

PHASE 1 GEO-ENVIRONMENTAL GROUND INVESTIGATION
AT
LONGFIELD SHOPPING CENTRE, PRESTWICH TOWN CENTRE,
MANCHESTER
FOR
THE HOLLINS MURRAY GROUP

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1.0 EXECUTIVE SUMMARY

- 1.1 Integra Consulting Engineers Ltd has been instructed by The Hollins Murray Group to undertake a Phase 1 geo-environmental ground investigation at Longfield Shopping Centre, Bury New Road in Prestwich, Manchester. The site is located at Ordnance Survey national grid reference, Easting: 381260 and Northing: 404080.
- 1.2 The objectives of the report were to assess the probable geological and contaminated land conditions on and beneath the surface and to identify potential contaminants present at the site. A preliminary conceptual model was then to be developed to define the scope and extent of any further investigations deemed necessary.
- 1.3 The site comprises an irregular shaped plot of land of approximately 1.7 hectares in area. The elevation across the site is generally level at about 92m above Ordnance Datum (AOD) and there is no evidence of ground subsidence. The eastern section of the site is occupied by a bitmacadam car park and the Longfield Shopping Centre which comprises low rise retail units situated in the centre of the site. A number of the buildings situated along the Bury New Road frontage are believed to be the original 19th Century red brick buildings. The site is covered by hard standing with the exception of a few 'decorative' trees scattered across the site area. A small area of dense vegetation is situated in the south west corner of the site.
- 1.4 The site is underlain by drift deposits of Quaternary sand and gravel deposits which in turn are underlain by the Carboniferous Westphalian C sandstone. The site is underlain by a minor aquifer and, due to the potential permeability of the overlying drift deposits, it is possible that any contamination on site may permeate into the underlying aquifer. The site does not lie within a Source Protection Zone.
- 1.5 The site was occupied by rows of traditional residential terraces from the 1890's until circa 1960 when the terraces were re-developed into the Longfield Shopping Centre formed as low rise masonry clad retail units. The eastern section of the site was occupied by railway land until circa 1960 when a car park associated with the shopping centre was constructed in this area.

- 1.6 The potential contamination on site could arise from a number of sources including railway embankments, dry cleaners and photographic processors. However, due to the impermeable hardstanding covering the site, there is considered to be a negligible risk to human health. On this basis, it is recommended that a relatively low level of environmental testing is undertaken on the basis that there remains a minor risk to construction workers and building fabric. There may also be a risk from ground gases and therefore it is recommended that a complete gas monitoring programme is undertaken.
- 1.7 The conceptual model for waters has not been included as it is considered that there is a negligible risk to controlled waters on the basis of the low sensitivity of the underlying minor aquifer, the distance of the surface water body from the site together with the effects of natural attenuation and dispersion. Furthermore, the site is not located in a Source Protection Zone and the nearest water abstraction point is located at least 1.4 km from the site. It should also be noted that there is no vertical migration pathway for any on-site contamination into the underlying aquifer as the proposed development will remain covered with hard impermeable surfaces.
- 1.8 Historic mine workings beneath the site are believed to be at sufficient depth that they will not detrimentally affect the proposed site development. The depth of the workable Worsley 4ft Seam was evident in a borehole located 15m to the east of the site where the seam was encountered at 227m below ground level. It is noted that a coal mining subsidence claim relating to the Forester Public House in the south of the site was made in 1995 but was subsequently withdrawn.
- 1.9 In summary, the site could be affected by contamination due to its past and present uses. However, the proposed retail development has only a nominal area of soft landscaping with the remainder of the site to be occupied by buildings or impermeable hard standing. On this basis it is considered that waters and human health risk will be low although there is considered to be a minor risk to construction workers and building fabrics. There is also a risk to human health and the proposed site development from ground gases. It is therefore recommended that a Phase 2 intrusive geo-environmental investigation is undertaken. The scope of this investigation is shown on the site plan in Appendix 8.

2.0 INTRODUCTION

This Phase 1 geo-environmental ground investigation and report has been prepared at the request of Mr Craig Foster of Craig Foster Architects acting on behalf of The Hollins Murray Group.

Instructions to proceed were received in June 2009. Desk study work was undertaken between 25th June 2009 and 29th June 2009. The walk over survey was carried out on 26th June 2009.

The Phase 1 report is to be used for submission to the Local Authority as part of the planning application for the re-development of the site to provide mixed use commercial premises to include a food retail unit, hotel, offices, residential units and a multi-story car park with associated access roads and hard landscaped areas. The proposed development plan is contained in Appendix 9.

