1. INTRODUCTION

1.1 The Arley Consulting Company Limited (TACCL) has been commissioned by P Casey Developments Limited (PCD) to assess the ground conditions at the former Tops Garage, Hayfield Road, New Mills, High Peak and to determine whether ground contamination issues affect the proposed residential end-use.

1.2 The site is presently derelict following recent demolition works, including removal of underground fuel storage tanks (USTs). Part of the former garage building was attached to an existing dwelling off site and as such, only the part of the building within the site boundary has been demolished. Three USTs were excavated and removed from site by Windmill Demolition Company Limited (WDCL) in January 2005.

1.3 PCD propose to redevelop the site for residential use and a planning application has recently been approved by the local authority subject to conditions. The proposed development has been designed by Jennings Design Associates (JDA) and comprises 4 semi detached residential dwellings and 1 detached dwelling all with front and rear gardens. The northern part of each rear garden will comprise part of the existing embankment sloping towards the north, north-east. The approved layout is presented on JDA Drawing No 212-012, in Appendix K.

1.4 PCD has commissioned Atkinson Peck (AP) to assess the site in relation to structural issues associated with the development including foundation design.

1.5 A site investigation was undertaken on 8 April 2005 to meet the requirements of both TACCL and AP. The investigation comprised 10 trial pits. Representative soil samples were collected and analysed as part of the contamination assessment.

1.6 This report presents the factual data obtained from the ground investigation results together with a quantitative risk assessment and site specific conceptual model to fully assess the ground conditions with respect to contamination and the proposed redevelopment proposals. Issues associated with historical mining will be investigated further and reported separately.

1.7 The conclusions and recommendations presented in this report are the result of our professional interpretation of the information obtained. TACCL reserve the right to amend the conclusions and recommendations if further information becomes available.

2. SITE DESCRIPTION

2.1 Site Location

2.1.1 The former Tops Garage site is located immediately to the west of the Hayfield Road, New Mills and to the east of the southern part of High Hill Road, New Mills, approximately 11 km south-east of Stockport town centre.

2.1.2 The approximate National Grid Reference for the centre of the site is SD 008 860. The site location is shown on Drawing No 05274/01 in Appendix K.

2.2 Surrounding Land Use

2.2.1 The site is situated off Hayfield Road, which provides the main access to the site.

2.2.2 The site is bound to the north, west and south by a mixture of residential properties.

2.2.3 Beyond Hayfield Road to the south-east is an area of marshy open space with a small pond with a minor issue towards the north.

2.3 Site Layout and Description

2.3.1 The site occupies approximately 1,700 m^2 and is currently derelict. Recent demolition works removed the former garage buildings and three USTs.

2.3.2 Part of the former garage building has not been demolished as it lies outside the current site boundary and is attached to an occupied dwelling.

2.3.3 The site is generally covered with hardstanding with the exception of where the USTs have been excavated and removed.

2.3.4 The northern site boundary is marked by a well vegetated embankment. The embankment raises the current site level by approximately 4 m from the land beyond.

2.3.5 Information derived from the petroleum licensing officer indicates there were 6 underground storage tanks (USTs) associated with the former garage activities, 2 of which are located outside the current site boundary. A copy of the UST location plan (Conoco Drawing) is presented in Appendix K.

2.3.6 A site layout plan is presented in Appendix K (Drawing 05274/02).

3. SITE HISTORY

3.1 The history of the site has been established using OS maps supplied by Landmark as well as other available data derived from the Sitecheck Report (1).

3.2 A detailed list of the OS maps inspected is presented in Appendix B, together with a selection of the maps reviewed.

3.3 The earliest available plans date from 1880, which show the site to be comprised of pastureland with some mature trees and a footpath or track in the north of the site. The land to the north appears to be farmland and comprises open fields with a stream or drainage ditch that flows away from the site towards the north. The eastern site boundary is marked by a north-east, south-west trending road marked as '1055'. A number of small buildings are located to the west of the road with open farmland beyond. To the south are some small buildings that sit in between a fork in the road. The westerly fork is located approximate 20 m to the west of the site beyond farmland. The Hayfield Union Workhouse is located approximately 300 m to the south.

