

**RESIDENTIAL DEVELOPMENT LAND
OFF NORTH ROAD, PONCIAU, WREXHAM**

PHASE 1 CONTAMINATION INVESTIGATION

**For: Freedom Land Developments Ltd
December 2008**

R1255-R01

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Phase 1 Contamination Investigation

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Signed For Smith Grant LLP

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RESIDENTIAL DEVELOPMENT LAND OFF NORTH ROAD, PONCIAU, WREXHAM

PHASE 1 CONTAMINATION INVESTIGATION

For: FREEDOM LAND DEVELOPMENTS LTD

December 2008

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1. Introduction

- 1.1. Freedom Land Developments Ltd (the developer) instructed Smith Grant LLP (SGP) to undertake a Phase 1 Contamination Investigation of land at North Road, Ponciau (see Figure 01). Outline planning permission (ref. RHO P/2007/1016) has been granted for the construction of up to 24 residential dwellings at the site.

- 1.2. The planning permission includes the following condition relating to contaminated land:

Condition 7) Development shall not begin on site until a scheme to deal with potential contamination at the site has been submitted to and approved in writing by the Local Planning Authority. The scheme shall include a phased investigation approach to identify the extent of contamination and any measures required to remediate the site, including post-development monitoring. Where remediation works are required, the development shall not be occupied / used until a Validation Report, to show that the works have been satisfactorily carried out, has been submitted to and approved in writing by the Local Planning Authority.

- 1.3. The scope of the contamination investigation required is also set out in a letter from Public Protection Officer, Mrs S Inglis, of Wrexham County Borough Council (WCBC), dated 18 September 2008. The letter includes the following comments in relation to contaminated land:

The planning condition in relation to contaminated land was placed on the above development due to the site being situated, in part, on land previously used as a colliery spoil tip known as Bryn-yr-Owen Colliery, a land use which has the potential to cause contamination.

A comprehensive Phase 1 Desk Study is an absolute requirement of the planning condition and should inform you of whether or not a Phase 2/3 Intrusive Site Investigation is required.

- 1.4. This report describes the Phase 1 Contamination Investigation carried out in accordance with Condition 7 of the planning permission and comments received from WCBC.

- 1.5. Site details are:

Address	North Road, Ponciau
National Grid Reference	329620, 347110
Local Authority	Wrexham County Borough Council

Site Area	~1.1 ha
Boundaries	
north	No boundary marked
east	Trees and shrubs with fencing
south	North Road and fencing in places
west	Trees and shrubs with fencing
Neighbouring land	
north	Playing fields
east	Dismantled railway now a footpath, with woodland and scrubland beyond
south	Residential properties along North Road
west	Residential properties along Park Road

- 1.6. The site comprises an irregular plot of land, to the north of, and connected by a track to, North Road. The site is currently unoccupied open land with grasses and shrubs, and includes the side of a raised area of old colliery spoil to the north. The colliery spoil lies on the site of a former small colliery and may form a future phase of the development. No structures are currently present at the site, other than a steel container adjacent to a small area of concrete hardstanding.
- 1.7. The surrounding landuse is agricultural and residential, with the settlement of Ponciau to the south of the site and residential properties immediately to the west. In the wider area, open grassland and agricultural land lies north, east and west of the site.
- 1.8. This report describes the Phase 1 (desk study and site inspection) Contamination Investigation undertaken by SGP. The report methodology follows the framework described in the EA / DEFRA Contaminated Land Report 11: 'Model Procedures for the Management of Land Contamination 2004'. The study comprised a review of readily available information on the environmental setting of the site and the site's previous and current uses with respect to potential risks to the environment and human health, and a preliminary site inspection. This report contains a qualitative risk assessment and where appropriate makes recommendations for intrusive investigations and remedial actions appropriate to the future residential use of the site.

2. Information Sources

- 2.1. The principle sources of information consulted in the preparation of this report are listed below.
- 2.2. Topography, geology and hydrology
- OS Map, Explorer Series, Sheet 256, Wrexham and Llangollen, 1:25,000

- Applied geological mapping in Wrexham area: Geology and land-use planning, Technical Report WA/91/4, BGS, 1991
- British Geological Survey 1:10,000 series solid geology map SJ24NE "Rhosllanerchrugog"
- Coal and Brine Report, ref. 00106751-07, The Coal Authority, October 2007
- NRA Groundwater Vulnerability Map, Sheet 16, West Cheshire, 1:100,000
- Hydrogeological Map of Clwyd and the Cheshire Basin, 1:100,000
- Indicative Atlas of Radon in England and Wales, HPA-RPD-033, HPA / BGS, November 2007

2.3. Consultations

- Mr Phil Hughes (Freedom Land Developments Ltd)

2.4. Historical maps

- 1:10,560 scale: 1879, 1900, 1914, 1938, 1963-64
- 1:10,000 scale: 1976-79, 1976-93, 2000, 2008
- 1:2,500 scale: 1874, 1900, 1912, 1963, 1974, 1988-92, 1993

2.5. Information review

- GroundSure Risk Screening Report, ref. PSGC-5-324579, October 2007
- Magic Website (www.magic.gov.uk)
- Environment Agency website

2.6. Previous investigations

- 2.6.1. SGP is not aware of any previous investigations undertaken at the site, although possible signs of a previous intrusive investigation were noted during the walkover.

