CAPITA

Murton Gap

Phase 1 Geo-Environmental Desk Study

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1/ Introduction

1. Introduction

1.1 Background

1.1.1 Capita Property & Infrastructure Ltd ("Capita") was commissioned by North Tyneside Council to undertake a Phase I Geo-Environmental Desk Study for the potential residential development of the Murton Gap site in North Tyneside.

1.1.2 A site location and existing site layout plan is presented on drawing MG-01 in Appendix A.

1.2 Proposed Development

1.2.1 Detailed development plans have not yet been made available however it is understood that Murton Gap is one of two sites which have been identified in the 2015 Draft Local Plan as together having the potential to accommodate up to 4,500 required new homes.

1.2.2 It can be assumed that the development would include the construction of mixed style residential housing, with associated gardens, landscaping, driveways and access roads.

1.3 Objective and Scope of Work

1.3.1 The objective of this assessment was to collate and review the available geo-environmental information to determine potential constraints on the development proposals such as ground contamination risks and geotechnical hazards.

1.3.2 To achieve the objective the following scope of work was defined and undertaken:

- A site visit to establish the site setting and visible ground conditions (photographs from a site reconnaissance are presented in Appendix B);
- Review of published and readily available information concerning the site:
  - Recent Ordnance Survey (OS) Map;
  - British Geological Survey (BGS) Published Maps;
  - A site-specific GroundSure Report (Appendix C);
  - OS Historical Map Archive (included in the GroundSure Report – Appendix C);
  - BGS GeoIndex Service (borehole logs reproduced in Appendix D);
  - A site-specific Coal Authority Report (Appendix E); and
- Develop a preliminary Conceptual Site Model (CSM) that relates the anticipated ground conditions at the site to the proposed development.
- Establish areas of potential concern based on identified risks and/or potential risks.
- Identify any actions (e.g. intrusive site investigation) required to reduce risks and/or minimise any uncertainties.

2. Site Characteristics

2.1 Site Location

2.1.1 The subject site occupies an area of land approximately 8km northeast of Newcastle City Centre. The site lies south of South Wellfield, east of Shiremoor and West Allotment, north of New York and west of the Monkseaton.

2.1.2 The site is bounded by the A191 to the south, residential properties of Shiremoor to the west, the Metroline to the north and residential properties, a school and playing field to the east.

2.1.3 The approximate centre of the subject site is located at Ordnance Survey National Grid Reference 433055, 570875. An indicative postcode for the site is NE27 0LR.

2.1.4 A site location and existing site layout plan is presented on Figure 1 in Appendix A.

2.2 Site Description

2.2.1 With reference to drawing MG-01, the subject site is an irregular shape in plan; covering an area of approximately 247.1ha.

2.2.2 The majority of the site area is formed of a number of fields (defined by various discontinuous hedgerows, field drains and tracks), interspersed with mature trees.

2.2.3 A number of above ground structures/developed parcels are currently present on the site, including:

- Murton Village located in the centre of the site and Murton Lane connecting the village to New York;
- Moorlands Farm and Murton Nurseries located in the southwest of the site;
- Allotment gardens along the central southern boundary of the site;
- Electricity substations located along the central southern boundary of the site;
- Rake House Farm located to the southeast along the southern boundary of the site; and
- Murton Steads Farm located to the northeast of the site.

2.2.4 The topography of the site is ostensibly level, with only minor undulations noted.

2.2.5 Access can be gained to the site at various locations around the perimeter. Murton Lane runs from New York to Murton Village. Two tracks run across the site towards Murton Village; to the southeast from Shiremoor and to the southwest from Monkseaton. A number of public footpaths are also present within the site boundaries.

2.2.6 Photographs of the site taken during the site walkover survey are presented in Appendix B.

2.3 Surrounding Land-use

2.3.1 To the **NORTH**, the subject site is bounded by the Metro line, beyond which lies further open fields and residential properties of South Wellfield.

2.3.2 To the **NORTHEAST**, the subject site is bounded by residential properties, a school and playing fields of Monkseaton.

2.3.3 To the **SOUTH**, the subject site is bounded by the A191 and residential properties of New York, beyond which lies further residential properties, North Tyneside General Hospital and New York Industrial Park.

2.3.4 To the **WEST,** the subject site is bounded by residential properties of Shiremoor, beyond which lies residential housing.

3. Environmental Setting

3.1 Geology

3.1.1 The regional geological information pertaining to the site was gained from a review of the BGS Digital Geological Map of Great Britain (DiGMapGB-50; available as a Web Map Service) and a 1:10 000 Series Solid and Drift Geology Map (NZ 37 SW). Additional reference has been made to a site-specific GroundSure Report (reproduced within Appendix C).

3.1.2 According to the GroundSure report, artificial infilled ground is present across much of the eastern site area (refer to Section 3.2 for further details).

3.1.3 The subject site is indicated to be underlain by Drift Deposits of (Devensian) Glacial Till.

3.1.4 The subject site is underlain by the Carboniferous Pennine Middle Coal Measures (PMCM), comprising of undifferentiated strata of mudstone, siltstone, sandstone and subordinate coal seams. Within the south-western site area prominent unnamed sandstone units are indicated to be present.

3.1.5 A number of coal seams are indicated to subcrop (beneath the Drift) across the subject site in a northwest-southeast trend throughout this geological sequence. The PMCM strata are indicated to dip to the southwest. 1:10 000 geological mapping has indicated that a significant area of open cast coal mining has taken place within the eastern section of the subject site. Furthermore 11 historic shafts are located across the subject site on the BGS map. The generalized vertical geological section provided on the BGS mapping suggests the coal seams may range in thickness from 0.2m up to 3.9m; with Bensham (also known historically as the “Main” or “Five Foot”) and the High Main indicated to be the thickest reaching up to 1.8 and 3.9m respectively. Coal mining is further assessed within section 3.2 of this report.