3.0 **BRIEF**

The brief was to carry out a Phase 1 geo-environmental ground investigation of the Longfield Shopping Centre, Bury New Road, Prestwich in Manchester. The extent of the site is shown on the aerial photograph and site plans contained in Appendix 1. The investigation was to include for the following studies:

- a) A desk study involving examination of available geological maps, historical Ordnance Survey maps, environmental maps and available Coal Authority plans to assess the probable geological and contaminated land conditions on and below the site.
- b) A walk over study of the site to ascertain any evidence of previous and current site uses that may have caused contamination of the ground and surface waters at the site. During the walk over survey, the topography of the site was to be noted along with any land features that could give an indication of probable sub-surface features and formations.
- c) Identify probable contaminants that may be present at the site using current contaminated land guidance and identify potential receptors which could be at risk from potential contaminants.
- d) Develop a conceptual model for the site to assess the potential risks of contamination.
- e) Determine whether further investigation and assessment is required.
- f) Define the scope and extent of further investigations.

A detailed report was to be provided to summarise findings and recommendations.

4.0 LIMITATIONS OF INVESTIGATION WORK AND REPORT

Desk Study References

The desk study has been produced using historical Ordnance Survey maps and environmental maps available at the time the report has been produced. The environmental information used was the current information available at the time of writing but there is no absolute guarantee of accuracy.

Boreholes / Trial Pits

Where the spacing of trial pits or boreholes for future intrusive investigation work has been presented as part of this report, the spacing has been determined to provide a reasonable indication of the general ground conditions and extent of land / groundwater contamination on the site but the number has ultimately been limited by commercial constraints. The ground conditions at the proposed borehole / trial pit locations are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between borehole / trial pit locations when preparing any assessments of the final foundation and land / groundwater remediation proposals.

Extent of Contamination Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection of the site if its presence is suspected.

Flooding

Flooding in this report is defined as flooding caused by the sea, ditches, rivers, streams, ponds, lakes, reservoirs and the like. It does not extend to flooding caused by surcharged piped drainage systems and investigations into flooding of this nature are excluded from this report.

5.0 THIRD PARTIES

This report has been prepared for the sole use of The Hollins Murray Group. It must not be copied or passed onto any third party or used for any purpose other than which it was prepared without the permission of the author. This report is copyright.

6.0 SCOPE OF INVESTIGATION WORK

6.1 Walk Over Survey

The site was visited during dry, sunny weather conditions and visually examined for evidence of the following:

- a) Features that could indicate the probable presence of contamination on site from present or past site uses.
- b) Physical features that could indicate the nature of the sub-surface ground conditions or features.

Photographs were taken of the site during the walkover survey and these photographs are contained in Appendix 2.

6.2 Desk Study Documentation

The following documents were obtained and examined during the desk study:

- a) An aerial photograph of the site dated circa 2000. The photograph is contained in Appendix 1.
- b) Historical Ordnance Survey maps as follows:
 - 1:2500 dated 1891
 - 1:10,560 dated 1894
 - 1:2500 dated 1909
 - 1:10,560 dated 1910
 - 1:2500 dated 1922
 - 1:10,560 dated 1923
 - 1:10,560 dated 1932
 - 1:10,560 dated 1938
 - 1:1250 dated 1952 – 1953
 - 1:2500 dated 1953 – 1954
 - 1:10,000 dated 1955 – 1956
 - 1:10,000 dated 1965 – 1968

- 1:1250 dated 1968 – 1984
- 1:10,000 dated 1974 – 1979
- 1:2500 dated 1975
- 1:1250 dated 1979 – 1990
- 1:2500 dated 1980
- 1:10,000 dated 1980 – 1986
- 1:10,000 dated 1989
- 1:10,000 dated 1990 – 1992
- 1:1250 dated 1992
- 1:1250 dated 1992 – 1993
- 1:1250 dated 1995 – 1996
- 1:1250 dated 1996
- 1:10,000 dated 1999
- 1:10,000 dated 2006
- 1:10,000 dated 2009

These maps are contained in Appendix 3.

c) Environmental maps obtained through Envirocheck as follows:

- Environment Agency and hydrological map dated 1999 to 2009.
- Groundwater vulnerability map dated 1999.
- Sensitive land uses map dated 1997 to 2009.
- Summary maps showing locations of recorded waste sites, industrial land use sites and hazardous substances sites in adjacent areas.