2.7. Site inspection

- 2.7.1. A site inspection was carried out by SGP Consultant, Gareth David, on 10 October 2008. This comprised a walkover of the site and surrounding area.

3. **Development History and Current Status**

3.1. Historical uses

- 3.1.1. A summary of significant features, developments and landuses shown on selected historical Ordnance Survey maps is provided below. Copies of selected maps are provided in Figures 02-07.

Map	Site	Surroundings
1874, 1:2,500 (Refer to Fig 02) 1879, 1:10,560	The site is shown as undeveloped open land with occasional trees. An area (~700m ²) of disturbed land, probably colliery spoil, lies in the northeast corner of the site.	The area of disturbed ground, probably colliery spoil, in the northeast site corner extends beyond the site boundary to the north. Two old coal shafts and a building are shown north of the site at ~20m distance. Bryn-yr-Owen Colliery, including coke ovens, is situated ~180m northeast of the site. A railway line within a cutting runs past the eastern site boundary in a southeast to northwest direction and terminates at the area of colliery spoil. The railway line passes immediately adjacent to the northeast site corner. Two other areas of disturbed ground, probably associated with colliery works, lie northeast of the site at ~10m and ~30m distance. Two old coal shafts are also shown ~150 and ~200m southwest of the site. The surroundings are predominantly rural, shown as open farmland, with the settlement of Ponkey south of the site. A pit is shown ~350m southeast of the site.
1900, 1:2,500 (Refer to Fig 03) 1900, 1:10,560	The area of disturbed ground in the northeast site corner is still present although its shape appears to have changed very slightly. Trees are no longer shown within the site or along site boundaries.	The coal shafts north of the site are no longer shown. The railway east of the site is marked as the GWR Legacy Colliery Branch and now continues to the northwest rather than terminating immediately north of the site. Bryn-yr-Owen colliery is marked as disused and Bryn-yr-Owen Cottages are shown northeast of the site at ~130m distance. In the wider area an old quarry is marked ~400m east of the site and the pit ~350m southeast of the site is now shown as a reservoir.

Map	Site	Surroundings
1912, 1:2,500 (Refer to Fig 04) 1914, 1:10,560	No significant changes.	A footpath now passes immediately adjacent to the southeast site corner, in a southwest to northeast direction. Residential development has occurred south of the site, along North Road and Park Road. In the wider area, there has been some residential development to the south, land north of the site remains predominantly open farmland. A school is shown ~300m southwest of the site.
1938, 1:10,560	No significant changes.	Two buildings, probably residential, are shown adjacent to the southern site boundary. Residential development along Park Road, west of the site, appears to have continued. There are no significant changes in the wider area.
1963, 1:2,500 (Refer to Fig 05) 1963 / 1964, 1:10,560	A track is shown passing through the site, from North Road, in a southeast to northwest direction. The area of disturbed ground in the northeast site corner and beyond (probably colliery spoil) appears to have been regraded. A rectangular block, possibly a building or container is also shown in the northeast corner but south of the disturbed ground. The eastern half of the site is shown as marsh.	The track passing through the site, extends beyond the northern site boundary into the area of disturbed ground which appears to have been regraded. Detached residential properties are shown immediately southeast (Grange Park) and southwest (Inglenook) of the site and the gardens of dwellings along Park Road now back onto the western site boundary. The railway to the east appears to be disused. In the wider area, the field boundaries northwest and east of the site have changed, resulting in larger fields. Allotment gardens are shown west and east of the site and the old quarry ~400m east of the site now appears to have been infilled and developed for housing.
1974, 1:2,500 1976 / 1979 1:10,000	No significant changes.	The railway east of the site is now marked as dismantled. There are no other significant changes.

Map	Site	Surroundings
1988, 1:2,500 (Refer to Fig 06)	The rectangular block, possibly a container or building, in the northeast site corner is no longer shown. There are no other significant changes.	No significant changes.
1993, 1:2,500 (Refer to Fig 07)	The area of disturbed ground in the northeast site corner is no longer shown and a linear feature, possibly a field boundary, is shown within the site. The track running through the site is no longer shown.	A landscape feature is shown immediately northwest of site, comprising 3 embankments and plateaus, indicative of regraded land.
2000, 1:10,000	No significant changes.	No significant changes.
2008, 1:10,000	The access road into the site is not shown. There are no other significant changes.	An additional building is present next to Grange Park, immediately south of the site. No other significant changes are shown.

3.1.2. The historical maps indicate that the site has remained largely undeveloped from 1874. However, a small area of disturbed land, probably colliery spoil, is shown in the northeast site corner at this time. This area of disturbed land appears to have been regraded at some time between 1874 and 1900 and also between 1912 and 1963. By 1963 a track had been constructed through the site, from the southeast to northwest. A building or container was also present in the northeast site corner at this time but appears to have been removed some time between 1974 and 1988. The track and the area of disturbed ground in the northeast site corner are no longer shown by 1993.