3.1.6 The Tinouth Dyke is recorded along the south west boundary, and is believed to be compositionally a microgabbro, a fine grained plutonic rock. The dyke trends northwest – southeast.

3.1.7 One major fault is recorded on site. The Ninety Fathom Fault crosses the site in an east-west orientation with the downthrown side to the north.

3.1.8 Additional ground condition information pertaining to the site and surrounding area (and indicative of deeper ground conditions on site) has been obtained from a search of the BGS GeoIndex service. The following exploratory logs have been identified:

- NZ37SW/36. Located in the central site area in the northeast of Murton Village, the record is for a borehole advanced to a depth of 258m in 1953. Boulder Clay is recorded to a depth of 2.9mbgl. Alternating sandstone, siltstone and shale is then recorded to the base. The Metal coal seam is recorded at 7.8m and is indicated to be 0.8m thick. The Yard seam is recorded between 30.2m and 30.9mbgl. The Bensham seam is recorded between 58.2 and 59.7mbgl. Further minor coal was recorded at greater depths.
- NZ37SW/633-637. Located along the western site boundary, the record is for a number of window sample boreholes formed to a maximum depth of 8.2mbgl in 2006. Between

0.25-0.45m of topsoil was recorded and was directly underlain by firm to stiff sandy gravelly clay with some sand bands. Completely weathered mudstone or sandstone was generally recorded at depths between 3.0 and 5.3mbgl.

- NZ37SW/632. Located in the north-western corner of the site, the record is for a cable percussion borehole with rotary follow on advanced to a depth of 25.1mbgl in 2006. Topsoil was recorded to a depth of 0.3mbgl and was directly underlain by stiff sandy gravelly clay with occasional cobbles. Rotary drilling commenced at 8.0mbgl. Moderately strong limestone was recorded between 8.6 and 12.50mbgl and was underlain by moderately strong siltstone to 23.30mbgl. Moderately weak mudstone was then recorded to the base.
- NZ37SW/652. Located approximately 40m northeast of the site, the record is for a rotary borehole advanced to a depth of 30mbgl in 1993. Topsoil is recorded to a depth of 0.2mbgl and overlies alternating stony clay and sand to a depth of 10.3mbgl. Alternating sandstone and hard shale is then recorded to the base. Various bands of coal were recorded but no workings or cavities were noted.

3.1.9 Given the size of the subject site, the information provided in these boreholes can only provide an indication of the likely geology in the area. The borehole logs are reproduced in Appendix D.

3.1.10 The site is in a lower probability radon area, as less than 1% of homes are above the action level. No radon protective measures are therefore considered necessary for new structures at this time.

3.2 Coal Mining, Mineral Extraction and Subsidence

3.2.1 The GroundSure report and a review of the 10,000 geological map of the area have identified the subject site as being "*in an area which may be affected by coal mining activity*". Furthermore the underlying solid geology of the Carboniferous Middle Coal Measures is associated with productive coal deposits.

3.2.2 The Coal Authority (CA) Report presented in Appendix E states that the subject site is in the likely zone of influence of workings from 5 seams of coal at shallow depth to 160m, and last worked in 1964.

3.2.3 The site is not in an area likely to be affected at the surface by present or future underground coal workings; however reserves of coal exist in the local area which could be worked at some time in the future.

3.2.4 The CA report also states that there are 18no known mine entries within, or within 20 metres of the site boundary. The locations of these are shown in the CA plan of the area (Appendix E). A single entry has been filled to an unknown specification; no treatment details are recorded for the other mine entries.

3.2.5 The CA report also states that the subject site is within the bounds of an historic open cast coal mine. The site is not in an area from which coal is currently being removed by opencast methods or likely to be affected by future opencast coal mining.

3.2.6 A damage notice or claim for alleged subsidence damage was made in November 2008 for buildings at Murton Equestrian Centre, The Bridle, Murton; however the claim was rejected. One further claim is present within 50m of the site boundary.

3.2.7 Finally the CA report states that there are no records of mine gas emissions within the site boundary.

3.2.8 According to the CA interactive map viewer, the southeast of the site is within an area of past surface mining. This coincides with the opencast coal mine shown on BGS mapping and the area of infilled ground highlighted in the GroundSure report. The Yard, Bentinck, Fiver-Quarter and Metal coal seams sub crop beneath the thin drift (Glacial Till) in this area.

3.2.9 According to the CA interactive map viewer, the central and western area of the site is within an area of recorded past shallow coal mine workings running in two bands in a northwest-southeast orientation. The Yard, Bentinck, Fiver-Quarter and Metal coal seams sub crop beneath the Glacial Till in the northernmost band of shallow coal mining. The High Main coal seam subcrops in the second band of recorded shallow coal mine workings.

3.2.10 A Geotechnical Hazards Constraints Plan is presented on drawing MG-02 in Appendix A. This has been produced using information provided on 1:10 000 and 1:50 000 geological maps, a Coal Authority report, mine abandonment plans (obtained via a visit to the CA records office in Mansfield), the CA Interactive Map Viewer and historical mapping.

3.2.11 Pillar and stall workings of the Yard coal seam are present across much of the central and south-western areas of the site. The Yard seam was worked at known depths of 91mbgl in the southwest, to sub-crop in the northeast. A note on the abandonment plans indicate the seam was worked to the northeast until it pinched out to clay (assumed to be Glacial Till at shallow depths of around 5-10mbgl but potentially thinner than this in the far north of the site).

