goodlass Road and Speke Hall Roads built. Varnish and Colour Works to north. Metal Drum Factory 150m to east
1952	Varnish and Colour Works including Tank feature.	Further industrial development to east. Ponds no longer shown in east.
1968	Extension of works across centre of site.	Extension of works to north.
1973	Works indicated as Paint Factory .	No significant changes.
1999-2006	No buildings shown on site.	Railway sidings less extensive.
2010	No significant changes.	Building shown east of site.

2.5 Potential Contamination Sources

Based on our review of historical information and our understanding of site activities, the following potential contamination sources have been identified on site.

Table 5 Potential Contamination Sources within the Site

Feature	Historic / Current	Potential Contamination Sources	Comments
Varnish and Colour Works / Paint Factory	Historic	Made ground associated with construction and subsequent demolition of factory	Made ground may contain ash and clinker with heavy metals, asbestos, sulphates and inorganics.
Varnish and Colour Works / Paint Factory	Historic	Leaks and spills of process chemicals at storage and production locations, in old drains and underground pipes and tanks.	Wide range of potential contaminants including inorganic pigments (e.g. cadmium, antimony, lead, chromium compounds), binders (e.g. phenol formaldehyde, hydrocarbon resins and alkydes), solvents (e.g. BTEX, styrene, naphthalene, white spirit, dichloromethane, methanol and acetone), plasticisers, catalysts surfactants etc.
Varnish and Colour Works / Paint Factory	Historic	Heating oil	Former tank shown on old OS maps may be fuel oil supply tank. Potential for leaks and spills of DRO hydrocarbons.
Varnish and Colour Works / Paint Factory	Current	Fly-tipped waste.	Mounds of waste present and pools of gel/resin of unknown composition and provenance.

In addition to the above, one potential off site source of contamination which may impact the site has been identified. This is the operational factory immediately to the north of

the site (Possibly Becker Industrial Coatings). Several large tanks are present at the boundary but it was not readily apparent what they contained.

3. ENVIRONMENTAL SETTING

3.1 Geology

The 1:50,000 scale geological map indicates that the site is underlain by glacial till (boulder clay).

The solid geology beneath the site comprises of Chester Pebble Bed Formation sandstones.

3.2 Hydrogeology

According to EA data the solid strata beneath the site are indicated to be a Primary Aquifer, and the drift deposits are classified as Unproductive Strata.

The soils beneath the site are of high leaching potential, and the site is indicated to be located in a source protection zone (Zone III).

There are several authorized groundwater abstraction licenses in operation in the area, the closest some 550m east of the site.

3.3 Hydrology

The nearest surface water course to the site is located some 500m north west of the site. It is assumed that the stream previously shown some 50m to the north on old OS maps has been culverted or possibly diverted.

The site is not in an area requiring flood defences.

3.4 Mining & Quarrying

The site is not located in a coalfield area.

3.5 Ecology

There are no protected or sensitive sites within or adjacent to the site. The nearest nature reserve is located some 2 km north of the site.

3.6 Summary of Site Sensitivity

The sensitivity of each of the identified receptors in the vicinity of the site to potential contamination sources are summarised in Table 6.

Table 6 Sensitivity of Environmental Receptors in the Vicinity of the Site

Receptor Type	Receptor(s)	Sensitivity	Reasoning
Groundwater	Primary Aquifer	Medium - High	SPZ III and important groundwater resource utilized for abstraction. Drift deposits may offer some protection from surface contamination sources.

4. RISK ASSESSMENT

4.1 Introduction

Environmental Risk has been addressed by adopting a site-specific qualitative approach to identify the risk of environmental harm. The guiding principle of this approach is an attempt to establish connecting links between a hazardous source, via an exposure pathway to a potential receptor. This is in accordance with the Department of the Environment, Transport and Regions (DETR) guidance on Contaminated Land (Ref.3) and the Construction Industry Research and Information Association (Ref. 4).

This assessment will identify where pollutant linkages may exist by considering where a viable pathway may exist which connects a potential source with a receptor. A pollutant linkage is the term used by the DETR in their standard procedure on risk assessment. If there is no pollutant linkage, then there is no risk. Our risk assessment is based on the redevelopment of the site with a commercial end-use.

4.2 Preliminary Conceptual Site Model

Contaminated land risk assessment is based on development of a conceptual model for the site. This is a representation of the relationship between potential contaminant sources, pathways and receptors. A preliminary conceptual site model is based on the inferred ground conditions and environmental data obtained from existing data sources.