3.4 By 1898, the mature trees are no longer present. A small building/structure is located in the centre of the site with an elongated feature that extends towards the north-east of the site. The feature appears to be connected to the stream or ditch to the north. Additional housing has been built approximately 35 m towards the north-east along the eastern boundary of the road. The land immediately beyond the road to the south-east is marked as a marsh.

3.5 The small structure previously noted in the centre of the site has been removed prior to 1922, although the elongate feature remains. New buildings are located adjacent to the southern and western site boundary and beyond the road to the east. Terraced housing has been built either side of the road, approximately 100 m to the south.

3.6 By 1938 the elongate feature within the site is no longer marked and the site appears undeveloped. Housing has been constructed either side of a new road 'Diglands Avenue' located approximately 55 m to the north.

3.7 By 1968 the central and southern parts of the site form part of a garage. The main garage building extends across the southern boundary and into the site by some 10 m. A separate small building is located immediately to the west of the garage building within the site. In addition, a number of small structures appear to be located immediately north of the centre of the site. The western and northern boundaries of the site are marked by an embankment that raises the site from the land beyond. Additional housing has been constructed to the south-west and north of the site. The road immediately to the east of the site is identified as Hayfield Road and a small pond that drains away towards the north is located beyond Hayfield road to the south-east.

3.8 Between 1968 and 1999 the historical maps are incomplete, however very little appears to have changed between these years. All buildings within the site boundary were demolished in January 2005. Part of the former garage building to the south of the site is now occupied as a residential dwelling and remains intact. The demolition works included the excavation and removal of 3 underground fuel storage tanks.

4. ENVIRONMENTAL SETTING

4.1 Published Geology

4.1.1 The site geology is illustrated on the following maps, published by the British Geological Survey (BGS):-

(i) British Geological Survey 1:50,000 scale Sheet 99

(ii) British Geological Survey 1:10,560 scale Sheet SK 08 NW

4.1.2 The above maps indicate that the site is underlain by glacial till (Boulder Clay), which in turn overlies Carboniferous rocks of the Lower Coal Measures (Westphalian A strata).

4.1.3 The glacial Boulder Clay is typically described as a red brown sandy and silty, stony clay with non-persistent sand beds.

4.1.4 The underlying Westphalian A Coal Measures strata generally comprise of undifferentiated strata (mudstone, siltstone and sandstone with coal and seat earth).

4.1.5 The Coal Measures strata are extensively faulted in the area and an unnamed east-west trending fault is located approximately 75 m to the south. In addition another east-west trending fault is located approximately 180 m to the north and a north-south fault is located approximately 200 m towards the west.

4.1.6 The Coal Measures strata have been extensively mined for coal in the region. There are a number of coal seams in the vicinity of the site marked on the geological maps. The outcrop of the Yard Coal seam extends from north to south approximately 210 m towards the east.

4.2 Mining

4.2.1 A Coal Mining Report has been acquired from The Coal Authority (TCA) to assess the potential historical coal mining activated to impact on the site.

4.2.2 The TCA indicate the site is not within the likely zone of influence on the surface from past underground coal workings and records in the TCA's possession do not disclose any damage or claim having been made with regard to subsidence and they have no records of the land being affected by subsidence.

4.2.3 However, the report has identified 1 mine entry (disused mine adit) approximately located beneath the north-western most part of the site.

4.2.4 Additional information has been sought from the Coal Authority with respect to the mine entry. All issues associated with historical coal mining activities will be assessed and reported separately.

4.2.5 A copy of the report is presented in Appendix C.

4.3 Hydrogeology

4.3.1 As stated in Paragraph 4.1.2 above, the site is underlain by Boulder Clay which is in turn underlain by the Coal Measures strata.

4.3.2 The Environment Agency (EA) define glacial till (Boulder Clay) as comprising clay with occasional sand lenses and classify them as a non aquifer or aquiclude (2). These formations are described as "formations with a negligible permeability".

4.3.3 The Coal Measures form a multi-layered aquifer, groundwater being contained in the most permeable horizons such as sandstones. Large areas of Coal Measures have been affected by mining, either directly by coal extraction or indirectly by subsidence deformation.

4.3.4 Strata disturbance caused by mining can have a dominant influence on the groundwater levels and movement. With deep mining, strata deformation may lead to an increase fracturing of competent strata above the mined horizon with an associated increase in permeability. The Coal Measures strata are classified as a minor aquifer.