3.2.12 With the exception of the eastern margins, the Bensham coal seam was worked across the entire site area at known depths of 48-150mbgl, however the abandonment plans map the workings close to the subcrop of the seam in the northeast of the site indicating shallow workings in this area. The ‘Main’ or ‘Five Foot’ seam in the abandonment plans are understood to relate to early workings of the Bensham seam.

3.2.13 A number of pits (‘D’ Pit, ‘E’ Pit, Old Pits and John Pit) are mapped on or close to the site. These pits were advanced to the High Main coal seam, however no abandonment plans were available for the High Main workings and therefore we have no further information on these workings below the site.

3.2.14 In the north of the site the Yard coal seam has been worked to subcrop and the Bensham seam has been worked close to subcrop at shallow depths below the drift deposits. Given the depth of these workings in the central and southern site areas any associated ground movement should have ceased by now and the primary concern therefore relates to the historic shallow workings at or close to the surface in the north. Furthermore the potential also remains for shallow workings in the High Main seam in the southeast of the site.

3.2.15 The natural hazards findings in the GroundSure Report indicates that there is:

- "Negligible" risk from:
  - Soluble Rocks stability hazards; and
- "Very Low" risk from:
  - Landslide Ground Stability Hazards;
  - Collapsible Ground hazards; and
  - Running sand hazards.
- "Low" risk from:
  - Shrinking or swelling clay ground stability hazards.
- "Moderate" risk from:
  - Compressible Ground hazards;
  - Natural Ground Subsidence.

3.2.16 The moderate risk rating indicates a significant potential for compressibility problems. This has been allocated to the site due to the presence of an area of worked out open cast coal mining to the east of the site.

3.3 Hydrogeology

3.3.1 According to information presented in the GroundSure Report, the underlying superficial Glacial Till deposits are classified as "Unproductive Strata". These drift deposits with low permeability that have negligible significance for water supply or river base flow.

3.3.2 The Bedrock is classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

3.3.3 A single dyke (microbabbro) in the south-western corner of the site is classified as a Secondary undifferentiated Aquifer. It has not been possible to attribute either category A or B for this dyke. The strata in question have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

3.3.4 No groundwater abstractions are located within 1km and the site does not lie within a Source Protection Zone.

3.3.5 The majority of the site been classified as having a low leaching potential to minor aquifers, owing to the presence of impermeable Glacial Till recorded at the subject site. Glacial till will prevent the vertical migration of water to the minor bedrock aquifer. However two discreet entries of high leaching potential are recorded at the site which are likely to relate to the area of infilled ground to the east which can be assumed to be permeable.

3.4 Hydrology

3.4.1 Two surface watercourses are present on the subject site, as shown on OS mapping. These are unnamed tertiary rivers which are shown to flow in a north eastern direction from the northwest and central areas of the site. It is anticipated that any shallow groundwater would flow in a north eastern direction ultimately towards the North Sea. A number of further field drains are also located in the east of the site.

3.4.2 In consideration of the local topography and the absence of widespread hardstanding, a degree of infiltration of rainfall is likely with any residual surface water run-off from the site entering the local land drainage system.

3.5 Potential Flood Risks

3.5.1 Two surface water features are recorded, and are located centrally and to the northwest of the subject site. Both appear to flow in a north easterly direction towards the North Sea, approximately 2.3km from the site. Neither feature has been awarded a flood risk rating.

3.5.2 The site itself is situated in an area considered to be at a very low risk of coast or river flooding. A very low risk rating indicates that the site has a less than 1 in 1000 chance of flooding in any given year. The site does not benefit from any form of flood defences or flood storage.

3.5.3 The site however is considered to be within an area which is susceptible to groundwater flooding, which primarily relates to natural superficial deposits beneath the subject site.

3.6 Landfill and Waste Management Activity

3.6.1 According to the GroundSure report there is 1no EA landfill located within 500m of the subject site, on Benton Road, West Allotment approximately 345m to the south west. The site is authorised to accept household, commercial and industrial waste, however the status of the landfill is recorded as ‘closed’.

3.6.2 There are 4no historic EA landfills located within 500m of the subject site. The nearest entry relates to a site approximately 70m to the south at New York, Norham Road North. Authorised waste included industrial, commercial and household. The licence for this site was issued on 09/08/1979 and surrendered on 01/05/1981. Other EA historic landfills within 500m landfills are recorded as receiving household and inert waste.

3.6.3 There are 3no records of EA licensed waste sites within 500m of the subject site. The nearest entry relates to a clinical waste transfer station operated by North Tyneside Health Care NHS Trust located at Rake Lane approximately 160m southeast of the subject site. Further entries relate to a landfill sites approximately 195m and 395m south of the site.

3.7 Industrial Land Use Information

3.7.1 Current Land Use data presented in the GroundSure Report indicates that there are 8no “potentially contaminative industrial sites” on-site and a further 47no located within a 250m search buffer of the site.

3.7.2 The on-site records relate to 3no electricity substations, 2no tanks, a piggery, civil engineers and manufacture of mobility equipment.

3.7.3 The surrounding land-use generally relates to commercial or light industrial processes and services including:

- Electrical features – 15no electricity sub stations and 1no pylon.
- Storage facilities, including depots.

- Manufacture of industrial and consumer products.
- Vehicle repair, testing, servicing and sales.
- Petrol and fuel stations – 1no located approximately 118m southwest.
- Gas Features – 1no gas governor and 1no gas meter house.