4.2.1 Identified Potential Sources

The following potential sources of contamination have been identified from historic uses of the site and surrounding area. Reference has been made to relevant DoE Industry Profiles (Ref.5) with regard to the range of potential contaminants that may be present. These are summarised below:

On Site Sources

Potential sources of contamination associated with the historical activities on the site include:

- Made Ground associated with construction and demolition of former buildings and infrastructure. This may contain brick and concrete rubble, timber, ash and clinker with elevated concentrations of metals, sulphates, organic contamination and asbestos. It is also a potential source of hazardous ground gas.

- Potential localised spillages of hydrocarbons associated with possible above ground fuel oil storage tank.
- Varnish / Colour Works / Paint Factory: Wide range of potential contaminants including inorganic pigments (e.g. cadmium, antimony, zinc, lead and chromium compounds), binders (e.g. phenol formaldehyde, hydrocarbon resins and alkydes), solvents (e.g. BTEX, styrene, naphthalene, white spirit, dichloromethane, methanol and acetone), plasticisers, catalysts surfactants etc.
- Fly-tipped waste of unknown composition and provenance including pools of clear gel/resin with pungent odour on site surface.

Off Site Sources

Potential sources of contamination in the immediate site surroundings may comprise:

- Possible leaks from above ground storage tanks situated to north at operational factory (Possibly Becker Industrial Coatings).

4.2.2 Receptors

The following receptors have been identified:

- Future site users;
- Construction workers during redevelopment works;
- Controlled waters -Groundwater in Primary Aquifer;
- Buildings/services.

The following pathways link the potential contaminants with the potential receptors:

- Direct contact, ingestion and inhalation of contaminants by humans;
- Infiltration/leaching of contaminants through rock mass to groundwater;
- Direct contact of underground services (particularly potable water supply pipes) with contaminated soils.

The Preliminary Conceptual Site Model is shown on Drawing No. 11029/G/151 presented in Appendix C.

4.3 Qualitative Risk Assessment

A qualitative risk assessment has been undertaken for these potential source-pathway-receptor linkages. This is based on consideration of both:

- The likelihood of an event (probability – takes into account both the presence of the hazard and receptor and the integrity of the pathway);
- The severity of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

The risk assessment has been based on redevelopment of the site with a proposed commercial end use (Table 7).

Table 7 Preliminary Environmental Risk Assessment – Proposed Commercial End Use

Source	Pollutant / Hazard	Receptors	Pathways to Receptor	Associated Hazard [Potential severity]	Likelihood of Occurrence	Potential Risk
Made ground and fly-tipped waste on site. Localised fuel oil spillages and leaks from possible on site and off site AST Former industrial operations – Varnish and Paint manufacture	Metals, high pH, sulphate, asbestos BTEX, DRO, PAH (contents of off-site tanks unknown). Wide range of potential soil and groundwater contaminants including inorganic pigments (e.g. cadmium, antimony, lead, chromium compounds), binders (e.g. phenol formaldehyde, hydrocarbon resins and alkydes), solvents (e.g. BTEX, styrene, naphthalene, white spirit, dichloromethane, methanol and acetone), plasticisers, catalysts surfactants etc.	Future Site Users	Direct contact, ingestion, inhalation of dust and vapours.	Effect on human health [Moderate - severe]	Made ground / fly tipped waste is visible. Site was operational for considerable period. No existing site investigation data to confirm absence or presence of contamination. New development will provide effective cover above any non-volatile contaminants.	Medium
		Construction Workers	Direct contact, ingestion, inhalation of dust and vapour.	Effect on human health [Moderate]	Construction workers are likely to come into contact with any contaminants. However risk is lowered due to limited exposure duration and frequency, and adoption of good practice on brownfield redevelopment.	Low / Medium
		Controlled Waters - Groundwater	Downwards migration via rock mass discontinuities.	Pollution of groundwater [Moderate]	Low permeability drift likely to be present above aquifer unit. Potential contaminants are mobile and persistent in environment. No existing site investigation data to confirm absence or presence of contamination.	Medium
		Future Buildings and services	Direct contact	Degradation [Moderate]	Made ground / fly tipped waste is visible. Site was operational for considerable period. No existing site investigation data to confirm absence or presence of contamination.	Medium

Potential ground gas generated from on site made ground and degradation of former process chemicals e.g. resins	Elevated methane, carbon dioxide- toxic, flammable and asphyxiating gases	Future Site Users New buildings	Migration through permeable strata and accumulation in confined spaces and sub-floor voids.	Chronic effect on human health from toxic / asphyxiating gas [Severe]. Fire/explosion (Severe)	No existing site investigation data to confirm absence or presence of contamination.	Low /Medium
		Construction Workers	Migration through permeable strata and accumulation in confined spaces e.g. service trenches.	Acute effect on human health from toxic / asphyxiating gas [Moderate/Severe]	No existing site investigation data to confirm absence or presence of contamination.	Low /Medium