These maps are contained in Appendix 4.

d) An environmental report obtained from Landmark, the environmental database company, which provides a list of recorded past and present activities at or adjacent to the site which could have an impact on the levels of contamination in the soils and groundwater at the site.

This report is contained in Appendix 5.

e) The British Geological Survey 1:10,560 solid and drift geological map, reference number: SD 80 SW. A part extract of the map covering the area

under consideration is contained in Appendix 6. The extracts have been copied under licence from the British Geological Survey.

- f) The Indicative Atlas of Radon in England and Wales published by the British Geological Society and the Health Protection Agency was examined to assess the probable presence or otherwise of radon gas in the ground. An extract of the relevant map is contained in Appendix 7.

7.0 FINDINGS

7.1 Description of the Site

The site is located in the mature residential / commercial town centre of Prestwich which lies approximately 5km to the north of Manchester. The location is shown on the site plans in Appendix 1. The national Ordnance Survey grid reference for the centre of the site is Easting: 381260, Northing: 404080 and it is located off Bury New Road (A56). The site is bounded by Bury New Road and residential properties to the west, Rectory Lane and the Metrolink light rail network to the east, commercial / residential premises to the north and residential properties and Prestwich Church of England Primary School to the south. An aerial photograph of the site prior to works commencing is also contained in Appendix 1.

The site is approximately 1.7 hectares in area, is generally level at an elevation of about 92m AOD with a slight slope towards the west and is accessed via Bury New Road or Rectory Lane. The eastern section of the site is covered by a bitmacadam car park which serves the local community utilising the shopping centre or Metrolink. The central section of the site is occupied by the Longfield Shopping Centre which comprises a series of low rise masonry clad retail units connected by either covered or open walkways. The frontage to Bury New Road comprises retail units and two public houses with these buildings believed to date from the 19th century. Prestwich Library and Adult Learning Centre is situated in the north of the site adjacent to the commemorative Millennium Fountain. The majority of the site is covered by decorative concrete paving stones with a number of isolated trees scattered across the site.

7.2 Walk Over Survey

During the walk over survey, the following features were noted relating to geology and contaminated land matters:

Geology

The site slopes gently downwards towards the west and there was no evidence of ground movement or instability. The ground underfoot was dry due the impermeability of the hardstanding surface and there was no evidence of water features crossing the site. There were no rock exposures, evidence of faulting or mining activities on site.

Contaminated Land

There was no visual or olfactory evidence of contamination detected during the site reconnaissance. Potential made ground deposits may be located beneath the car park which is located in the eastern section of the site (refer to plate 1).

Photographs taken during the walkover survey are contained in Appendix 2.

7.3 Geology

The 1:10,000 geological map of the area (ref: SD 80 SW) indicates that the entire site is underlain by drift deposits of Quaternary glacial sand and gravel. The site is underlain by the Worsley Delf Rock which consists of sandstone appertaining to the Carboniferous Westphalian C geological age. The Worsley 4 foot mine (coal seam) outcrops 400m to the north east of the site and is indicated as lying at approximately 120m below the Worsley Delf Rock on the vertical section. The nearest recorded dip in the Middle Coal Measures recorded at 18° SW was located approximately 250m north east of the site.

A borehole located 10m to the west of the site recorded 48m of drift comprising sand, gravel and boulder clay, Carboniferous Coal Measures were encountered between 48m and 88m and red sandstone was encountered between 88m and 100m below ground level. A second borehole located 15m to the east of the site recorded drift deposits comprising sand and gravel to 61m below ground level with the Worsley 4 foot mine (coal seam) encountered at 227m below ground level.

7.4 Site History

The site development history has been researched by reference to historical maps and street plans. These are included in Appendix 3 to this report and the principal observations are summarised below.

1:2500 dated 1891

The site is situated in the centre of the small settlement of Prestwich which is located in the county of Lancashire and Furness. This map indicates that the majority of the site area is covered by rows of traditional terrace houses with a school building located in the south of the site. Railway land occupies the south east corner of the site with associated embankments located in this area.

The land to the west of the site has a relatively high density of residential terraced properties with the land to the east comprising railway land and fields. Bury New Road and tramway is located adjacent to the western site boundary with railway land situated adjacent to the east and south. An historic burial ground is situated adjacent to the south west of the site and the Albion and Britannia Mills are located just to the north of the burial ground.