3.8 Environmental Permits, Incidents and Registers

3.8.1 There are no recorded historic IPC authorisations, Part A(1) and IPPC Authorised Activities, entries of category 3 or 4 Radioactive Substances Authorisations, Records of COMAH & NIHHS sites or sites determined as Contaminated Land under Part 2A EPA 1990 within a 500m radius of the site.

3.8.2 One entry of List 1 Dangerous Substance Inventory Sites is recorded within 500m of the site, relating to Northumbria Plating Shiremoor located approximately 130m south of the site, regarding Mercury and Cadmium.

3.8.3 4no entries of List 2 Dangerous Substance Inventory Sites are recorded within 500m of the site, the nearest of which relating to Cookson Fukuda Ltd approximately 113m south of the site, regarding Chromium, Copper, Nickel and Zinc.

3.8.4 15no entries of Part A(2) and Part B Activities are recorded within 500m. The nearest entry is 88m southwest of the site at the Gotec industrial unit relating to rubber processing, adhesive coating and the coating of metal and plastic; however the part B permit is now revoked. The nearest active entry is 112m south of the site at New York Service Station, relating to unloading of petrol into storage.

3.8.5 3no discharge consents are located within 500m of the site. 2no of these entries are recorded onsite. Both entries relate to active final/treated effluent sewerage discharges at Murton Steads Farm, and the Rake House Farm office complex. The nearest offsite entry relates to a historic sewerage discharge, at Shiremoor House Farm, 444m south of the site.

3.8.6 National Incidents Recording System List 2 has highlighted 1no incident within 500m of the study site. This relates to inorganic chemicals/products at a site approximately 118m southeast, leading to a Category 3 (Minor) impact to water.

3.9 Ecology

3.9.1 With respect to the specific definition of Contaminated Land, the site does not lie within 1km of one of the following *sensitive* sites: Site of Special Scientific Interest (SSSI), National Nature Reserve, Marine Nature Reserve, Ramsar Site, Special Area of Conservation, Special Protection Area or World Heritage Site. However 1no Local Nature Reserve (LNR) is located within 1km of the subject site. This relates to the Silverlink Biodiversity Park approximately 173m to the southwest of the site. The North East Greenbelt is also located approximately 12m north of the site.

4. Site History

4.1 Historical Map Review

4.1.1 The following summary of the site's history is based on a review of historical 1:10000, 1:10560, 1:2500, 1:1250 and 1:500 scale Ordnance Survey maps as presented in the GroundSure Report (presented in Appendix C), as well as internet sources.

4.1.2 With reference to the available historical maps, the subject site has largely comprised fields separated by hedgerows and several public footpaths from 1854 (the earliest available map) to the present day. The predominant land uses have included agriculture and coal mining.

4.1.3 Noteworthy features of the subject site area are as follows:

- Murton Village is located centrally onsite, and predates 1854 historical mapping. A number of presumed residential dwellings and agricultural structures are displayed. East Farm and North Farm are present within the village. Two ponds are recorded, one to the north and one to the south of the village. Both ponds are no longer recorded in 1921 mapping and are presumed to have been in-filled. Further residential dwellings are constructed prior to both 1976 and 1993. The village remains in this configuration to the present day. To the south east of the village, the Murton cottage and Woodbine cottages with a pond are recorded until 1955 and 1964 respectively, until their demolition. Both areas are then utilised as allotment gardens and agricultural land. The pond was displayed until the 1920 mapping edition.
- An area recorded as 'Philadelphia' is present in the south west of Murton village. 1859 mapping identifies a quarry and a shaft and a number of associated above ground structures. The shaft and building are no longer recorded as of 1920, and buildings are presumed to have been demolished. The area is later utilised as allotment gardens from 1938. The quarry is shown until 1955, and is presumed to have been in filled. The Murton Nurseries are constructed prior to 1955 mapping, which later undergoes various minor extensions in 1993. Two ponds are recorded in close proximity within local agricultural land on mapping predating 1859 and 1920. Both are presumed to have been in filled.
- Within agricultural land in the north west of the site, two field drains are recorded from 1854 to the present day. Both appear to flow in a north eastern direction towards the North Sea. A powder magazine (gunpowder storage) is recorded within agricultural land from 1859 to 1920 and is thought to be associated with the coal industry at the nearby Murton coal pits. A pond is displayed from 1859 and remains to the present day. To the far north of the site a spring is recorded in 1897 along with a number of buildings identified as Dickeys Holm, all structures are presumed to have been demolished prior to 2014, when they are no longer recorded.
- 1938 mapping identifies the Burnt House Nurseries along the north eastern boundary. Tanks are recorded from 1954 until 2001. All structures are no longer recorded and are presumed to have been demolished.
- The Murton Steads Farm is located centrally on the subject site, to the east of Murton village, and is shown from 1860 to the present day. 1993 mapping indicates an extension of the farm. A Pond is displayed to the south west of the farm building until 1920, when it is no longer recorded and presumed infilled.
- A substation is recorded in the south of the subject site from 1938, and remains on site to the present day.

- A significant area in the east of the site is recorded as the Rake Lane Drift mine from 1955 to1966. Tanks are recorded to the south of this area. Following the closure of the mine, the land use is returned to agriculture. However two field drains are now present, and flow in a north eastern direction towards the North Sea.
- The Rake House Farm is shown from 1859 mapping. The farm was redeveloped commercially as offices in 2009.
- Overhead electricity lines are shown on mapping from 1993. These trend northeast-south west across the northern section of the site.
- Rake Lane is present to the very east of the site from 1859. 1977 mapping indicates the roadway to have been straightened. The road then forms the south-eastern site boundary.