4.3.5 Information included in the Envirocheck Report (1) indicates the site is not within a currently defined groundwater source protection zone and there are no active groundwater abstractions within 500 m of the site.

4.3.6 A copy of the Envirocheck Report is presented in Appendix D.

4.4 Groundwater Vulnerability

4.4.1 The EA has published a series of groundwater vulnerability maps that cover the whole of England and Wales. The maps identify the vulnerability of groundwater from contamination within a specific area. To assess vulnerability, consideration must be given to the distribution of aquifers, the physio-chemical properties of the overlying soils and to the characteristics of strata in the saturated and unsaturated zone.

4.4.2 The site is detailed on the 1:100,000 scale Groundwater Vulnerability Map 17 Derbyshire and West Staffordshire. This shows the site to be underlain by minor aquifer with overlying soils of low leaching potential.

4.4.3 The characteristics for these soils are where pollutants are present, they are unlikely to penetrate the soil layer either because the water movement is largely horizontal or they have a large ability to attenuate/diffuse pollutants.

4.4.4 The classification of the minor aquifer (Coal Measures) indicates that the rocks are unlikely to have a high primary permeability.

4.4.5 These aquifers can be important for local supply or for providing base flow to rivers. They are considered unlikely to produce large quantities of water for abstraction and the Envirocheck Report (1) indicates there are no active abstractions within the vicinity of the site.

4.5 Hydrology

4.5.1 The site is situated in the catchment area of the River Goyt, which is located approximately 3 kilometres to the north-west of the site.

4.5.2 Although there are no surface waters on site, historical maps indicate that prior to 1938 a drainage ditch was present on the site. The ditch extended northwards towards a further ditch or stream. There is no evidence of any of the above from 1968 onwards.

4.5.3 There is only one established body of water within 250 m of the site. This is a small pond located approximately 22 m to the south-east.

4.5.4 According to the EA's hydrological flood plan the site is not in an area prone to flood at times of heavy or prolonged rainfall (1).

4.5.5 According to the Envirocheck Report (1) there are no water abstractions or discharge consents within 500 m of the site.

4.6 Contaminated Land and Landfill Sites

4.6.1 Information provided in the Envirocheck Report (1) indicates there are no landfill sites, waste management facilities or waste transfer sites within 500 m of the site.

4.7 Petroleum Licensing Information

4.7.1 Information was requested from the County Fire Officer (CFO) at Greater Manchester Fire Service Headquarters on the activities associated with the former fuel station.

4.7.2 The CFO has provided plans showing 4 USTs at the site, although 1 had been decommissioned. The UST locations are detailed on Conoco Drawing presented in Appendix K.

4.7.3 In addition they provided tank pressure test certificates issued following testing by the fire brigade as well as all reported complaints and investigations into fuel spillages and contamination incidents between 1979 and 1992.

4.7.4 Complaints were received by the fire brigade from local residents relating to petrol or diesel smells. On each occasion, a fire brigade officer was sent to investigate. A number of minor leaks and spillages had occurred and were rectified on each occasion. No major incidents are recorded.

4.7.5 Copies of the information provided by the CFO are presented in Appendix E.

4.8 Radon

4.8.1 The Building Research Establishment (BRE) has issued guidance "for reducing the concentration of radon in new dwellings, hence reducing the risk to occupants of exposure to radon" (3).

4.8.2 Using the maps contained in the BRE guidance document it can be seen that the site is not located in an area where:

(i) basic or full radon protection should be provided, or

(ii) where a geological assessment should be carried out.

4.8.3 Landmark report that the site is located in an area where "less than 1% of homes are above the action level" and therefore "no radon protection measures are necessary" (1).

5. DECOMMISSIONING WORKS

5.1 General

5.1.1 Information provided by the petroleum licensing officer indicates there were 6 USTs associated with the former garage activities, however 2 USTs (Tanks 1 and 2) are outside the current site boundary. One UST within the site boundary (Tank 3) was decommissioned and infilled in April 1980.

5.1.2 The location of all the USTs are detailed on Conoco Drawing dates 7/4/79 (Project No 616:3) presented in Appendix K.