3.1.3. In the immediate surroundings, land north of the site is shown as disturbed ground, probably colliery spoil, from at least 1874. Two coal shafts are shown approximately 20m north of the site at this time, indicating the presence of coal workings in the area forming part of the Bryn yr Owen Colliery. The historical mapping also shows that a railway line ran past the eastern site boundary to the coal workings from 1874. At this time, two other areas of disturbed ground, probably comprising colliery spoil, are shown on the opposite side of the railway line, 10m and 30m northeast of the site. At some time between 1900 and 1912, residential development occurred south of the site and by 1938 two dwellings had been constructed immediately southeast and southwest of the site. At some time between 1988 and 1993, land immediately northwest of the site was regraded to form a landscape feature of embankments and plateaus. From geological mapping it appears that this was part of a large area to the northwest of the site worked for opencast coal.

3.1.4. Anecdotal evidence from a previous landowner suggests that the colliery spoil

heap to the west of the site, forming the possible phase 2 of the development, was previously used as a scrapyard, although there is no map or remaining physical evidence of this former use. The surface of the colliery spoil tip appears to have been cleared of vegetation by earthmoving equipment recently.

- 3.1.5. In the wider area, the historical maps indicate predominantly agricultural land use north of the site and residential development to the south, with little industrial / commercial land use (other than coal mining).

3.2. Present situation and land use

- 3.2.1. A description of the current site status is provided below and is based on observations made during the site inspection carried out by SGP Consultant, G David, on 10 October 2008. The weather at the time of the site visit was dry and overcast. A layout of the site is provided as Figure 08.
- 3.2.2. The site is accessed from North Road, Ponciau. The access road passes between residential properties into the southern part of the site and an area (~400m²) of exposed made ground was observed to the east of the access road, as shown on Figure 08. The made ground comprises exposed soils, brick rubble, broken up concrete and occasional coal fragments. General litter was also observed in this area including empty tins of lacquer and car cleaning products and also an old outboard boat engine. The access road terminates at Grange Park, a detached dwelling immediately southeast of the site although an unsurfaced track continues through the site in a southeast to northwest direction. This track is slightly raised above the surrounding ground, indicating that it may have been built up with fill material.
- 3.2.3. The central part of the site is occupied by rough grassland with stockpiles of brick rubble, soil, tree cuttings and areas of burning. A steel container, adjacent to a small area of concrete hardstanding, was observed to the northwest of Inglenook, a detached dwelling immediately south of the site. A possible inspection pit is present within the concrete hardstanding and has been filled with general litter, including empty tins of paint and car maintenance products, timber and corrugated iron. An empty oil drum was also observed in proximity to the concrete hardstanding although there was no evidence of oil spills or staining in this area. SGP was advised, by the developer, that this part of the site was previously occupied by a domestic garage and workshop not used for commercial purposes.
- 3.2.4. Two trial pits had been excavated in the central part of the site, as shown on Figure 08, and had been left open. Both pits had filled with water and observations of the

excavated material indicate that the ground in this part of the site comprises natural ground of silty clay topsoil over a stiff brown / grey clay. It is understood that the developer excavated the trial pits in order to assess ground conditions to facilitate foundation design.

3.2.5. Three pipe/vent structures associated with a septic tank for the adjacent Grange Park are present in the eastern part of the site.

3.2.6. The northeast part of the site comprises a raised bank of colliery spoil, which extends beyond the northern site boundary. Exposed ground was observed along the face of the raised bank, comprising shale and coal fragments, indicative of colliery spoil. Two empty and corroded metal drums, the former contents of which could not be confirmed, were observed at the base of the bank.

3.2.7. The area of colliery spoil immediately north of the site appears to have been recently cleared of vegetation. This is corroborated by aerial photographs which indicate that this land was previously vegetated with trees and shrubs. The area also appears to have been recently regraded. Exposed ground in this area comprises soil with shale, slate, coal and brick rubble. Some broken asbestos cement sheeting was also observed in this area along with general litter. The brick rubble and litter appears to have been 'tracked' into the northwest part of the site.

3.2.8. SGP was advised, by the developer, that the raised area of land immediately north of the site was occupied by a scrap yard approximately 20 years ago although there is no evidence of this landuse from historical mapping. SGP was also advised that following the use of the land as a scrap yard, some brick rubble was tipped in the area, corroborated by site observations.

3.2.9. Land north of the site slopes down towards a series of playing fields and land to the east slopes steeply down to the dismantled railway, which is now a footpath. The southern site boundary is formed by North Road and the residential properties of Grange Park and Inglenook, and the western site boundary is marked by the garden areas of dwellings along Park Road.

3.2.10. No built development was observed at the site.

3.3. Adequacy of information

3.3.1. There is no information on the site use before 1874 and it is possible that coal mining activities may have taken place within the site prior to this time. There are also no large scale (ie, 1:2,500) historical maps for the period 1912 to 1963, during

which time some use could have occurred at the site. However, the large scale map for 1963 and the small scale map (1:10,560) for 1938 do not indicate any development at the site over this period.

- 3.3.2. In conclusion, there is some uncertainty regarding the historical use of the site and in particular the use of the site prior to 1874. There is also uncertainty regarding the former use of part of the site as a residential garage / workshop and the use of land immediately north of the site as a scrap yard.