4.1.4 The development of the surrounding area has undergone more extensive change throughout the mapped records; details of which are outlined in the following table:

Map Dates	Approximate Location	Description/comments
c1858	30m South West	Backworth Colliery. The colliery is present along with associated infrastructure including a number of railway lines; a substation; 2no air shafts, a main shaft (Algerton Pit); 1no tank; 1no pond and several spoil heaps. The Colliery is no longer recorded on 1973 mapping and is presumed demolished. In 1993 the site is redeveloped as the Algerton Industrial estate.
c1954-1977	30m West	A substation is observed from 1954 to 1977 when it is no longer recorded and presumed demolished. The land surrounding the substation remains undeveloped.
c1858 -c1955	90m West	John Pit. A small scale mining operation is recorded from 1854, with a single shaft and pond. The Shaft is no longer recorded from 1955; however the pond remains until 1967. Following this the pond is no longer recorded and presumed infilled. No further development is shown on historical mapping, and the area of the pond is utilised as landscaped area.
c1967-c1993	10m West	An unnamed factory and substation is identified in 1967 mapping. In 1993 the unit is redeveloped into a retail park with associated car parking features.
c1854-c1938	250m West	A pond is recorded within presumed agricultural land from 1854 mapping. From 1938 the pond is no longer recorded and presumed infilled. In 1954 the area is redeveloped as residential dwellings.
Pre1895	Immediately North	A railway is recorded along the northern boundary from 1895 mapping. While the railway line is present to this day, it now forms part of the Newcastle Metro line.

Map Dates	Approximate Location	Description/comments
c1858 –c1932	15m South	A smithy is recorded from 1858 until 1932. The building is no longer recorded as a smithy, presumably due to a change in occupation. The surrounding land is utilised by terraced housing. The structure is no longer displayed and is presumed to have been demolished in 1994.
c1930 & c1960	Omnidirectional Adjacent	The surrounding local area has undergone significant phases of urbanisation with residential estates constructed in the 1930's and 1960's.
c1955-c1966	10-350m south east	Although not obvious from historical mapping, 1:10 000 geological mapping illustrates a section of the Rake Lane Drift Mine which was present within land immediately to the south east of the site from 1955. 1966 mapping no longer displays any evidence of mining activities and the land use appears to be agricultural. In 1983 the land is redeveloped as a hospital.
c1954-c1993	Immediately North East	Allotment gardens are recorded from 1954 mapping adjacent to the north east site boundary. The land is redeveloped as residential dwellings with a sub station from 1993.

NOTE: All locations are approximate; measured from the nearest site boundary.

4.2 Summary

4.2.1 With reference to the available historical maps, Murton Village is the most prominent feature; located centrally onsite. A number of cottages and farms have existed onsite but have been demolished. Allotment gardens have commonly developed in areas of former buildings.

4.2.2 Numerous ponds have existed throughout the subject site; the majority are no longer recorded and are presumed to have been infilled or drained by field drains.

4.2.3 A powder magazine was present within agricultural land to the northwest of the subject site, and is believed to have been associated with the extensive coal industry both onsite and within the local area.

4.2.4 The east of the site formed the Rake Lane Drift Mine from 1955 to 1964. Upon the mines' closure the affected land returned to an agricultural land use. A substation is present to the south of the former open cast mining area.

4.2.5 To the south of Murton Village, mine shafts and a quarry are located on historical mapping until 1920.

4.2.6 Tanks associated with the Burnt House Nurseries were identified along the north eastern boundary from 1954 to 2001.

4.2.7 Much of the site area has remained undeveloped to the present day and has not been subjected to potentially contaminative land uses; therefore the contamination potential for these areas is considered to be Low.

4.2.8 However the following potentially contaminative land uses have been identified within areas of the site itself and the surrounding land and comprise;

- General Made Ground/in-filled ground (i.e. potentially poor quality/contaminated materials)
- Murton Colliery, Rake Lane Drift Mine and the offsite Backworth Colliery to the south west (i.e. fuel/oil storage, mine shafts/adits, colliery spoil/waste)
- Former ponds (i.e. contaminative infilling, organic deposits)
- On site sub station (i.e. possible PCB impact owing to the age of substation -pre 1975)
- Tanks (i.e. chemical/fuel/solvent storage and use)

4.2.9 On the basis of the historical information reviewed, the contamination potential for the previously developed areas of the subject site is considered to be Moderate.

5. Conceptual Site Model

5.1 Introduction

5.1.1 This section summarises the findings of the desk study (including our review and re-appraisal of existing intrusive site investigation information) in the form of a geo-environmental conceptual site model (CSM).

5.1.2 The CSM provides a qualitative evaluation of potentially active "*contaminant linkages*" at the site; these being plausible scenarios whereby a contamination source is connected to a possible receptor by one or more pathways:

i) Potential sources of contamination: these include any actual or potentially contaminating materials and activities, located either on or in the vicinity of the site;
ii) Potential pathways for contamination migration: these comprise the routes or mechanisms by which contaminants may migrate from the source to the receptor including environmental migration pathways and human health exposure pathways; and
iii) Potential receptors of contamination: these include present and/or future land users, ecological systems, water resources and property.

5.2 Contamination Sources

5.2.1 From the information reviewed in this report, few potential sources of contamination associated with the site's previous/historic and current usage have been identified for the majority of the site. This is largely due the long standing agricultural use of much of the site.