5.2 Works Undertaken

5.2.1 WDCL were commissioned by PCD in January 2005 to excavate and remove the USTs from the former Tops Garage, Hayfield Road, New Mills.

5.2.2 Prior to excavation, King TankTechnic Limited (KTL) were commissioned by WDCL to clean and de-gas the USTs for man entry work.

5.2.3 On the 17 January 2005, KTL issued a certificate to declare the following USTs were cleaned and gas free. The following information was provided for each UST: Tank 4 (1,000 gallon), Tank 5 (2,000 gallon) and Tank 6 (10,000 gallon). A copy of the KTL certificate is presented in Appendix E.

5.2.4 The 3 USTs (Tanks 4, 5 and 6) were subsequently excavated by WDCL and removed from site.

5.3 Review of Decommissioning Works

5.3.1 Tanks 4, 5 and 6 have been excavated and removed from the site. However, Tank 3 (decommissioned in 1980) remains in-situ in the south-western corner of the site. In addition, most of the associated fuel pipework system remains in place at the site.

5.3.2 Although they are outside the boundary of the site, there is no information on the status on Tanks 1 and 2.

5.3.3 A number of minor fuel leaks and spillages occurred in the past and the ground surrounding the USTs, associated pipework and the pumps may be contaminated with diesel and/or petrol.

6. POTENTIAL POLLUTANT LINKAGES

6.1 General

6.1.1 This section identifies the potential contaminants of concern, sources, pathways and receptors that may be associated with the site based on its known history and current land use. The information is used to develop a preliminary conceptual model to identify all potential pollutant linkages.

6.2 Potential Contaminants of Concern

6.2.1 Based on previous site use, and current condition a number of potential contaminants may be present on site.

6.2.2 The primary former use of the site was as a garage fuelling station. Information supplied by the petroleum licensing officer indicates there were 4 USTs at the site, 1 of which had been decommissioned (infilled).

6.2.3 Following site clearance works the 3 remaining USTs have also been removed. The decommissioned UST (Tank 3) remains in-situ. However, there may still be residual contamination present associated with the tanks and/or fuel pipelines.

6.2.4 In addition, the site is likely to be overlain by made ground, which would have originally been used as fill material beneath the hardstanding that covered the site. The origins of the made ground is unknown and it's potential to pose a risk to the statutory receptors is therefore also unknown.

6.2.5 For the purposes of this assessment, a general suite of contaminants has been tested for. The actual contaminants tested for are listed in Table 1 (Section 8).

6.3 Potential Pathways

6.3.1 The pathways through which contaminants may reach receptors are in part dependent by the nature and behaviour of the contaminant.

6.3.2 The following potential pathways have been identified; all of which are assessed in the indicative conceptual model:

(i) Direct dermal contact

(ii) Ingestion (eg of soil or home grown produce)

(iii) Inhalation of contaminants in the particulate form

(iv) Volatilisation and migration of volatile organic contaminants through the unsaturated zone of soil leading to inhalation

(v) Breakdown of contaminants generating gaseous phase products (eg carbon dioxide, methane)

(vi) Dissolution or suspension (leaching) of contaminants from site soils into groundwater

(vii) Lateral migration of contaminants in shallow groundwater (dissolved and immiscible phases) providing base flow to surface waters

(viii) Further downward migration of contaminants in shallow ground water (dissolved and immiscible phases) to the underlying aquifer

(ix) Preferential flow pathways may be provided by:

- more permeable layers within the made ground and/or natural strata
- underground services
- piles and foundations

6.4 Receptors

6.4.1 A table is presented in Appendix F that lists the Statutory Receptors and identifies all those to be included in the preliminary conceptual model (PCM).

6.5 Preliminary Conceptual Model

6.5.1 The identified potential sources of contaminants, pathways and receptors have been assessed to establish plausible pollutant linkages, these are detailed within a preliminary conceptual model presented in Appendix F.

6.6 Possible Significant Pollutant Linkages

6.6.1 A number of possible Significant Pollutant Linkages (SPLs) have been identified relating to the potential harm to the health of humans and/or domestic pets both on and off site due to the potential for direct contact with contaminants their ingestion and or inhalation of gas/vapours (link 1, 2 & 3).

6.6.2 There is also the possibility of windblown particulates being inhaled by people/animals both on site and off site (link 4).