4. Site Characterisation

4.1. Topography and setting

- 4.1.1. The site is undulating at approximately 150 to 155m AOD, with a gentle upward slope across the site in a general east to west direction. However, the natural topography is interrupted by a raised bank of colliery soil in the northeast part of the site. The landform immediately northwest of the site, comprising a series of plateaus and embankments to create playing fields, is also man-made. Land to the east of the site slopes steeply down to approximately 140m AOD to a public footpath, where a railway once existed. A raised area of land, probably colliery spoil, also lies to the east of the public footpath about 20m northeast of the site.
- 4.1.2. The site setting is generally rural and residential, with the residential areas of Ponciau and Rhosllanerchrugog south of the site and farmland to the north. There is no commercial or industrial development in the vicinity of the site.

4.2. Geology

- 4.2.1. BGS mapping shows the site to be underlain by productive Coal Measures of the Bettisfield Formation. The rocks comprise a cyclical sequence of fireclays and coal seams, mudstones and sandstones. Coal seams of the Fireclay Group, comprising the Stone, Half Yard and Firedamp Seams, of variable thickness, are the uppermost seams recorded near to the site. These were the uppermost seams worked in the opencast pit up to 100m to the north, and 120m to the west of the site. The estimated angle of dip of the seams is on average about 5° to the southeast, showing these to underlie the bulk of the site.
- 4.2.2. Projecting the level of the Fireclay Group from its outcrop below the site would put the seams at approximately 17.5m depth on the northwest side of the site, and over 26m depth on the southeast side of the site. The names of the seams suggests that these were worked for coal and fireclay in the past.

- 4.2.3. The geological section shows a further coal seam, the Red Coal, 0.7m thick, lying 12m above the Fireclay Group, i.e. about 6 - 14m below the site. The outcrop of the Red Coal is not recorded on the map in the vicinity of the site; the absence of a recorded outcrop on the geological map and thinness of the seam suggests that it might either have been absent or not worked locally.
- 4.2.4. The geological section marks the presence of the Vanderbeckei (Llay) Marine Band above the Red Coal. Marine Bands and the Coal Measures around them are usually associated with elevated quantities of iron pyrites which can decompose on exposure to air and water to release sulphates and sulphuric acid. Acid and sulphate-rich conditions may therefore be present in the ground, or in associated colliery waste tips, although no visible evidence of plant toxicity or acid mine drainage was noted during the site inspection.
- 4.2.5. The Ty Gwyn Fault line is shown running across the southern part of the site in an east to west direction with a downthrow to the south. This cuts off the strata described above, which are replaced by a sandstone stratum to the southwest. The Main Coal, comprising two leaves of 1.8m and 0.7m thickness, lies at the base of the sandstone, and its projected depth, using the same 5° angle of dip, will range from about 8m to 15m across this part of the site.
- 4.2.6. A second fault runs southwest from the Ty Gwyn Fault, and cuts off the Main Coal under the southeast part of the site. However the geological section shows the 1.6m thick Lower Bench Coal lying 6m below the Main Coal. At an angle of dip of 5°, the Lower Bench Coal outcrop should lie about 69m to the west of the outcrop of the Main Coal, placing it within the southeast corner of the site, although the Lower Bench Coal is not shown on the geological map.
- 4.2.7. The mapping also shows the site and the immediate surroundings to be underlain by glacial till (ie, boulder clay). The thickness of drift across the site is indicated as around 5m, and the presence of glacial till can be observed in the two open trial pits on the site. Made ground, specifically, 'man-made deposits on the original ground surface due to mining', is shown immediately north of the phase 1 site and also in the northeast site corner. Further areas of mine spoil associated with the Bryn yr Owen colliery lie outside the site to the northeast.
- 4.2.8. It should be noted that the positions of faults and coal seam outcrops (actually sub-crops at rockhead below the superficial soils) may be uncertain and subject to local variations that the published maps often cannot show. Drawing 08 shows the

approximate positions of faults and inferred depths of coal seams based upon an average angle of dip of 5° . The angle of dip may vary locally, with measurements suggesting a range between 3° and 7.5° which may substantially alter the projected seam positions and depths below the site

4.3. Mining

- 4.3.1. The Coal Authority report indicates that the site 'is in the likely zone of influence from workings in 4 seams of coal at shallow to 80m depth, and last worked in 1878 (see Appendix A). The report also includes a plan showing 2 mine entries, one within the site along the eastern site boundary, as shown on Figure 08, and a second entry approximately 10m west of the site in the area of the playing fields. These mine entries were not shown on the historical mapping, and the shaft within the site is not shown on the 1:10,000 geological map. The report also notes that 'there is no record of what steps if any have been taken to treat the mine entries'.
- 4.3.2. Two coal shafts shown on the historical map for 1874 within phase 2 are not included in the Coal and Brine Report for the site which covered the phase 1 site, and land within 20m of the boundary only. The 1:10,000 scale geological map shows no shaft within the phase 1 area, and 2 shafts on the old colliery site in phase 2.
- 4.3.3. The Coal Authority was questioned regarding the source of information for the entry within the site, and stated that the location was taken from a historical map, dated 1900. The Ordnance Survey 1:2500 scale map examined by SGP shows no mine shaft within the site, and it is possible that the Coal Authority record was incorrectly plotted.
- 4.3.4. In summary, local coal mining activities took place up to 1874. The possibility of shallow coal seams and old coal workings below the site exists, with resultant shallow mining voids. As a rule of thumb, the depth over which the collapse of old workings can extend to surface is calculated as a ratio of 10 times the worked seam thickness. Thus for the widely exploited Main Coal, with a possible thickness of 2.5m, areas where the seam lies less than 25m below the bedrock surface to the south of the Ty Gwyn Fault may be at risk. If the drift cover is 5m thick, then areas where the seam is less than 30m below ground level could potentially be subject to instability. Similarly the Lower Bench Coal overlying the Main Coal in the southeast part of the site, at 1.6m thick, is likely to have been worked. The safe bedrock cover depth for this seam would be 16m.
- 4.3.5. The thickness of the Fireclay Group below the site to the north of the Ty Gwyn