5.2.2 Notwithstanding, general Made Ground deposits are likely to be present, associated with the various small scale current and historic developments around the site. Deposits may have been imported to level sites and facilitate construction of buildings. The large area of opencast coal mining to the east is also indicated to have been infilled. Made Ground deposits are likely to comprise materials of unknown provenance, quality and composition.

5.2.3 Murton Colliery and Rake Lane Drift mine were once located onsite; therefore the potential exists for colliery spoil or waste to be present.

5.2.4 In addition, 2no substations are present in the south of the site and therefore dielectric transformer fluids containing PCBs may have leaked or could have been spilled. Historical maps indicate the presence of tanks of tanks along the north eastern boundary of the site and a number of farms are currently located onsite, as such there is the potential for impacts to soil to have occurred from fuel or oil spillages and fuel or chemical storage at these locations.

5.2.5 The development may be at risk from potential ground gas generation from any extensive Made Ground or fill deposits at the site. The site is in a radon area with less than 1% of homes above the action level; therefore radon gas is not considered a potential contamination source. Furthermore the absence of mine gas beneath the site cannot be fully discounted at this stage.

5.2.6 The most significant off-site sources of potential contamination with the potential to have affected the subject site are:

- Railway Line, located immediately north of the site;
- Industrial Estate, located 30m southwest of the site.

5.2.7 Given their respective distances from the site, the railway line and industrial estate could have the potential to affect the subject site. Notwithstanding, for such sources to have affected the site, cross-boundary migration pathways would have to have been active at some stage.

5.2.8 On the basis of the above, it is feasible that contamination could potentially exist within the site footprint and could include substances such as:

- Heavy metals and metalloids
- Inorganic compounds (sulphates, cyanide)
- Asbestos
- Poly-Aromatic Hydrocarbons
- Petroleum hydrocarbons
- Volatile and Semi-volatile Organic Compounds
- Ground Gases (methane, carbon dioxide etc.)

5.2.9 A Geo-Environmental Constraints Plan highlighting the previous potentially contaminative land uses on the site which could potentially pose constraints on future development (or at least inform future Phase 2 investigations) is presented on drawing MG-03 in Appendix A.

5.3 Pathways

5.3.1 Potential migration pathways are discussed below.

Airborne Migration Pathways

- Under the developed scenario, the area to be covered in some form of hardstanding will be increased; however landscaped areas will be included and as such (without consideration of any mitigation) the particulate inhalation pathway is considered active. Notwithstanding landscaped areas are likely to be grassed and as such dust generation is likely to be minimal.
- During development works, sub-surface soils could be exposed and therefore dust has the potential to be generated. Notwithstanding, typical dust suppression techniques could be employed during construction and events such as these would only result in short-period exposures linked to the development programme.
- Vapour inhalation pathways are potentially active irrespective of site status.

Aqueous Migration Pathways

- Leaching of contaminants in the shallow soils is likely to be negligible in areas of hard-standing (buildings, pavement etc.) where infiltration of rainfall is minimal.
- The site is recorded as being underlain by a Secondary A (bedrock) Aquifer and on this basis the aqueous migration of contamination laterally in deep groundwater could occur.
- The bedrock is anticipated to be overlain by cohesive Glacial Till (Unproductive Strata); as such vertical and lateral aqueous migration pathways in shallow groundwater are

considered inactive. As such there is unlikely to be a pathway between shallow/surface-derived contamination and deep groundwater.

Direct Contact Exposure Pathways

- Under the developed scenario, a significant proportion of the site area will be covered in some form of hard-standing (building floor slabs, road pavement, driveways etc); however gardens and landscaped areas will be included and as such (without consideration of any mitigation) direct contact pathways are considered active.
- During the construction phase of the development, soils can become exposed at the surface and hence the direct contact pathways should be considered active for the duration of the development programme and also during any later in-ground maintenance works.
- The proposed development plan will include gardens and as such the consumption of home-grown produce is an active pathway for consideration.

5.3.2 Ground gas migration follows pressure gradients (i.e. from high to low pressure via the path of least resistance). Given the nature of the ground conditions, ground gas migration will be predominantly vertical, migrating from the theoretical source to the surface along the path of least resistance. Ground gas migration pathways are therefore considered active.

5.4 Receptors

5.4.1 With reference to Part 2a of the Environmental Protection Act (1990), the potential receptors to be considered in any contaminated land scenario can be summarised as follows:

Human Health

- The proposed development is for a residential end-use and as such the future residents are the primary receptor for any contamination risk.
- Construction workers/contractors could potentially be exposed to contaminants during the construction process, particularly during the initial groundworks phase. We would however anticipate that the adoption of appropriate health and safety risk assessments and use of suitable personal protective equipment (PPE) will reduce risks to manageable levels.
- Residents of the existing surrounding properties could also be at risk; though for exposure to occur, active cross- boundary migration pathways would be required.

Eco-systems

- There are no sensitive or protected habitats associated with the land upon which the proposed development sits or in the nearby area.

Property (buildings, etc)

- The proposed development will comprise new structures and associated infrastructure; however these should be designed on the basis of a site/development-specific geotechnical investigation which should include an appraisal of relevant risks including historical abandoned coal mine workings and the potential for sulphate attack on buried concrete.

Controlled Water

- All groundwater is Controlled Water; therefore the groundwater beneath the site requires consideration and protection as a potential receptor of any site-derived contamination.
- Surface watercourses are also considered Controlled Water receptors; two tertiary rivers are present in the northern site area. These are therefore considered to be plausible receptors for any site-derived contamination.

5.5 Preliminary Risk Assessment

5.5.1 Based on the CSM the following table presents the plausible contaminant linkages that apply to this site. An indicative qualitative assessment of the likelihood that a risk could be realised is provided with Table 6.1 constituting the Preliminary Risk Assessment (PRA) as outlined in CLR 11 (DEFRA & EA, 2004).