1:10560 dated 1894

There are no discernable changes on site between this map and the 1891 map. Prestwich Clough (natural stream) is located approximately 400m to the south of the site and Mere Clough (Bradley Brook) is located approximately 750m to the north west of the site. Prestwich Hills Reservoirs (Manchester Water Works) are situated 800m to the south of the site.

1:2500 dated 1909

There are no discernable changes on site between this map and the 1894 map. There is a higher density of residential properties in the surrounding area and a hospital is located approximately 100m to the north west of the site.

1:10560 dated 1910

There are no discernable changes on site between this map and the 1909 map. There is a higher density of housing to the west and south of the site.

1:2500 dated 1922

There are no discernable changes between this map and the 1910 map.

1:10560 dated 1923

There are no discernable changes between this map and the 1922 map.

1:10560 dated 1932

There are no discernable changes on site between this map and the 1923 map.
There is a higher density of residential properties in the surrounding area.

1:10560 dated 1938

There are no discernable changes between this map and the 1932 map.

1:1250 dated 1952 – 1953

There are no discernable structural changes on site between this map and the 1938 map. The site is occupied by commercial premises including a post office, public house, school, beer house, bank and telephone call box. There is an electrical substation located approximately 30m to the south east, tanks are located 50m to the south west and a garage is situated 40m to the north west.

1:2500 dated 1953 – 1954

There are no discernable changes on site between this map and the 1952 – 1953 map.

1:10000 dated 1955 – 1956

There are no discernable changes on site between this map and the 1953 – 1954 map.

1:10000 dated 1965 – 1968

There are no discernable changes on site between this map and the 1955 – 1956 map.

1:1250 dated 1968 – 1984

The traditional terraces have been replaced with the Longfield Shopping Centre which is located in the eastern section of the site along with an associated car park. A public library, hall and government offices are also located on the site. The school located in the south of the site is called Prestwich Parish Church of England Junior School. A builder's yard is situated adjacent to the eastern site boundary and a health centre and car park are adjacent to the north of the site. There are three electrical substations located in close proximity to the site with one located 30 metres to the north east, a second 20 metres to the west and the third 40 metres to the north west.

1:10000 dated 1974 – 1979

There are no discernable changes between this map and the 1968 – 1984 map.

1:1250 dated 1979 – 1990

There are no discernable changes between this map and the 1974 – 1979 map.

1:2500 dated 1980

This map is incomplete and does not cover the entire area of the site.

1:10000 dated 1980 – 1986

There are no discernable changes on site between this map and the 1979 -1990 map. The Prestwich Hill Reservoirs located 800 metres south of the site are now disused

1:10000 dated 1989

This map is incomplete and does not cover the entire area of the site.

1:10000 dated 1990 – 1992

This map is incomplete and does not cover the entire area of the site.

1:1250 dated 1992

Prestwich Church of England Junior School is no longer occupying the building in the south of the site and has moved to a building adjacent to the southern site boundary.

1:1250 dated 1992 – 1993

There are no discernable changes on site between this map and the 1992 map. Metrolink tramline and Prestwich Station are located adjacent to the eastern boundary.

1:1250 dated 1995 – 1996

There are no discernable changes on site between this map and the 1992 – 1993 map.

1:1250 dated 1996

This map is incomplete and does not cover the entire area of the site.

1:10000 dated 1999

There are no discernable changes between this map and the 1996 map. Prestwich Clough is indicated to flow from east to west.

1:10000 dated 2006

There are no discernable changes between this map and the 1999 map.

1:10000 dated 2009

There are no discernable changes between this map and the 2006 map.

7.5 Waters and Flooding

Environmental data relevant to the site and its immediately surrounding area has been obtained from sources available in the public domain. In addition, an environmental report was obtained from Landmark, the commercial suppliers of environmental data. The Landmark report and associated maps that have been inspected are presented in Appendices 4 and 5 and the principal observations in relation to waters and flooding can be summarised as follows:

- The site is not located in an area prone to flooding from rivers or seas without defences but will however still require a Flood Risk Assessment (FRA) to comply with Planning Policy Statement 25 (PPS25) Development and Flood Risk.

- The main body of Prestwich Clough (natural stream) is located approximately 400m to the south of the site. A tributary to this stream branches towards the north and is located approximately 300m to the south of the site.
- Mere Clough (Bradley Brook) is located approximately 750m to the north west of the site.
- The site is not located on or near a groundwater Source Protection Zone.
- There are no water abstraction points within 1.4 km of the site.
- The area of the site is classed as a minor aquifer by the Environment Agency with soils of a high leaching potential that may transmit a wide range of contaminants.
- The site is within a nitrate vulnerable zone with regard to surface waters.