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Environmental Risk Assessment

The preliminary risk assessment undertaken for the site based on existing desk study data has identified:

- The site has been occupied by a Varnish and Colour Works / Paint Factory which was operational for about 40 years.
- The factory buildings have been mostly demolished and both made ground and fly-tipped waste are exposed at the ground surface.
- The previous land uses have the potential to give rise to contamination.
- An operational factory close to the northern boundary may have the potential to impact the site.
- No site investigation data has been provided and the presence and extent of any contamination is currently unknown;
- No information has been provided to indicate whether or not remedial works have been carried out on site.

On the basis of the information reviewed it is considered likely that contamination may be present arising from the previous site use, presenting potential risks to proposed new site users and environmental receptors

5.2 Ground Engineering

At present, no geotechnical ground investigation data is available and consequently it is only possible to estimate the ground conditions. Before firm foundation recommendations can be given, it will be necessary to undertake an appropriate ground investigation. However, tentative recommendations are provided below.

The published geological map indicates that glacial till (boulder clay) is present beneath the site to an unspecified depth. These overly sandstones of the Chester Pebble Beds Formation.

The ground conditions are likely to vary across the site as a result of previous upfill operations to construct the terrace on which the former factory complex was built.

The ground surface predominantly comprises concrete hard standings and former

building floors and access roads. Made ground is visible at ground level and is expected to be present underlying the site to an unknown depth. Made ground is not generally considered a suitable founding material and foundations should be taken through it, into underlying natural in-situ strata of adequate bearing capacity.

Weathered sandstone rock and stiff natural clay drift deposits should provide sufficient bearing capacity to enable the adoption of conventional reinforced strip and pad footings for typical portal steel frame commercial units. Reinforcement is considered necessary to allow for variation in the rock weathering profile and in the strength and density of natural cohesive and granular drift deposits and thus to limit differential settlement between these and the surrounding deposits.

Alternatively if made ground if proved to be too deep for strip footings or deep trench fill then it is likely a piled solution will be required. This could either be driven or cast in-situ. Vibro piling may also be a feasible solution depending on the nature of the made ground.

Redundant in-ground structures are likely to be present including pipes, drains, service ducts and storage tanks. These will require breaking out during the demolition of existing buildings. Foundations that conflict with relict foundations should be taken to greater depth than the relict foundations and into natural ground of adequate bearing capacity.

Where service trenches cross the site, foundations should be placed below a line drawn up at 45° from the base of any service excavations.

Care will be required during demolition to prevent accidental releases of any chemicals or heating oil remaining in storage tanks. An asbestos survey should also be undertaken in view of the age of the building.

5.3 Recommendations

With respect to historic land contamination, Planning Policy Guidance: Planning and Pollution Control (PPS 23) (Ref.6) states that ground contamination is a material planning consideration. Local planning authorities must take account of such issues in determining applications for planning permission. In addition, building work is regulated under the Building Regulations 1991. Schedule 1 (Ref. 7) requires 'precautions shall be taken to avoid danger to health and safety caused by substances found on, or in the ground covered by the building'.

In this context, the significance of the conditions identified and the likelihood that risk and liability will be realised cannot be determined from the findings of the Phase I environmental review alone, and uncertainty remains with respect to determination of actual risks presented.

Therefore, it will be necessary to carry out more detailed analysis of environmental risk and associated liabilities based on site specific data.

It is therefore recommended that Speke Business Park Limited proceed with the completion of a Phase 2 intrusive investigation designed to:

- Adequately characterise the nature, degree and extent of potential contamination,
- Confirm whether potential pollutant linkages are actually present;
- Determine the severity of the impact of identified pollutant linkages on future redevelopment; and
- Evaluate the engineering properties of the underlying soils.