Fault is undocumented, but comprises 3 coal seams and fireclays which were mined, and there is potential for surface instability over at least part of the site. It is unclear whether the overlying Red Coal was worked.

- 4.3.6. In the wider area, a former open-cast coal working lies north of the site and the former Bryn-yr-Owen Colliery lies to the northeast.

4.4. Hydrology and hydrogeology

- 4.4.1. With the exception of the small area of concrete hardstanding, the ground at the site comprises bare earth or is covered with grasses and shrubs. Therefore, rainfall is likely to infiltrate through permeable surface soils and any fills present, although the cohesive subsoils are likely to be poor-draining and to give rise to surface runoff or shallow flows down-gradient to the east.
- 4.4.2. At the time of the site inspection, which took place during a period of wet weather, the site was waterlogged in places, particularly in the central areas. The trial pit excavations which had been left open had filled with water, indicating that the underlying boulder clay across the site is of low permeability. The northern part of the site, including the raised bank of colliery spoil appeared to be more free draining.
- 4.4.3. No surface water drains, interceptors or any other drainage infrastructure were observed during the site inspection.
- 4.4.4. There are no surface water features at or in the immediate vicinity of the site. The nearest surface watercourse to the site is an unnamed watercourse following an engineered channel across the former opencast workings, approximately 250m to the northwest at its closest point. This flows in a southwest to northeast direction and appears to discharge into a small stream 300m north of the site. This stream ultimately joins Pentrebychan Brook, further to the northeast. Other surface water features in the surrounding area include a pond (marked on historical plans as a reservoir), approximately 350m southeast of the site.
- 4.4.5. The Environment Agency does not monitor the water quality from surface water features in the vicinity of the site. Information also held by the Environment Agency indicates that the site is not located within a zone subject to flooding.
- 4.4.6. The strata that underlie the site are classed by the Environment Agency as a minor aquifer. Minor aquifers are not generally productive and are not able to support large abstractions for public water supply. This is corroborated by the

Hydrogeological Map of Clwyd and the Cheshire Basin, which indicates that the nearest abstraction for public water supply is approximately 1km northwest of the site (the Talwrn Borehole) although SGP understands that this abstraction has been abandoned due to water pollution from an industrial source at Llwyneinion. There may be private abstractions nearer to the site, and minor aquifers can be important in supplying baseflow to rivers.

- 4.4.7. The Groundwater Vulnerability Map assumes that soils are of high leaching potential, on the basis that soil information for urban areas is less reliable and based on fewer observations than in rural areas. Soils of high leaching potential are considered to readily transmit liquid discharges, with low attenuation potential. However, site observations indicate that the natural silty clay soils at the site are unlikely to be of high leaching potential.

4.5. Radon

- 4.5.1. The Indicative Atlas of Radon in England and Wales (HPA-RPD-033) indicates that the site lies within an area where between 5 and 10% of homes are above the radon protection limit as defined by the Health Protection Agency (HPA).
- 4.5.2. The HPA advises that basic radon protection measures are therefore required in the construction of new dwellings.

4.6. Excavation and landfilling

- 4.6.1. The Environment Agency website does not identify any current or historic landfills in the immediate vicinity of the site. The nearest landfill to the site is a historic tip, referred to as 'Cae Dwr Old Tip' located about 470m southwest of the site at its closest point. The information available indicates that this landfill received all types of waste between 1930 and 1941. There are no operational landfills within 1km of the site.
- 4.6.2. The BGS Technical Report indicates a backfilled open-cast coal mine, approximately 70m north of the site. There is no information regarding what material was used to backfill the mine site, although this would usually be the mineral overburden. The opencast restoration created a stepped landform north of the site comprising embankments and plateaus, now occupied by playing fields.
- 4.6.3. The historical plans described in Section 3.1 also indicate made ground, probably colliery spoil, immediately north of the site (within phase 2) and encroaching into the northeast site corner, corroborated by site observations. Made ground, also likely to be heaps of colliery spoil are shown northeast of the site, approximately 10

and 30m from the site, now occupied by scrubland.

4.7. Industrial landuse

4.7.1. With the exception of coal mining activities, the historical maps do not indicate any past industrial landuse at or in the vicinity of the site. In the surrounding area the historical maps indicate predominantly agricultural and residential landuse, with little commercial or industrial development (with the exception of coal mining). Coke Ovens associated with the Bryn-yr-Owen Colliery were located down-gradient of the site.

4.7.2. Information on current landuses, obtained from the GroundSure Report and the walkover of the surrounding area, indicate no commercial / industrial developments and the principal landuses in the area are agricultural and residential. A former garage / workshop in the southwest part of the site was limited to domestic use. A former scrap yard was located on the colliery spoil tip to the west of the site, but is not recorded on historical maps, and there was no evidence of such use observed during the site inspection.