7.6 Hazardous Installations, Landfill and Waste

The following information relating to hazardous installations, landfill and waste obtained from the Landmark report, published information and the walkover survey can be summarised as follows:

- An authorised Local Authority Pollution Prevention and Controls is located on site which relates to dry cleaning processes and is dated December 2006.
- 3 No. authorised Local Authority Pollution Prevention and Controls are located within 500m of the site relating to two petrol filling stations and the manufacture of timber and wood based products.
- There are no registered historical landfills within 800m of the site.
- Industrial land uses on site include dry cleaners whose status is recorded as inactive and photographic processors whose status is recorded as active.
- Industrial land uses within 100m of the site include a laundrette, dry cleaners, gate manufacturers, optical goods manufacturers, car dealers, printers, food manufacturers and commercial cleaning services.
- There are 2 No. petrol filling station within 500m of the site:
 - Grimshaws Service Station is located 70m to the north west and status is recorded as obsolete.
 - Tesco Service Station is located 300m to the north west and status is recorded as open.
- There are no waste EP OPRA sites within 1000m the site.

7.7 Mining

7.7.1 Coal Mining

The Coal Authority report (ref: 00026553-09) was obtained on the basis that the development site is located within a recognised coal production area. The report confirms the working of seams at depths of 290m and 480m below the site which ceased circa 1971. This information is consistent with the findings of the geological map desk study.

A coal mining subsidence claim was made in March 1995 in relation to the Forester Public House located in the south west of the site. This claim was subsequently withdrawn by the owner Joseph Holts Plc after it became apparent that an agent had made the claim without the authorisation of Joseph Holt Plc who did not wish to pursue the claim. No other issues were raised relating to present or future workings (other than the usual reserved rights for extraction of remaining coal) or undocumented historical shallow mine workings.

7.7.2 Brine Extraction

The site is not subject to past or future ground subsidence from salt or brine extraction.

7.8 Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies in an area unaffected by radon with 0 – 1% of homes at or above the Action Level. On this basis, no protective measures are required in this area.

Map 13 of the Indicative Atlas of Radon in England and Wales contains information on the region in which the site is located and is presented in Appendix 7.

8.0 CONCLUSIONS

8.1 General

The site walkover indicated that the site is presently occupied by the Longfield Shopping Centre comprising low rise retail units and an associated bitmacadam car park plus traditional masonry clad 19th century buildings situated along the Bury New Road frontage. There was no visual or olfactory evidence of any potential sources of contamination observed during the site walkover.

8.2 Geology

The desk study carried out indicated that the upper drift deposits in the area were glacial sands and gravels. Examination of the existing geological maps and Coal Authority records (see sections 7.3 and 7.7) indicated two coal seams worked at depths between 290m and 480m (completed circa 1971) below the site overlain by a sequence of Pennine middle coal measures. Mine workings may therefore be present at depth beneath the site although it is likely that these workings are at a sufficient depth beneath the site in order not to detrimentally affect the proposed retail development of the site. The above statement accords with CIRIA Special Publication 32 (2002) where it is noted that any underlying mine workings should typically have a ratio of 10:1 ratio (competent cover to worked seam thickness) in order to avoid ground instability associated with new building development.

In order to determine the ground conditions with more certainty, it is recommended that boreholes and trial pit excavations are undertaken on site together with associated laboratory geotechnical tests. On the basis of the results of this intrusive investigation (refer to section 8.10 for details), final proposals for structures, roads and sewers can be prepared.

8.3 Contaminated Land Legislative Framework

The assessment of contaminated soils is carried out within the current legal framework, which is based upon the Environmental Protection Act Part 2A and current national planning guidelines. Under this framework, the potential contamination of a proposed development site is a material planning consideration. In addition, land that is deemed harmful to human health or has the potential to pollute waters can be designated as contaminated land and appropriate remediation can be enforced by the Local Authority.

Following the “Way Forward” report undertaken by Department for Environment, Food and Rural Affairs (DEFRA) a new approach to land contamination was issued by DEFRA and the Environment Agency (EA). Two documents have been produced which supersede the previous Contaminated Land Reports (CLR) 7 – 10. The two reports are ‘Human health toxicological assessment of contaminants in soil’ (formerly CLR 9) and ‘Updated technical background to the CLEA model’ (formerly CLR 10) and other supporting documentation including revised toxicological reports.