5.4 Phase 2 Scope

We would propose to investigate the land in line with good practice guidance in BS:10175 (Ref.8) and published by EA (Ref.9). The approach would be to target potential point sources of contamination and to examine the wider site area on a random grid basis where accessible and safe to proceed. The scope should include:

Method	Purpose
Enquiries made of adjacent industrial premises operator.	To establish current condition of ASTs close to northern perimeter and whether there have been any historic leaks or spills.
Drainage survey	To sample contaminated silt in drains and identify possible contaminant migration pathways.
Trial Pits	To determine the general nature of soils underlying the site, including the nature, distribution and thickness of made ground nature, degree and extent of any contamination, proportion of undesirable elements e.g. biodegradable matter, foundations etc & suitability of the ground for founding new structures.
Window Sample Boreholes	Recovery of shallow soil samples for chemical and geotechnical testing purposes. The purpose of the testing would be to provide information on contamination levels and also to allow for geotechnical testing and classification purposes.
	In order to characterise groundwater and ground gases / vapours. All boreholes will be monitored in line with CIRIA guidance.
Cable Percussion Boreholes	To retrieve geotechnical data from depth and establish geological structure and prevailing ground conditions.
	To install monitoring wells across the site in order to determine groundwater levels and monitor for hazardous gas.

All data should be assessed in relation to published guidelines and an environmental risk assessment carried out in accordance with current best practice as described in CLR11. The nature and extent of contamination would be determined based on the findings of these works and the risks to site users and the wider environment then assessed. The need for, and scope of, any further investigations/ monitoring and / or remediation to allow redevelopment to proceed would be identified in the report.

6. REFERENCES

1. Department of the Environment, Transport and the Regions and Environment Agency, Model Procedures for the Management of Land Contamination. Contaminated Land Report 11.
2. EA and NHBC 2000. Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66.
3. Department of the Environment, Transport and the Regions, Environment Agency and Institute of Environmental Health. Guidelines for Environmental Risk Assessment and Management. HMSO July 2000.
4. Construction Industry Research and Information Association (CIRIA). Contaminated Land Risk Assessment. A Guide to Good Practice. CIRIA C552 2001.
5. DoE, 1995 Industry Profile. Chemical Works, Coatings (Paints and Printing Inks) Manufacturing works
6. OPDM Planning Policy Statement 23: Planning and Pollution Control. Annex 2 Development on Land Affected by Contamination.
7. Approved Document C – Site Preparation and Resistance to Contaminants and Moisture (Relating to Building Regulations 2000 (SI 2000/2531).
8. BSI, 2001 Investigation of Potentially Contaminated Sites, Code of Practice, BS:10175.
9. EA, 2001 Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination.

APPENDIX A

Legal Framework

Legislative Background

Land affected by contamination is regulated under two separate regulatory regimes – The Town and Country Planning Regulations and the Part 2A Contaminated Land Regulations. The former is the preferred route for sites undergoing redevelopment, whereas the latter is an intervention regime designed to tackle sites considered to be causing unacceptable risks in their current situation.

Environmental risks are evaluated in terms of a source – pathway - receptor relationship in accordance with the approach set out in the 1995 Environment Act, The Contaminated Land (England) Regulations 2000 and the DETR circular 01/2006 Environmental Protection Act 1990: Part 2A Contaminated Land. Under the Part 2A regime contaminated land is defined as land which is in such condition by reason of substance in, on or under the land that:

- a) significant harm is being caused or there is a significant possibility of such harm being caused;
- b) significant pollution of controlled waters is being or is likely to be caused.

The potential for significant harm is based on the presence of three factors:

- Source: Substances that are potential contaminants or pollutants that may cause harm;
- Pathway: A potential route by which contaminants can move from the source to the receptor; and
- Receptor or target: A defined receptor that may be harmed, for example humans and controlled waters.

In the absence of evidence indicating significant harm is already occurring, the possibility of it being caused is assessed by considering whether a pollutant linkage may exist, and if the possibility is significant, and if so whether the resulting harm would be significant. Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and unacceptable risk of harm.

The key principle which underpins this approach is the 'suitable for use' criterion. This requires remedial action by the 'appropriate person' (polluter or landowner) where contamination is considered to pose unacceptable actual or potential risks to health or the environment and appropriate and cost effective remediation techniques exist, taking into account the actual or intended use of the site.

In contrast, under the planning regime the 'precautionary principle' applies to sites which are being redeveloped. Land affected by contamination is also assessed using the source-pathway-receptor protocol, however, there is no test of 'significance' as applied under the

Part 2A regime. In addition, the potential receptors are not prescribed. The policy is designed to achieve high standards of remediation by the developer as part of the site redevelopment, which is the best opportunity to consider a potentially wider choice of remedial action. For example, the site layout or end use could be amended to address the potential risks, and site clearance provides access to contaminated soils for removal or treatment.

Guidance

PWA Geo-Environmental Ltd (PWAG) is part of a registered Engineering Practice which is a member of the Association of Consulting Engineers (ACE).