Summary of the preliminary risk associated with Potential Pollutant Linkages

Potential Receptor	Potential Source	Potential Pathway	Preliminary Risk*
Site Users - Residents	Contaminated soil, perched groundwater and groundwater	Particulate inhalation / dermal contact / ingestion	Low to Moderate
		Vapour inhalation (indoor and outdoor)	Low (Locally Moderate)
	Ground Gas	Migration through structures	Moderate
Adjoining site users	Contaminated soil	Particulate inhalation (during construction only)	Low
	Contaminated Groundwater	Vapour Inhalation	Low
Construction Workers/ Maintenance Workers	Contaminated soil & perched groundwater	Particulate inhalation / dermal contact / ingestion / vapour inhalation.	Low to Moderate
Property (future building)	Sulphate impacted soil & groundwater	Chemical Attack	Low to Moderate
	Ground Gas	Structural damage due to explosion of combustible gas	Moderate

Potential Receptor	Potential Source	Potential Pathway	Preliminary Risk*
Property (future landscaping)	Contaminated Soil	Root uptake	Low (Locally Low-Moderate)
Controlled Water – Groundwater	Contaminated soil and perched groundwater	Leaching and migration of contaminants into the aquifer	Low
Controlled Water – Watercourses	Contaminated soil and perched groundwater	Leaching and migration of contaminants into the watercourses via offsite surface water drainage.	Low

* assuming no mitigation or remedial measures are implemented.

5.6 Discussion

5.6.1 Substantial or wide spread sources of contamination are not expected to be present across the site. Nonetheless on-site potential sources of contamination do exist.

5.6.2 A review of the PRA above indicates that, in the majority of “Active” SPR linkages, the preliminary risk is considered to be Low/Low-Moderate, however a number of specific aspects have been assigned an elevated risk (Moderate) and these generally relate to the possible presence of ground contamination in the areas of potential sources as identified above.

5.6.3 Near surface contaminants in these areas could impact upon construction workers during redevelopment ground works activities, however it is envisaged that appropriate health and safety risk assessment and personal protective equipment would provide appropriate mitigation.

5.6.4 A risk (moderate) exists from hazardous ground gas in areas of extensive made ground, infilled ground or mine shafts/workings until proven otherwise or mitigated through incorporation of appropriate gas protection measures into new buildings.

5.6.5 The environmental risk posed by the site to Controlled Water (groundwater and surface water) would only be significant if substantial, mobile, on-site ground contamination sources are confirmed to exist. The risk to groundwater is not indicated to be significant due to the intervening unproductive superficial strata which might act to eliminate the migration pathway.

5.6.6 Risks to property including chemical attack and geotechnical stability hazards will be mitigated by design.

6. Conclusion & Recommendations

6.1 Overview

6.1.1 This Phase 1 Geo-Environmental Desk Study Report presents an assessment of the geo-environmental information pertaining to the site based on readily available desktop/published information and any available site investigation data.

6.1.2 The objective of this assessment was to collate and review the available geo-environmental information (including previous site investigations) to determine potential ground contamination risks associated with the Site in its current condition and evaluate potential geo-environmental constraints with regards to its proposed future development.

6.2 Geo-Environmental Risks

6.2.1 From the review of the available site information it is unlikely that the historical land uses of the majority of the site and surrounding area will have generated significant or widespread contamination impacts at the site. Nonetheless a number of on-site potential sources of contamination do exist.

6.2.2 The preliminary risk associated with any “active” Source-Pathway-Receptor linkages is in the majority of cases considered to be low/Low-Moderate, but locally elevated where direct exposure can occur in areas with potential sources of contamination.

6.2.3 Under the development proposals the site will comprise a combination of hardstanding and landscaped areas including private gardens therefore certain exposure pathways will remain active (particularly in the landscaped areas and during development) and therefore may require mitigation by management and design.

6.2.4 A potential risk exists from hazardous ground gas in areas of extensive made ground, infilled ground or mine shafts until proven otherwise or is quantified with appropriate recommendations for mitigation measures.

6.2.5 The environmental risk posed by the site to Controlled Water receptors is not anticipated to be significant; however this should be confirmed by appropriate testing and risk assessment during Phase 2 Investigations if substantial, mobile, on-site ground contamination sources are encountered.

6.3 Geotechnical Hazards & Coal Mining Related Risks

6.3.1 Murton Gap is in the likely zone of influence from workings from 5 seams of coal at shallow depth to 160m, and last worked in 1964. The seams/strata subcrop beneath the Glacial Till (anticipated to be circa 5-10m thick but potentially thinner than this in the far north of the site) and dip to the southwest.

6.3.2 The available records from the Coal Authority suggest that the most productive (and therefore exploited) seams were the Bensham and Yard seams. The High Main seam is also indicated to have been worked in the past. These reserves have been extracted via shafts to pillar and stall workings as follows:

- Bensham (via various pits): Worked across the majority of the site (with the exception of the eastern margin) at known depths of between 150-48mbgl. However the workings continue up-dip close to subcrop and are therefore assumed to be shallower to the north.
- Yard (via various pits): Worked across the central and south-western site areas at known depths of 91mbgl to subcrop (assumed 5-10mbgl).
- High Main (via various pits and adits (Rake Drift Mine)): Worked in the southwest of the site however no abandonment plans are available.