4.7.3. No pollution hazards or incidents, at or in the vicinity of the site, are listed on the Environment Agency website.

4.8. Ecology / Conservation

4.8.1. The site lies within a predominantly rural and residential area, with agricultural land north of the site and the residential area of Ponciau to the south. At the time of the site inspection, the majority of the site was occupied by open grassland with shrubs. A number of trees and taller shrubs were evident along the site boundaries. Some of the trees around the site boundaries are mature and may therefore provide a roost for bats. The central areas of the site comprise bare earth and occasional weeds and grasses, however, no growth of Japanese Knotweed or other notifiable weed species was observed during the walkover inspection.

4.8.2. From information provided on the Magic Website there are no designated nature conservation or protected sites within 500m of the site.

5. **Hazard Identification**

5.1. Potential contaminants on site

5.1.1. The historical mapping indicates that the northeast part of the site was occupied by

a mound of colliery spoil from at least 1874, associated with coal workings immediately north of the site. Observations at the time of the walkover inspection confirmed the presence of colliery spoil in this part of the site. Colliery spoil can contain elevated concentrations of metals and metalloids, specifically arsenic, and polyaromatic hydrocarbons (PAHs), and can contain elevated sulphates and acidity. Colliery spoil also has minor potential to produce methane and carbon dioxide gases, and unburnt coal residues may be present in sufficient quantities to support combustion. No evidence of past or present burning of the spoil tip was observed, or of leachate or vegetation toxicity from sulphates and acidity.

- 5.1.2. The Coal Authority has indicated a coal shaft at the site, adjacent to the eastern site boundary, although no map evidence of this has been found, and the ground appears undisturbed. The principal hazards associated with mine entries are ground instability, leading to building damage, and the existence of a pathway for the migration of explosive and toxic mine gases (carbon monoxide, carbon dioxide and methane).
- 5.1.3. Potential contaminants related to the possible use of part of the site as a garage / workshop may be inferred by reference to the DoE Industry Profile for '*Road vehicle fuelling, service and repair: Garages and filling stations*' and include: petroleum products, fuels, hydraulic oils, lubricants, brake fluids, antifreeze, detergents, vehicle batteries, brake and clutch linings (which are potentially asbestos containing). Whilst general litter, including empty tins of oil and car maintenance products, was observed in the area of the former garage, no oil or fuel stains were seen on the concrete hardstanding and there was no other evidence of significant contamination. Given the private domestic use of the garage, any contamination is likely to be very limited in extent and significance compared to commercial garages.
- 5.1.4. Similar contamination may be associated with the former scrapyards area, although there is evidence that the surface of the tip has been stripped. However, in the absence of additional information it should be assumed that there is potential for contamination to be present in near surface soils over the former colliery tip.
- 5.1.5. Made ground was observed to the east of the site access road, covering a small proportion (approximately 400m²) of the site area. Observations indicate that the depth of the made ground is unlikely to be much greater than 1m, and there was no superficial evidence of significant contamination. The source and nature of the fill is however unknown.

5.1.6. Made ground was also observed along the length of the track passing through the centre of the site and in the absence of further investigation, it is not possible to determine whether the fills underlying the track would be suitable for re-use within the residential development.

5.1.7. General litter is present across the site surface, including empty metal drums, empty tins of lacquer and car cleaning products and some asbestos cement sheeting. Fly-tipping is particularly prevalent in the northwest part of the site, where it appears to have been tracked into the site from the phase 2 area immediately north of the site. The litter present is unlikely to be a significant source of contamination.

5.1.8. The soakaway in the eastern part of the site and any interconnecting pipe-work could be a potential source of localised sewage contamination although any contamination is likely to be limited and temporary.

5.1.9. The site lies within a radon affected area.

5.2. Potential contaminant migration from the site

5.2.1. The key potential migration routes for any mobile contaminants (ie, liquid, gaseous or dissolved) are via surface runoff and shallow seepages down-gradient. Boulder clay (possibly around 5m thick) underlying the site is likely to restrict downward migration into the minor Coal Measures aquifer. Therefore, any migration is likely to be in a vertical and then horizontal direction through surface soils and any made ground present, including colliery spoil.

5.2.2. Migration of any gases via the subsoils appears to be unlikely due to their cohesive and saturated state, however the service trenches if present could provide preferential migration pathways out of the site.

5.3. Potential contaminative uses adjacent to the site

5.3.1. The site is located within a predominantly agricultural and residential area, with no commercial or industrial premises in the vicinity of the site, which are likely to be potentially contaminative.

5.3.2. The mound of colliery spoil within the northeast site corner extends to the north of the site in to the phase 2 area. There are also mounds of spoil further northeast but still in close proximity to the site. As discussed above, colliery spoil can contain elevated concentrations of metals and PAHs. The spoil also has limited potential to generate explosive and toxic ground gases, and the presence of two mine shafts

may further introduce gases to the tip.