This report has been prepared in accordance with:

- CLR11 – Model Procedures
- Contamination and Environmental Matters – Their implications for Property Professionals (2nd Edition RICS Nov 2003)
- Brownfields – Managing the development of previously developed land – A client's guide, CIRIA 2002
- DEFRA and Environment Agency (EA) publications CLR7 – 10, (subsequently withdrawn) supported by the TOX guides and SGV guides, dated March 2002
- DETR Circular 01/2006, Contaminated Land: Implementation of Part 2A of the Environmental Protection Act 1990
- OPDM Planning Policy Statement 23: Planning and Pollution Control. Annex 2 Development on Land Affected by Contamination
- Environment Agency technical advice to third parties on Pollution of Controlled Waters for Part IIA of the EPA1990, May 2002

And any other protocols advised by DEFRA and the EA and guidance's prepared by BSI, CERTA, BURA, and other industry advisory bodies including BS5930 and BS10175.

Judicial Precedents and Legislation

The following non-exhaustive list of the legislative framework documents has been considered in the compliance of this document.

- The Environment Act (1995)
- The Environment Protection Act (1990)
- The Water Resources Act (1991)
- The Radioactive Substances Act (1993)
- The Pollution Prevention and Control (England and Wales) Regulations (2000)
- The Contaminated Land (England) Act (2000)
- The Environment Act 1995 (Commencement No.16 and Saving Provision) (England) Order (2000)
- The Contaminated Land (England) (Amendment) Regulations (2001)
- The Landfill Regulations (England and Wales) Regulations (2002)
- The Landfill (England and Wales) (Amendment) Regulations (2004)
- Rylands v Fletcher – Private Nuisance, Escape
- Health and Safety at Work Act
- The Building Regulations 1991, Part C of Schedule 1
- The Controlled Waste Regulations 1992
- Special Waste Regulations 1996

Neither the list of guidance nor the list of judicial precedents and legislation should be considered exclusive or comprehensive. There are approximately 85 individual items of legislation regulating contaminated land work. PWAG makes every effort to ensure that all are adhered to in the preparation and presentation of this report.

Technical Competence

PWAG is a leading specialist multi-disciplinary engineering practice working in the contaminated land market. Most of the workload undertaken by PWAG is within the property development market dealing with brownfield re-development and associated environmental and geotechnical issues.

Established in 2009 PWAG is at the forefront of environmental asset management providing expertise in environmental risk assessments, environmental site investigations, geotechnical site investigations and remediation strategies.

PWAG's staff come from a wide variety of backgrounds within the geotechnical and environmental sectors and are all degree qualified. Specialists include geotechnical engineers, geologists, chartered environmentalists and chartered engineers.

PWAG's technical protocols are described in our reports and are strictly adhered to by quality control checks in the field and in the laboratory. PWAG only uses UKAS and MCERTS accredited laboratories for all methods used to derive determinant concentrations.

PWAG operates a quality assurance process under ISO9001:2000 which facilitates rigorous in-house administrative and technical protocols. PWAG also initiates a robust health and safety program for each site and ensures the regular training of staff in new guidance's and techniques.

APPENDIX B

General Notes

Generic Notes – PWAG Geo-environmental Investigations

Environmental Setting

General

Third party information obtained from the British Geological Survey (BGS), the Coal Authority, the Local Authority etc is presented in the Correspondence Appendix of this Geoenvironmental Report.

Geology, Mining & Quarrying

In order to establish the geological setting of a site, PWAG refer to BGS maps for the area, and the relevant geological memoir.

A coal mining report is obtained from the Coal Authority. Further information is sourced from the Local Authority and by reference to current and historical OS plans.

Landfills

PWAG obtain data from the Landmark Information Group, the Environment Agency and the Local Authority with respect to known areas of landfilling within 250m of the proposed development site. Reference is also made to historical OS plans, which are inspected for evidence of backfilled quarries, railway cuttings, colliery spoil tips etc.

Radon

Radon is a colourless, odourless gas, which is radioactive. It is formed in strata that contain uranium and radium (most notably granite), and can move through fissures eventually discharging to atmosphere, or the spaces under and within buildings. Where radon occurs in high concentrations, it can pose a risk to health.

In order to assess potential risks associated with radon gas, PWAG refer to BRE Report BR211, 1999: *“Radon: guidance on protective measures for new dwellings”*.

BR211 provides a preliminary indication of the measures required for a particular site, but it is also often necessary to request a Stage 2 Protective Measures Site Report from the BGS.

The level of protection needed is site-specific and is determined by reference to the radon potential map for the area followed by a geological assessment of the site. This information is contained in the Annexes of BR211.