6.6.3 Home grown produce could be affected by ground contamination (link 5 & 6).

6.6.4 In addition, possible pollution to perched groundwater could occur through the downward migration of leachable contaminants (link 7).

6.6.5 Property could also be affected by direct contact to high concentrations of contaminants and/or build up of potentially explosive gases/organic vapours (links 8 & 9).

6.6.6 Site investigation is required to identify site specific conditions and assess the risks associated with each identified plausible pollutant linkage.

7. GROUND INVESTIGATION

7.1 General

7.1.1 A site investigation was undertaken by TACCL in March 2005. The investigation was specifically designed to provide information for Atkinson Peck for foundation design as well ground conditions for the assessment of risks associated with contamination.

7.2 Trial Pits

7.2.1 The investigation comprised 10 trial pits excavated to depth between 3 m and 3.7m

7.2.2 Trial Pit Records are presented in Appendix G and a trial pit location plan is presented as Drawing No 05274/03 in Appendix K.

7.3 Ground Conditions

7.3.1 The site is covered by hardstanding, generally concrete with the exception of the areas where the USTs have been removed. The site is overlain by between 1.6 and over 3.7 m of made ground which comprises a mixture of sand, silt and clay with ash, gravel, bricks and occasional glass, concrete, plastic and clay pipe and metal.

7.3.2 The base of the made ground is unproven in the north-west and north of the site, on the edge of the embankment and in the area of the former USTs. Elsewhere the made ground overlays glacial clay (Boulder Clay).

7.3.3 The Boulder Clay is generally described as very soft to firm, sandy, silty clay with gravel and cobbles and occasional coal fragments.

7.3.4 Bedrock was not encountered during the investigation

7.3.5 Trial Pits 1, 2 and 3 all recorded slight hydrocarbon odours associated with the made ground. These pits were located in the southern part of the site, near the location of the former pump islands and the remaining decommissioned UST (Tank 3).

8. LABORATORY TESTING

8.1 Sixteen soil samples were collected during the investigation and 12 representative samples were selected for chemical testing.

8.2 The samples were delivered to the laboratories of Scientific Analysis Laboratories Limited for selected chemical analyses. Where available, testing was undertaken to MCERTS Standard.

8.3 Eight samples were tested from the made ground and 4 from the underlying clay stratum.

8.4 A total of 12 samples were submitted for the determination of total contaminant concentrations. The analytical testing suite is presented below.

Arsenic	Cyanide
Boron	Phenols (total)
Cadmium	Sulphate
Chromium (total)	Sulphide
Copper	Sulphur (elemental)
Lead	pH
Mercury	Total PAH
Nickel	Speciated PAH
Selenium	Total TPH
Zinc	Speciated TPH (ali/aro)[1] - TPHCWG

Table 1: Chemical Testing Suite
[1] seven samples tested

8.5 The results for all samples analysed are presented in Appendix H.

9. CONTAMINATION ASSESSMENT

9.1 General

9.1.1 This section presents the rationale and results of the contamination assessment. The assessment has been undertaken cognisant of the EA Policy Statement (4) and as advocated in the 'Guidelines for Environmental Risk Assessment and Management' (5) a tiered approach has been adopted. The tiered approach is central to Part IIA of the Environment Protection Act (6) and the Town and Country Planning Act (7).

9.1.2 The full rationale for the basis of assessment is presented in Appendix I.

9.2 Introduction

9.2.1 Planning permission has been applied for by PCD to develop the site for a residential end use. The development includes 5 private dwelling with associated front and rear gardens.

9.2.2 The interpretation of soil contamination concentrations have been compared to a range of generic guideline values that have been prepared to allow the assessment of contamination relative to uncontaminated / background levels, and toxicological information and is generally referred to a tier 2 assessment. In this assessment we have utilised the Soil Guideline Values (SGV) (8) for a residential land use with plant uptake.

9.2.3 In accordance with the EA Policy Statement (4), where an SGV has not been developed for a particular contaminant, the assessment proceeds to a tier 3 assessment where site specific assessment criteria have been derived. The tier 3 risk assessment requires the development of an appropriate conceptual exposure model for the site that represents end user behaviour for the particular land use scenario.