- 5.3.3. Contaminants associated with a former scrapyard on the colliery area to the north of the site could include metals, petroleum products, fuels, hydraulic oils, lubricants, brake fluids, antifreeze, detergents, vehicle batteries, brake and clutch linings (which are potentially asbestos containing).
- 5.3.4. Land to the north and northwest of the site, formed part of an opencast coal mining site and appears to have been backfilled to form a series of embankments and plateaus, now occupied by playing fields. From the information available, it was not possible to determine the type of fills that were used to create this landform. This area of made ground could form a source of ground gas and possibly leachate.
- 5.3.5. The nearest landfill to the site is at 470m distance and at such distance there is minimal potential for the landfill to form a source of contamination which would affect the site.

5.4. Potential contaminant migration towards the site

- 5.4.1. Given the predominately residential and agricultural landuse in the surrounding area, there are few potential contamination sources that could affect the site. Historical contamination from the scrap yard (unconfirmed) is unlikely to have migrated through surface soils / fills (colliery spoil) into the site, although earthmoving could have transferred some residues onto the phase 1 development.
- 5.4.2. The generally cohesive shallow strata mean that the sub-surface migration of gas and liquids into the site is unlikely other than via discrete pathways e.g. backfilled mine entries, faults and service trenches.

6. **Preliminary Conceptual Model**

6.1. Conceptual model

- 6.1.1. The conceptual model for the site describes the potential contamination sources, pathways and receptors. Development of a conceptual model is required in order to evaluate potential risks to receptors. The plausible sources, pathways and receptors are outlined below.

6.2. Potential hazards posed by the site

- 6.2.1. The desk study and site inspection carried out indicate the following potential

hazards:

- colliery waste in part of the site, containing low pH, and elevated metals / metalloids, polyaromatic hydrocarbons (PAHs), and sulphates;
- localised contamination of underlying soils and fills with petrol and diesel range hydrocarbons, PAHs and other organic compounds, from the former use of part of the site as a garage and adjacent scrapyards (unconfirmed);
- contaminated soils within other areas of made ground, to the east of the site access road and underlying the track passing through the site;
- localised organic contamination from boreholes and associated pipework connected to a nearby septic tank (unconfirmed);
- explosive and toxic gases from historical mining activities and organic matter within made ground;
- toxic radon gas;
- asbestos cement sheet.

6.2.2. The general litter and debris observed during the site inspection is not considered to be a significant source of contamination although all litter and debris will require removal and appropriate disposal prior to development. Most of the site appears to have remained undeveloped and to be underlain by clean uncontaminated soils.

6.3. Potential hazards from outside the site

6.3.1. The desk study and site inspection carried out indicate the following potential minor hazards:

- migration of mobile contaminants and potentially explosive and toxic ground gases from colliery waste within phase 2 immediately north of the site;
- migration of potentially explosive and toxic ground gases from other areas of colliery waste northeast of the site;
- migration of mobile contaminants including metals, petrol and diesel range hydrocarbons, PAHs and other organic compounds, from land immediately north of the site previously used as a scrap yard (unconfirmed);
- migration of potentially explosive and toxic gases (and possibly leachate) from the former opencast coal mine north of the site, now infilled.

6.4. Potential receptors

6.4.1. The key potential receptors for the proposed future residential use of the site are listed below:

- construction workers who may be exposed to any soil contaminants or explosive / toxic gases during any excavation works;
- future residents affected by the ingress of explosive or toxic gases into built development;

- future residents affected by exposure to hydrocarbon and metal contaminants within the underlying ground in garden areas, primarily via ingestion and inhalation, and to a lesser extent dermal contact;
- built development affected by potentially explosive ground gases and possibly by aggressive ground conditions;
- sensitive plants affected by toxic concentrations of soil contaminants, specifically metals, and acidity.

6.4.2. The minor aquifer is not considered to be a sensitive receptor and in any case is likely to have already been impacted by historic coal mining activities in the area. There are no other water features at or in the vicinity of the site which will be affected by the site and its development.

6.5. Pollution Linkages

6.5.1. The following assessment of potential significant pollution linkages has been prepared and the preliminary site conceptual model is summarised below:

	source		
	solid phase contaminants	leachable / liquid / dissolved phase contaminants	flammable / toxic gasses / vapours
receptor	pathway to exposure / pollution linkage		
humans: development workforce / future maintenance engineers	some of the underlying soils and fills may contain elevated metals, metalloids, hydrocarbons and (very locally) asbestos fibres from the former uses of the site and activities in the surrounding area; this may give rise to exposure via dermal contact, ingestion or inhalation of dust; exposure likely to be of short duration ✓	hydrocarbons and dissolved phase metals may be locally present in underlying soils and fills from the former uses of the site and activities in the surrounding area; there is no evidence of surface contamination and any mobile contaminants may have migrated from site or degraded over time; exposure via dermal contact / ingestion likely to be short-lived ✓	any residual liquid hydrocarbons in the soils and fills are unlikely to give rise to explosive / toxic gasses; potentially explosive / toxic gasses may be present due to the presence of made ground and historic mining activities at and near to site; the area is also affected by potentially toxic radon gas; exposure unlikely assuming appropriate health and safety measures adopted x
humans: future residents	underlying soils and fills may locally contain elevated metals, metalloids, hydrocarbons and asbestos fibres from the former uses of the site and activities in the surrounding area; potential for residents to be exposed to soils in gardens via dermal contact, ingestion or inhalation of dust ✓	hydrocarbons and dissolved phase metals may be locally present in underlying soils and fills from the former uses of the site and activities in the surrounding area; there is no evidence of surface contamination and any mobile contaminants may have migrated from site or degraded over time; potential for residents to be exposed in gardens via dermal contact and ingestion ✓	any residual liquid hydrocarbons in the soils and fills are unlikely to give rise to explosive / toxic gasses; potentially explosive / toxic gasses may be present due to the presence of made ground and historic mining activities at and near to site; the area is also affected by radon gas ✓
property: future built development	underlying soils and fills may contain elevated sulphate with potential to attack concrete structures within the ground (post-development) ✓	potential for organic contaminants associated with former uses of the site and surrounding area to locally affect water pipes (post-development) ✓	property risks from explosive / flammable gasses addressed under human health (future residents); no evidence of ground combustion ✓