Annex A – derived from statistical analysis of radon measurements in existing houses carried out by the NRPB and grouped on a 5km grid.

Annex B - based on an assessment of the same radon measurements grouped by geological units. The maps show the 5km grid squares underlain completely or in part, by geological units which potentially exceed the action levels for radon protective measures. The grid squares are coded according to the highest potential within the square. In many cases the actual geological radon potential varies considerably within a grid square.

PWAG adopt the following procedure when assessing risk associated with radon.

Firstly, Annex A maps are reviewed to see whether the site requires full, basic or no measures. If the site is in a dark brown square, full radon protection measures are required. If the site is in a light brown square, reference should be made to Annex B.

Secondly, Annex B maps are reviewed to see whether a further geological assessment is required which may result in upgrading the result from Annex A. If a site lies within a shaded square, it may require radon protection, and PWAG request a Stage 2 Protective Measures Site Report from the BGS.

If the site is in a square that is not coloured or shaded in either set of maps then no radon protection is needed and therefore a BGS Report is not normally necessary.

The BGS geological assessment involves checking whether the site is on or close to a geological unit that has statistically been found to have elevated radon potential. The geological assessment is based on either 1:50,000 or the 1:250,000 scale data. The search area specified as part of the request is increased by 50m in areas where 1:50,000 data is available and by 500m in areas with 1:250,000 scale data to allow for potential inaccuracies in the position of boundaries. The BGS report indicates the highest level of protection required within the search area and its buffer zone.

When requesting a BGS report, PWAG select the search radius carefully, since too large a search radius may result in the inclusion of areas underlain by geological units of a higher radon potential, thereby giving rise to recommending too high a level of protection.

The report also includes (where available), a list of the geological units included in the assessment. PWAG check that these actually underlie the site, rather than the buffer zone only.

On the basis of radon measurements in dwellings and on their geological interpretation, the BGS report stipulates the level of protective measures required for the proposed development site, and this could be:

1. no measures,
2. basic measures, or
3. full measures.

Details of these measures are provided in the Hazardous Gas section of this Geoenvironmental Report.

Hydrogeology

PWAG obtain information from the Environment Agency (EA) and the Landmark Information Group with respect to:

- groundwater quality
- recorded pollution incidents
- licensed groundwater abstractions

Reference is also made to the EA document *"Policy and Practice for the Protection of Groundwater"* (1998) and the relevant Groundwater Vulnerability Map.

Bedrock and any overlying granular Drift deposits are classified by the EA:-

- **Major aquifers:** *“Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public water supply and other purposes”.*
- **Minor aquifers:** *“Fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers will seldom produce large quantities of water for abstractions, they are important both for local supplies and in supplying base flow to rivers”.*
- **Non-aquifers:** *“Formations which are generally regarded as containing insignificant quantities of groundwater. However groundwater flow through such rocks, although imperceptible, does take place and needs to be considered in assessing the risk associated with persistent pollutants. Some non-aquifers can yield water in sufficient quantities for domestic use”.*

Groundwater vulnerability is determined by 4 variables:

1. The presence and nature of overlying soil (the weathered zone affected by living organisms; soil in the UK can extend up to 2m in depth). Physical properties of the soil affect the downward passage of water and its ability to attenuate pollutants. The EA make reference to a three-fold classification of soil types:-
 - Soils of **low** leaching potential are defined as *“soils in which the pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants”.*
 - Soils of **intermediate** leaching potential are defined as *“soils which have a moderate ability to attenuate diffuse source pollutants or in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer”.*
 - Soils of **high** leaching potential are defined as *“soils with little ability to attenuate diffuse source pollutants and in which non-adsorbed diffuse source pollutants and liquid discharges have the potential to move rapidly to underlying strata or to shallow groundwater”.*

In urban areas and restored mineral workings the soil information is based on fewer observations than elsewhere. A worst-case vulnerability (H) is therefore assumed for these areas and for current mineral workings by the EA. All are given a designation of **HU** unless proved otherwise.
2. The presence and nature of Drift, which often overlies bedrock. Where Drift is of substantial thickness and low permeability, it can provide an effective barrier to surface pollutant migration. Permeable Drift is classified as a Minor Aquifer except where it is in probable hydraulic continuity with a Major Aquifer, where it is regarded as part of the Major Aquifer unless proven otherwise by site investigation.
3. The nature of the geological strata (bedrock). Rocks that contain groundwater in exploitable quantities are called aquifers.
4. The depth of the unsaturated zone; ie that part of the aquifer which lies above the water table

The EA have also designated Source Protection Zones, which are based on proximity to a groundwater source (springs, wells and abstraction boreholes). The size of a Source Protection Zone is a function of the aquifer, volume of groundwater abstracted and the effective rainfall, and may vary from tens to several thousand hectares.