Broadly, the approach consists of preparation of conceptual models to illustrate how potential contamination (source) can reach (through a pathway) humans or receptors (targets).

As a result of these conceptual models, each of which are site specific, a risk analysis can be carried out to determine the frequency of testing to establish levels of source contamination, possible mobility of those contaminants and the potential hazards those mobilised contaminants could cause to human receptors.

In addition to direct human receptors, water courses, aquifers and agricultural resources must be considered as these are potential indirect pathways to humans.

The government is part way through the publication of a number of updated toxicological reports and associated updated Soil Guideline Values which give guidance on acceptable soil contamination for a limited number of contaminants and further authoritative guidance on the toxicity of other contaminants for risk assessment purposes.

As of March 2009, updated toxicological reports and revised Soil Guideline Values have been published for the following determinands:

- Arsenic
- Nickel
- Selenium
- Benzene
- Toluene
- Ethylbenzene
- Mercury (elemental, methyl and inorganic)
- Xylene (O, M and P)

Where no updated toxicological reports or Soil Guideline Values are available, the existing toxicological reports and associated Soil Guideline Values will naturally be used to classify the risk and toxicity posed by the selected determinands.

In addition, where updated Soil Guideline Values and/or toxicological reports are not available, guidance is available from the Environment Agency on acceptable methods of assessing human health risks utilising recognised methodology developed in the UK and abroad. The means available to assess human health risks and to be utilised on this site are as follows:

Assessment	Means
Production of conceptual models	Human health toxicological assessment of contaminants in soil and Contaminated Land Report 11
Scope of contamination testing	Human health toxicological assessment of contaminants in soil (2009) and DEFRA Industry Profiles
Contamination sampling rates	Contaminated Land Report 4
Laboratory testing	MCERTS Accreditation
Acceptable contamination levels for Arsenic, Nickel, Mercury, Selenium, Ethylbenzene, Toluene, Benzene and Xylenes	Updated Published Soil Guideline Value Reports (March 2009 onwards)
Acceptable contamination levels for Cadmium, Chromium, Lead and Phenol	Current Published Soil Guideline Value Reports (2002 – 2004)
Acceptable levels for other contaminants except cyanide and except where the conceptual model includes dermal absorption	SNIFFER Worksheets
Acceptable contamination levels for cyanide and where the conceptual model includes dermal absorption	RISC v 4.02 and updated technical background to the CLEA model
Assessment of Total Petroleum Hydrocarbons within the above framework as adopted by the Environment Agency	Total Petroleum Hydrocarbon Criteria Working Group and updated technical background to the CLEA model

8.4 Sources of Contamination and Probable Contaminants

The historical Ordnance Survey maps, the Envirocheck report and other environmental information reveal that the site has historically been occupied by a number of potential contaminative sources including dry cleaners, photographic processors and railway land. Embankments located on the site could be indicative of imported made ground deposits of an unknown origin. A number of electrical substations, petrol filling stations and a burial ground within close proximity to the site could be potential off site sources of contamination.

In consideration of the above and the guidance contained in Contaminated Land Report 8 and the appropriate DEFRA industry profile, it is therefore proposed to test for the following contaminants on the site both within the soils and any groundwater encountered during the intrusive investigation works:

Metals and metalloids

Arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, potassium, selenium, vanadium, zinc

Non metals and inorganics

Asbestos, cyanide, sulphate, sulphur, pH

Organic contaminants

Phenol, benzene, toluene, ethylbenzene, xylenes, Total Petroleum Hydrocarbon (TPH) screen followed by Speciated Aliphatic and Aromatic Total Petroleum Hydrocarbon Fractions (TPHCWG) where appropriate, Speciated Polycyclic Aromatic Hydrocarbons (PAH), polychlorinated biphenyls, volatile and semi-volatile organic compounds.

Due to the potential presence of made ground deposits, it is proposed to test for the following ground gases over a minimum three month monitoring period:

Methane, carbon dioxide and hydrogen sulphide

8.5 Pathways for Contamination

Waters

The area of the site is classed as a minor aquifer with soils of a high leaching potential and the overlying drift deposits consist of glacial sands and gravels which may allow the leaching of any on site contaminants into the underlying aquifer. However, the majority of the site will be covered by hard surfaces after the completion of the proposed development with a negligible amount of soft landscaping. It is therefore considered that, due to impermeability of the hardstanding covering the majority of the site, there is minimal risk to the underlying aquifer.