6.3.3 According to the CA interactive map viewer and 1:10 000 BGS mapping, the southeast of the site is within an area of past surface mining and a significant area of open cast coal mining has taken place. The Yard, Bentinck, Fiver-Quarter and Metal coal seams sub crop beneath the thin drift (Glacial Till) in this area and are indicated to have been worked by opencast methods.

6.3.4 In the north of the site the Yard coal seam has been worked to subcrop and the Bensham seam has been worked close to subcrop at shallow depths below the drift deposits (potentially 5 to 10mbgl). Given the depth of theworkings in the central and southern site areas any associated ground movement should have ceased by now and the primary concern therefore relates to the historic shallow workings at or close to the surface in the north.

6.3.5 The High Main seam is also indicated to have been worked close to subcrop and therefore shallow workings at or close to the surface in the southwest of the site is also a primary concern.

6.3.6 Based on the depth of the coal seams and the thickness of drift deposits indicated by the available information, it is considered that the potential risk posed to the proposed development by shallow coal workings is **high** for the majority of the site; the risk is greatest in the vicinity of the subcrops where the most exploited coal seams are at their shallowest.

6.3.7 There are a number of former mine entries recorded by the Coal Authority to be within the site boundaries. No treatment details are available for these; they therefore pose a risk locally due to the potential for the collapse of abandoned mine shafts.

6.3.8 On the basis of the available information, the development risk associated with coal mining related hazards is high across much of site (with the exception of the eastern margins) given the recorded shallow mine workings in seams close to subcrop and the existence of recorded/known mine shafts.

6.3.9 An extensive intrusive investigation will need to be undertaken to determine the presence, depth and extent of shallow coal seams and abandoned workings beneath the site and therefore fully characterise the risk from shallow coal mining on the site.

6.4 Preliminary Geotechnical Appraisal

6.4.1 The site topsoil is indicated to be underlain by cohesive Glacial Till across much of the site with the exception that fill deposits are present in the eastern site area in the location of the former opencast mine.

6.4.2 The Glacial Till Drift deposits are indicated to extend to depths of around 5 to 10mbgl in the site area and are anticipated to be of firm to stiff consistency at relatively shallow depth (i.e. 1 to 2mbgl).

6.4.3 Beneath drift deposits, the site is underlain by Solid undifferentiated strata of the PMCM which are indicated to predominantly comprise mudstones and sandstone with subordinate coal seams.

6.4.4 Shallow spread foundation solution (pads/strips) may be feasible; subject to confirmation that the ground conditions are reasonably competent beneath new building footprints. Depending on the findings of future investigations into to depth to rockhead and the presence of abandoned workings beneath the site, shallow spread foundations may need to be suitably reinforced. Ground-bearing ground floor slabs may also be feasible for the proposed site development, subject to the nature and competence of underlying strata.

6.4.5 It is likely that either deep foundations or ground improvement (to support reinforced shallow foundations) will be required in the area of the infilled opencast mine. Piled foundations will almost certainly be required for any structures situated over the “high wall” of the quarry.

6.4.6 Given the cohesive subsoils and in the absence of adequate testing, a low CBR value should be assumed for the design of new road pavement at this stage.

6.4.7 Groundwater may be encountered at shallow depths however due to the low permeability groundwater ingress into open excavations is likely to be slow. Due allowance should therefore be made for dealing with shallow groundwater which could be encountered during ground works/in excavations.

6.4.8 In consideration of the indicated site geology and near-surface ground conditions, it is unlikely that on-site soakaways will be feasible to attenuate surface water drainage and therefore discharge of surface water to the adjacent watercourse at an appropriate/restricted discharge rate (i.e. with suitable storm water storage and attenuation) would be the preferred option.

6.5 Recommendations

6.5.1 Prior to any redevelopment of the site, Phase 2 Intrusive Investigations will be required to establish the nature of the ground conditions and to obtain development-specific geotechnical design parameters. In particular future intrusive investigations will be required to establish the depth to competent bearing strata.

6.5.2 It is recommended during any pre-development surveys to carry out a borehole investigation to determine the presence, depth and extent of shallow coal seams and workings beneath the site. It should be noted that any intrusive activities which may intersect or disturb coal seams will require the prior written permission of the Coal Authority.

6.5.3 The investigation strategy should also include an “environmental” investigation; designed to interrogate the Phase 1 CSM, establish the status of the identified Source-Pathway-Receptor linkages and thereby reduced uncertainties in the PRA.

6.5.4 Investigation should be undertaken in line with BS5930 (1999) and BS10175 (2011) with the aim of determining the ground conditions, allowing sampling of soils for geotechnical and environmental testing. Such investigations will determine the need for mitigation against aggressive ground, establish the suitability of materials for re-use and characterise ‘Waste’ for future disposal.

6.5.5 The findings of the Phase II intrusive investigation and subsequent assessments will establish the need (or otherwise) for any mitigation measures necessary for the development to progress including whether land remediation is needed. In such an event, further site investigation maybe appropriate or risk assessment in order to develop a Remediation Strategy may be required. In this respect reference should be made to CLR11 (DEFRA & Environment Agency, 2004) and supporting guidance.

7. References

British Standards Institution (BSI), 1999. Code of Practice for Site Investigations – BS5930:1999.

British Standards Institution (BSI), 2001. Investigation of Potentially Contaminated Sites – Code of Practice. BS 10175 – 2001.

Department for Environment, Food and Rural Affairs (DEFRA) & Environment Agency (EA), 2004. Model Procedures for the Management of Land Contamination. CLR 11.

Appendix A Figures & Drawings

Appendix B Photographs

Appendix C GroundSure Report

Appendix D BGS Borehole Records

Appendix E Coal Authority Report & Mine Abandonment Plans

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