Hydrology

PWAG obtain information from the Environment Agency and the Landmark Information Group with respect to:

- surface water quality
- recorded pollution incidents
- licensed abstractions (groundwater & surface waters)
- licensed discharge consents
- site susceptibility to flooding

The EA have set **water quality** targets for all rivers. These targets are known as River Quality Objectives (RQOs). The water quality classification scheme used to set RQO planning targets is known as the River Ecosystem scheme. The scheme comprises five classes (RE1 to RE5) which reflect the chemical quality requirements of communities of plants and animals occurring in our rivers.

General Quality Assessment (GQA) grades reflect actual water quality. They are based on the most recent analytical testing undertaken by the EA. There are six GQA grades (denoted A to F) defined by the concentrations of biochemical oxygen demand, total ammonia and dissolved oxygen.

The susceptibility of a site to **flooding** is assessed by reference to a Flood Map on the Environment Agency's website. These maps provide show natural floodplains - areas potentially at risk of flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas.

There are two different kinds of area shown on the Flood Map:

1. Dark blue areas could be flooded by the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or by a river by a flood that has a 1% (1 in 100) or greater chance of happening each year
2. Light blue areas show the additional extent of an extreme flood from rivers or the sea. These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.

These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements

The maps also show all flood defences built in the last five years to protect against river floods with a 1% (1 in 100) chance of happening each year, or floods from the sea with a 0.5% (1 in 200) chance of happening each year, together with some, but not all, older defences and defences which protect against smaller floods.

The Agency's assessment of the likelihood of flooding from rivers and the sea at any location is based on the presence and effect of all flood defences, predicted flood levels, and ground levels.

It should also be noted that as the floodplain shown is the 1 in 100 year (or 1 in 200 year as appropriate), areas outside this may be flooded by more extreme floods (e.g. the 1 in 1000 year flood). Also, parts of the areas

shown at risk of flooding will be flooded by lesser floods (e.g. the 1 in 5 year flood). In some places due to the shape of the river valley, the smaller floods will flood a very similar extent to larger floods but to a lesser depth.

If a site falls within a floodplain, it is recommended that a flood survey be undertaken by a specialist consultant who can advise on appropriate mitigating measures; ie raising slab levels, provision of storage etc.

COMAH & Explosive Sites

PWAG obtain information from the Landmark Information Group with respect to COMAH or explosive sites within 1km of the proposed development site. PWAG's report refers to any that are present, and recommends that the Client seeks further advice from the HSE.

Areas around COMAH sites (chemical plants etc) are zoned with respect to the implementation of emergency plans. The HSE are a statutory consultee to the local planning authority for all COMAH sites. The COMAH site may have to revise its emergency action plan if development occurs. This might be quite straightforward or could entail significant expenditure. Consequently, the COMAH site may object to a proposed development (although it is the Local Authority who have final say, and they are likely to place more weight on advice from the HSE).