9.2.4 The policy statement further states that where the use of a site (allowing for reasonable variation) matches that of one of the standard land uses in CLR10 (9), then the CLR10 conceptual model should be used as the basis for developing any site specific assessment criteria. The basis for the assessment as well as a conceptual exposure model for a residential end use is presented in Appendix I.

9.2.5 The site specific assessment criteria have been derived using the CLEA (10) and SNIFFER model (11). The CLEA model considers the risks to human health via the oral, dermal and inhalation pathways. The SNIFFER model has been used to derive the speciated TPH assessment criteria for each carbon band Tables detailing the toxicological data used in the model as well as the derivation of the assessment criteria are provided in Appendix I.

9.2.6 The outputs from the CLEA and SNIFFER models are presented in Appendix J.

9.3 Contamination Assessment: Made Ground

9.3.1 All chemical test results are presented in Appendix H.

9.3.2 Organic screening was undertaken to determine the presence of hydrocarbons on the site. The screen included speciated total petroleum hydrocarbons (TPH), which includes carbon banding and total polyaromatic hydrocarbons (PAH) which is the sum of 16 common PAH compounds.

9.3.3 All determinands have been assessed against the relevant assessment criteria. The following table summarises the contamination assessment for made ground.

	No. of Samples Tested	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	Number Fail	95th Percentile	Pass / Fail
Arsenic	8	4 - 54	20	3	30	F
Cadmium	8	<1 - 2	2	0	-	
Chromium	8	7 - 100	130	0	-	
Copper	8	55 – 2,200	5,000[1]	0	-	
Lead	8	57 – 3,500	450	1	1,047	F
Mercury	8	<1	8	0	-	
Nickel	8	9 - 84	50	1	51	F
Selenium	8	2 - 15	35	0	-	
Zinc	8	35 - 660	5,000[1]	0	-	
Total Cyanide	8	<1	100[1]		-	
Phenol	8	<1	100[1]		-	
Naphthalene	8	<1 - 12	18[1]	0	-	
Benzo(a)pyrene	8	0.3 - 75	1.15[1]	7	32.6	F
TPH Aromatics						
C8-C10	4	<1 - 30	29.8[1]	0	-	
C10-C12	4	<1 - 200	185[1]	1	167	P
C12-C16	4	1 – 1,300	387[1]	1	1090	F
C16-C21	4	28 – 1,300	493[1]	1	1096	F
C21-C35	4	48 - 590	515[1]	1	506	P
TPH Aliphatics						
C8-C10	4	<1 - <10	20.2[1]	0	-	
C10-C12	4	<1 - <10	103[1]	0	-	
C12-C16	4	<1 - 60	1244[1]	0	-	
C16-C21	4	6 - 560	21711[1]	0	-	
C21-C35	4	8 - 110	21711[1]	0	-	

Table 2: Comparison of Determinand Concentration with Assessment Criteria: Made Ground
[1] Derived Assessment Criteria

9.3.4 The above table indicates the made ground contains elevated concentrations of inorganic and organic contamination.

9.3.5 Based on the information obtained to date there is a significant possibility that significant harm could be caused as a result of the contaminants identified.

9.3.6 In addition, the made ground present across the site has the potential to produce ground gas, although not much biodegradable matter identified. Ground gases have the potential to accumulate in confined spaces and can cause asphyxiation. The risks associated with ground gas should be assessed.

9.3.7 The pH values of the natural soils ranged from 7.4 to 8.1 with a mean value of 7.7 indicating the made ground conditions are generally neutral.

9.3.8 The total sulphate concentrations in the made ground were between <0.06 and 0.89% for all natural soils tested. The results are less than BRE total potential sulphate concentrations (1.2%) for Class DS-3 concrete (12). This information should be used by AP to determine suitable/appropriate concrete mix design.

9.4 Contamination Assessment: Natural Strata

9.4.1 All chemical test results are presented in Appendix H.

9.4.2 All determinands have been assessed against the relevant assessment criteria (as shown on the Table 2). None of the determinands tested for exceeded the assessment criteria, therefore there is no evidence of contamination to the underlying natural strata. The natural stratum does not represent a potential risk to human health or the environment.

9.4.3 The pH values of the natural soils ranged from 7.2 to 7.9 with a mean value of 7.4 indicating the ground conditions are generally neutral.