Site Occupants

The pathways along which contamination could potentially reach the targets on site during use after completion of development works are detailed in Contaminated Land Report 10 but can be summarized as follows:

- a) Ingestion of soil and/or dust
- b) Inhalation of soil and/or dust
- c) Dermal contact with soil and/or dust
- d) Inhalation of soil vapours

8.6 Targets of Contamination

Targets for these pathways include the following:

- a) Construction workers

8.7 Conceptual Model for Human Health Risk Assessment

A site conceptual model in the form of a linkage table for the purposes of a preliminary risk assessment for the human health of site occupants has been produced as a result of the probable contaminants, pathways and targets identified in sections 8.4, 8.5 and 8.6 above:

CONTAMINANT	PATHWAY	RECEPTOR
Arsenic	Ingestion of contaminated soil and/or dust	Construction worker
Barium	Dermal contact with contaminated soil and /or dust	Construction worker
Chromium		
Vanadium	Inhalation of contaminated dust	Construction worker
Beryllium	Ingestion of contaminated soil and/or dust	Construction worker
Cadmium		
Copper		
Lead		
Nickel	Dermal contact with contaminated soil and/or dust	Construction worker
Zinc		
Boron		
Selenium		
Inorganic mercury compounds	Inhalation of contaminated dust	Construction worker
Methylmercury		
Cyanide		
Sulphur		
Sulphur	Direct contact with building fabric	Fabric of buildings on and off site
Sulphate		
Complex Cyanide		
pH	Direct contact with building fabric	Fabric of buildings on and off site

CONTAMINANT	PATHWAY	RECEPTOR
Total Petroleum Hydrocarbons	Ingestion of contaminated soil and/or dust	Construction workers
Volatile Organic Compounds		
Semi-Volatile Organic Compounds	Inhalation of contaminated dust	Construction workers
Polycyclic Aromatic Hydrocarbons		
Phenols	Dermal contact with contaminated soil and/or dust	Construction workers
Benzene		
Toluene		
Ethylbenzene		
Xylenes	Inhalation of soil vapours indoors and outdoors	Construction workers
Elemental Mercury		
Polychlorinated biphenyl		
Asbestos	Inhalation of contaminated dust	Construction workers
Carbon dioxide	Inhalation of accumulated CO ₂ gas	Human occupant
Methane	Accumulation in buildings	Human occupant & building
Hydrogen Sulphide	Inhalation of accumulated HS ₂ gas	Human occupant

8.8 Conceptual Model For Waters Risk Assessment

The conceptual model for waters has not been included as it is considered that there is a negligible risk to controlled waters on the basis of a minimal extent of soft landscaping, the low sensitivity of the underlying minor aquifer, the distance of the nearest surface water body to the site combined with the effects of natural attenuation and dispersion.

The site is underlain by a minor aquifer located within the Carboniferous coal measures. The aquifer is regarded as a low sensitivity receptor on the basis that the quality of groundwater located within coal measures with workings is typically poor as a result of the naturally occurring indigenous determinands which comprise the coal measures. There is also an absence of any surface or groundwater abstraction points within 1.4km of the site and the site is not located within a Source Protection Zone.

The Prestwich Clough watercourse is located approximately 300 metres south of the site and therefore it is considered that, due to natural attenuation and dispersion, the development site poses a minimal risk to the water quality in this watercourse.

There is no pathway for vertical migration into the underlying minor aquifer through infiltration as the site is currently and will remain covered by hard surfaces after completion of the proposed development thus preventing any surface waters permeating / filtrating into the aquifer below.

Despite the presence of potential historical contaminative sources on site including railway embankments, dry cleaners and photographic processors, it is considered that there is a negligible risk to controlled waters on the basis of the low sensitivity of the underlying aquifer and the absence of any abstraction points within 1.4km of the site.

8.9 Preliminary Risk Assessment Summary

Human Health

The risk to human health associated with the past and present uses of the site is considered to be low on the basis of the proposed retail development of the site which includes a minimal area of soft landscaping. It is therefore recommended that a relatively low level of environmental testing is undertaken to reflect the risk to construction workers that still exists. It is advised that a Phase 2 investigation should be undertaken as outlined in section 8.10 to include soil testing to determine if any contamination is present at the site. There may be a risk to retail staff and the general public from exposure to ground gases and accordingly a full subterranean gas monitoring programme is recommended prior to the commencement of the development.