Preliminary Conceptual Ground Model

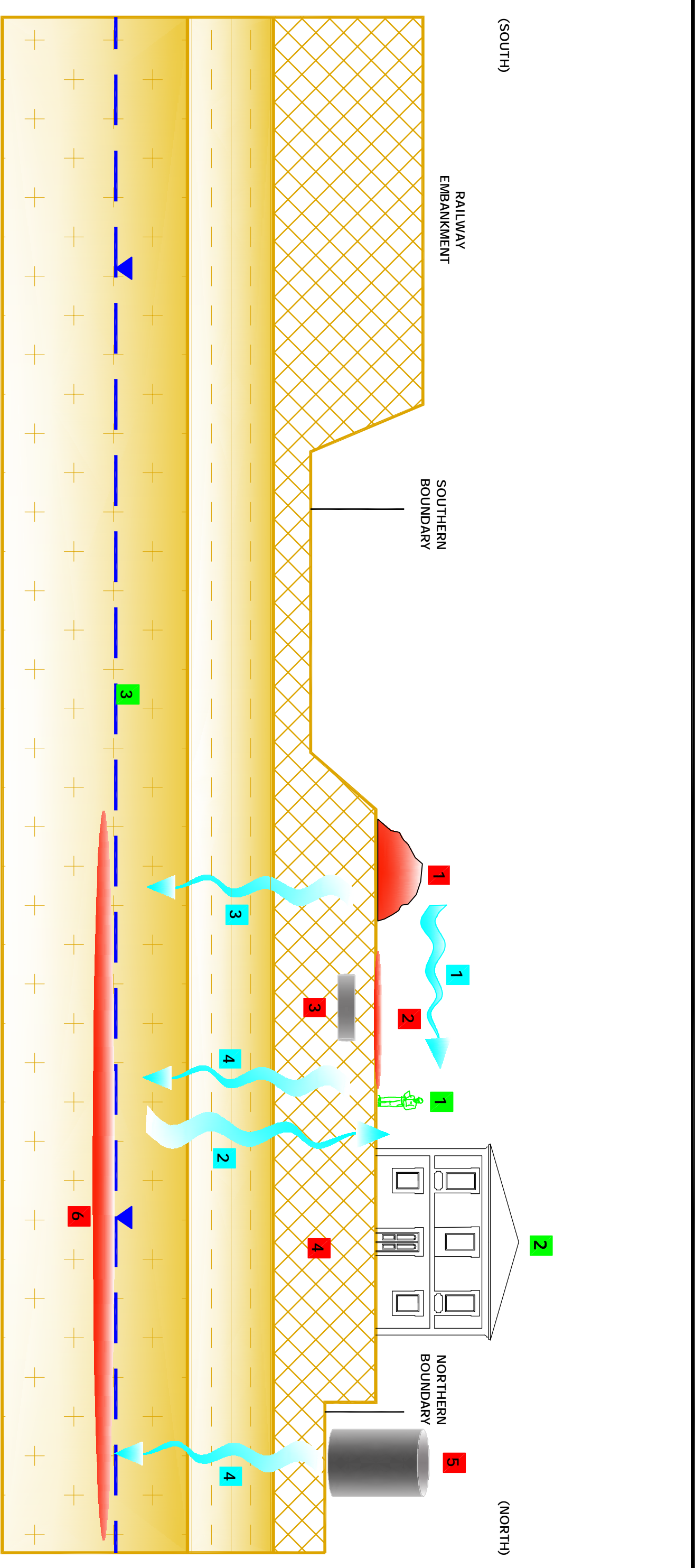
The site's environmental setting (and proposed end use) is used by PWAG to assess the significance of any contamination encountered during the subsequent ground investigation

Assessment of contaminated land is based on an evaluation of pollutant linkages (source-pathway-receptor). Contaminants within the near surface strata represent a potential source of pollution. The environment (most notably groundwater), site workers and end users are potential targets.

Potential pollutant linkages are shown on a preliminary conceptual site model, presented as a Drawing in an Appendix to this Geoenvironmental Report. The preliminary model is revised in light of data arising from the subsequent ground investigation.

APPENDIX C

Drawings



KEY	SOURCES
	1 FLY-TIPPED WASTE
	2 CONGEALED RESIN/GEL
	3 LEAKS FROM PIPES, TANKS, DRAINS
	4 MADE GROUND
	5 OFF-SITE ABOVE GROUND STORAGE TANKS
	6 NAPL

PATHWAYS
1 DIRECT CONTACT INGESTION
2 INHALATION
3 LEACHING
4 VERTICAL MIGRATION

RECEPTORS
1 SITE USERS AND CONSTRUCTION WORKERS
2 NEW DEVELOPMENTS
3 CONTROLLED WATERS: (GROUNDWATER - PRIMARY AQUIFER)

<input checked="" type="checkbox"/> Summit House, Randon Way, The Crossings, Oswestry, Cheshire, CH20 7BW T - 01566 833840 F - 01566 833842	
<input type="checkbox"/> Oaks Wood, 2 The Oaks Leek, ST2 7JU T - 0113 237 2929 F - 0113 237 2701	
Client:	SPEKE BUSINESS PARK LTD
Job:	PROPOSED COMMERCIAL DEVELOPMENT GOODLASS ROAD SPEKE
Drawn By:	CEB
Checked By:	PJW
Date:	23/02/11
Scale:	NTS
Sheet:	A3
Drawing Number:	11029-G-151
Rev:	/

APPENDIX D

Site Reconnaissance Photographs



Plate 1: An overview of the site looking west



Plate 2: Off-site storage tanks (unknown content) near northern site boundary



Plate 3: Gel/resin-like substance dumped on the site



Plate 4: Mounds of fly-tipped waste in west of site



Plate 5: Hut on site containing waste.



Plate 6: Void exposing metal pipes beneath reinforced concrete hardstanding



Plate 7: Bund at northern site boundary



Plate 8: Drain adjacent to bund at northern site boundary



Plate 9: Possible paint spill



Plate 10: Looking north west showing raised development platform of former paint factory buildings