9.4.4 The total sulphate concentrations in the natural soils were between <0.05 and 0.09% for all natural soils tested. The results are less than BRE total potential sulphate concentrations (0.24%) for Class DS-1 concrete (12). This information should be used by AP to determine suitable/appropriate concrete mix design.

10. QUALITATIVE ASSESSMENT

10.0.1 The contamination assessment summarised above has confirmed the presence of concentrations of contaminants within the made ground at concentrations exceeding the assessment criteria.

10.0.2 To ascertain the risks to sensitive receptors due to the presence of elevated contaminants it is necessary to review the conceptual model following the source-pathway-receptor rationale. This section reviews the statutory receptors defined under Part IIA of the Environmental Protection Act (6) and identifies any associated significant pollutant linkages.

10.1 Human Health

10.1.1 Pollutant linkages have been identified in the preliminary conceptual model with respect to risks to human health for a residential land use.

10.1.2 Elevated concentrations of contaminants have been identified within the made ground. A number of potential pathways exist with regard to the contaminants identified and the proposed residential end use which include the following:

(i) Ingestion of soil and/or dust

(ii) Ingestion of soil attached to vegetables

(iii) Consumption of home grown vegetables

(iv) Vapour inhalation (indoor)

10.1.3 Based on the information obtained to date there is a significant possibility that significant harm could be caused as a result of the contaminants identified, the presence of a pathway and a receptor. In this scenario the receptor could be either future site users or construction workers. Remediation and/or mitigation measures are therefore required.

10.2 Controlled Waters: Groundwater and Surface Water

10.2.1 No surface waters are located at the site and only 1 minor groundwater seepage was encountered during the investigation.

10.2.2 In the southern parts of the site the base of the made ground was proven. The underlying natural strata comprised Boulder Clay which is assumed to be present across the whole site. Perched groundwater was not encountered during the investigation and is not considered to be present beneath the site.

10.2.3 The site is underlain by Coal Measures strata which the EA classify as a minor aquifer. The site is not within a source protection zone and there are no licensed abstraction wells within 500 m of the site.

10.2.4 With respect to the minor aquifer, the likelihood of the contaminants of concern causing significant pollution to the groundwater is considered to be negligible and the detrimental effects on the existing groundwater quality would be minimal.

10.3 Flora and Fauna

10.3.1 Flora and fauna are only deemed to be a statutory receptor if certain criteria are satisfied as defined in Part IIA. An ecological system or living organism must form part of a system within certain sensitive locations, for example; 'a Site of Special Scientific Interest (SSSI) under section 28 of the Wildlife and Countryside Act 1981(13); or any nature reserve established under section 21 of National Park and Access to Countryside Act 1949' (14). More detailed information is documented in the DETR 02/2000 circular (15).

10.3.2 The Hayfield Road site does not support any areas that fall within the ecological systems criteria defined under Part IIA.

10.4 Property

10.4.1 Part IIA of the Environment Protection Act (6) refers to two definitions of property, as summarised below:

(i) 'Building means any structure or erection and any part of a building including any part below ground level, but does not include plant or machinery comprised in a building'.

(ii) 'Crops, including timber; produce grown domestically or on allotments for consumption; livestock; other owned or domesticated animals; wild animals which are the subject of shooting or fishing rights'.

10.4.2 Following site clearance and demolition work, there are no buildings within the site boundary. The proposed development is to include 4 semi-detached and 1 detached house.

10.4.3 The contaminants of concern identified represent a significant risk to home grown produce. The contaminants can be taken-up by plants which could affect their growth potential.

10.4.4 In addition, the mine adit identified on TCA mining report may represent a potential risk to property through subsidence. The risks associated with historical mine workings will be assessed and reported separately.

11. CONCLUSIONS

11.1 TACCL was commissioned to characterise the ground conditions at the former Tops Garage, Hayfield Road, New Mills to identify all potential risks associated with contamination to the proposed residential development.

11.2 Following a detailed assessment of the findings, the following conclusions have been made:

(i) The site occupies approximately 1,700 m² and has a history of industrial, potentially contaminative land use. Since 1968, the site has been used as a fuel filling station (garage).