Waters / Groundwater

A waters conceptual model has not been included as it is considered that there is negligible risk to controlled waters on the basis that the site will be continue to be covered with impermeable hard surfaces.

As a result of the risks identified, a Phase 2 intrusive environmental ground investigation including contamination testing of soils and ground gases should be undertaken on the basis of this Phase 1 report.

8.10 Scope of Phase 2 Intrusive Geo-Environmental Ground Investigation

As a result of the preliminary risk assessment undertaken, a Phase 2 intrusive environmental ground investigation should be carried out to determine the concentrations of probable contaminants in the ground. This investigation should include the installation of boreholes and excavation of trial pits across the site. Samples of soil and groundwater should be collected and an MCERTS accredited laboratory should undertake chemical composition tests to determine chemical contamination levels.

Due to the proposed retail use of the site, it is not deemed appropriate to undertake intensive sampling on the basis that the development site will generally be covered by buildings / hard surfacing with consequently fewer pathways posing a risk to human health. However, it is considered that a minor risk is still posed to construction workers and that the buildings and their occupants are still potentially at risk from the accumulation of and exposure to ground gases.

On the basis of the above, it is therefore proposed that a Phase 2 intrusive investigation should be carried out on site to include the following elements:

- 5 No. 150mm diameter shell and auger boreholes to a depth of 6m below ground level.
- 2 No. 150mm diameter shell and auger boreholes to a depth of 12m below ground level.
- Gas testing wells to be installed in the above boreholes.
- 15 No. mechanically excavated trial pits to a depth of 2m below ground level.
- CBR testing.
- Standard penetration tests.
- Undisturbed sampling for triaxial testing.
- Plasticity Index tests.
- Moisture content testing of clays in the vicinity of trees.
- Chemical tests for contaminants scheduled in 8.4.

The scope of the proposed Phase 2 investigation works are shown on the site plan in Appendix 8.

9.0 RECOMMENDATIONS

- 9.1 As a result of the risks identified, a Phase 2 intrusive environmental ground investigation including contamination testing of soils, groundwater and ground gases should be undertaken on the basis of this Phase 1 report. In addition, these works should include sufficient boreholes, trial pits and associated laboratory tests to establish the actual ground conditions at the site so that designs for foundations, roads and drainage works can be completed.
- 9.2 The following works comprise the recommended scope of the Phase 2 intrusive investigation:
- 5 No. 150mm diameter shell and auger boreholes to a depth of 6m below ground level.
 - 2 No. 150mm diameter shell and auger boreholes to a depth of 12m below ground level.
 - Gas testing wells to be installed in the above boreholes.
 - 15 No. mechanically excavated trial pits to a depth of 2m below ground level.
 - CBR testing.
 - Standard penetration tests.
 - Undisturbed sampling for triaxial testing.
 - Plasticity Index tests.
 - Moisture content testing of clays around trees.
 - Chemical tests for contaminants as scheduled in section 8.4.

The scope of the proposed Phase 2 investigation works are also shown on the site plan in Appendix 8.

- 9.3 From the results of the Phase 2 work, a Phase 3 numerical risk assessment may be required and the conceptual models refined accordingly.
- 9.4 From the results of the Phase 2 intrusive works, the type of foundation construction and associated bearing capacities should be calculated.
- 9.5 In addition, from the results of the Phase 2 intrusive works, the type of buried services, highway and drainage constructions should be established.

- 9.6 A site specific Flood Risk Assessment to comply with PPS25 will be required by the Environment Agency and should be prepared as part of a separate report.

APPENDIX 1

SITE LOCATION PLANS AND AERIAL PHOTOGRAPH

APPENDIX 2

WALK OVER SURVEY PHOTOGRAPHS

APPENDIX 3

HISTORICAL ORDNANCE SURVEY MAPS

APPENDIX 4

ENVIRONMENTAL MAPS

APPENDIX 5

LANDMARK ENVIRONMENTAL REPORT

APPENDIX 6

EXTRACTS OF 1:10,000 BGS GEOLOGICAL MAP AND COAL AUTHORITY MINING REPORT

APPENDIX 7

EXTRACTS OF RADON ATLAS FOR ENGLAND AND WALES

APPENDIX 8

SITE PLAN SHOWING SCOPE OF THE PHASE 2 INVESTIGATION

APPENDIX 9

PROPOSED DEVELOPMENT PLAN