(ii) The site lies to the west of Hayfield Road and is surrounded to the north, west and south by a mix of residential properties. Beyond Hayfield Road to the east is an area of marshy open space with a small pond draining towards the north.

(iii) PCD propose to develop the site for a residential land use. The approved development comprises 4 semi-detached and 1 detached house with associated front and rear gardens. The rear gardens will include part of the existing embankment that slopes towards the north, north-east.

(iv) Recent site clearance works included demolition of all site buildings and removal of 3 USTs associated with the former garage activities. However, 2 USTs remain beneath adjacent land to the south-west.

(v) The site is overlain by made ground, which varies between 1.6 and over 3.7 m in depth. The base of the made ground is unproven in the north-west and north of the site (on the edge of the embankment) and in the area of the former USTs. Elsewhere the made ground overlays glacial clay (Boulder Clay).

(vi) The made ground generally comprises a mixture of sand, silt and clay with ash, gravel, bricks and occasional glass, concrete, plastic and clay pipe and metal.

(vii) Geological plans indicate the underlying bedrock comprises the Carboniferous rocks of the Lower Coal Measures (Westphalian A strata).

(viii) A Coal Authority mining report has identified a mine entry (adit) near the north-west corner of the site. Information has been sought on the exact location, depth, condition of the identified mine entry.

(ix) Following a site specific quantitative risk assessment, there were no contaminants of concern identified within the natural ground. However, the following contaminants of concern have been identified in the made ground:

- Arsenic
- Lead
- Nickel
- Benzo(a)pyrene
- TPH (aromatics)

(x) The above contaminants of concern are considered to be widespread throughout the made ground and represent a risk to human health and domestic produce. The most significant pathway for human health is through the ingestion of soil/dust, consumption of home grown vegetables and indoor vapour inhalation.

(xi) There is no surface water located on the site and perched groundwater was not recorded.

(xii) The EA classify the underlying aquifer as 'minor'. There are no groundwater or surface water abstractions within 500 m of the development site and the site is not located within a source protection zone.

(xiii) The site is not within an area which is affected by radon gas.

11.3 On the basis of these conclusions it is our professional opinion that the site does represent a significant potential hazard with regard to human health and home grown produce, given the proposed residential end use.

11.4 Based on the information derived to date and with consideration of the proposed residential end use, remediation and/or mitigation measures will be required.

12. RECOMMENDATIONS

12.1 Following the TACCL investigation at the Hayfield Road site, New Mills and the assessment of ground conditions with respect to the potential redevelopment of the site for a residential land use, and based on the information currently available, we recommend the following:

(i) Risks associated with the mine entry should be further investigated and assessed.

(ii) All new builds should include full gas and vapour mitigation measures within their design in accordance with Characteristic Situation 3 of CIRIA 149, as modified by Wilson and Card (13).

Gas measures should include a well constructed suspended or ground slab, vapour resistant membrane and passively ventilated underfloor sub-space.

(iii) The rear garden areas of all houses should comprise of a minimum of 1 m of clean, inert, uncontaminated material suitable for use.

It may be impractical to place 1 m of clean, inert fill on the steeply sloping embankment area at the rear end of each rear garden. If this is the case, alternative measures will be designed and agreed with the local authority prior to implementation.

(iv) The front garden areas of all houses should comprise a minimum of 0.5 m of clean, inert, uncontaminated material suitable for use.

12.2 In addition to the above, all service trenches should be backfilled with clean material. Excavated soils/made ground should not be re-used.

12.3 The specification for all service pipework should be sought from the appropriate service providers.

12.4 AP should provide advice regarding the use of sulphate resisting Ordinary Portland cement for cast-in-situ concrete. However, all total sulphate concentrations recorded within the made ground are less than BRE potential sulphate concentration for Class DS-3 concrete (12).

12.5 All remediation works should be agreed in advance with the planning authority and should be undertaken in accordance with a detailed Method Statement.

12.6 Any material removed from the site should be disposed of in accordance with appropriate legislation and regulations, including the Duty of Care Regulations (16).

12.7 Any imported material should be inert, uncontaminated and suitable for a residential land use in accordance with appropriate guidance (see Appendix I).

12.8 Detailed records of all remediation works undertaken should be maintained by the developer and a completion report should be prepared on completion of the works.

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