✓✓ pollution linkage likely, ✓ pollution linkage reasonably possible, ✕ pollution linkage missing or insignificant even if source & receptor present

7.1. Human health

7.1.2. A soil contamination survey will be necessary in order to determine what if any contamination is present, and what remediation measures will be required. These might involve some limited removal of unsuitable or hazardous materials such as asbestos-cement fragments and refuse, and possible the use of clean soil cover in future garden areas. The typical clean cover thickness of soil over any residual contamination might be 600mm although this will depend upon the nature of any contamination.

- 7.1.3. Sources of potentially hazardous ground gas were identified during the investigation, principally mine gas and gases generated from colliery spoil at and in the vicinity of the site. There is potential for ground gases to accumulate within voids and underneath any built development, presenting a risk to future residents through the inhalation of toxic vapours and by the explosion of gases (assuming the presence of an ignition source). Risks from these geological sources tend to be low, and the generally cohesive nature of the subsoils will limit the potential for migration.
- 7.1.4. Assuming appropriate health and safety measures are adopted (i.e., the adoption of appropriate methods for working in confined spaces such as trenches) the construction workforce and future maintenance engineers are unlikely to be affected by toxic or explosive gases.
- 7.1.5. The information available also indicates that the site lies within a radon affected area and in the absence of adequate protection measures, there is a risk to future residents through the inhalation of toxic radon gas.
- 7.1.6. It is likely that gas protection measures will be required for housing within the development. Gas monitoring is likely to be required in order to confirm the gassing regime across the site and to be able to specify appropriate protection measures. Typically these will include the use of a landfill gas resistant membrane within building foundations, sealed service entries, and possibly the use of a passively ventilated sub-floor void.

7.2. Property

- 7.2.1. Underlying soils and fills, particularly the colliery waste in the northeast part of the site, may contain elevated concentrations of sulphate or sulphide with the potential to aggressively attack concrete structures placed within the ground. Soils and groundwater testing will be necessary in order to determine the requirement for sulphate protection in buried concrete.
- 7.2.2. No evidence of ground combustion was noted, however there may be some future potential for this depending upon the quantities of unburnt coal present in the spoil. Similarly, any coal seams out-cropping below or adjacent to building foundations may present a risk. Any risk of combustion can be minimised by the prevention of fires on the site, and the placing of compacted clay over any potentially combustible materials. It is normal to require at least 2m separation between coal seam outcrops and building foundations; assuming that the natural boulder clay on

the site provides at least this depth of cover, then specific measures with respect to coal seam outcrops will not be required.

7.2.3. Due to the former use of part of the site as a domestic garage, the soils and fills underlying the site may contain elevated concentrations of organic contaminants (specifically hydrocarbons) which could affect any water supply pipes laid within the ground. Soils analysis will be required in order to determine whether any precautionary measures are needed, such as construction of oversize trenches backfilled with clean material, or use of protected pipe materials.

7.2.4. Although outside the scope of this investigation, it is anticipated that due to the potential presences of shallow mineworkings below the site, drilling will need to be undertaken to determine the presence of any voids and requirements for ground consolidation.

7.3. Vegetation and plants

7.3.1. There is no evidence of vegetation disease or death at or in the immediate vicinity of the site. However, the underlying soils and fills may contain elevated concentrations of certain contaminants that could affect any plants or vegetation introduced to the site as part of the proposed residential development. Soils investigation will be required in order to establish any remediation requirements, however any such remediation is likely to be subsumed within any requirements for the protection of human health.

7.3.2. No invasive weed species such as Japanese Knotweed were observed during the site inspection.

7.4. Controlled waters

7.4.1. There are no surface waters at or in the vicinity of the site, therefore there are unlikely to be any immediate associated risks. However the avoidance of silty runoff during development works will be required. No contaminated leachate or mine discharges were noted during the walkover, although it is possible that piped drainage could leave the site, and this will require investigation.

7.4.2. Any acid leachate draining from colliery spoils, shafts or coal outcrops could require treatment if present. This might entail passing any drainage through limestone filters or lagoons.

7.4.3. No specific measures for the protection of groundwater are likely to be required, although any potentially significant sources of water pollution such as oil

contamination associated with the former scrapyard will require remediation.

8. Conclusions and Recommendations

8.1. Conclusions

- 8.1.1. The Phase 1 Contamination Investigation comprises a review of available information on the environmental setting of the site and the site's previous and current uses, and an assessment of the potential risks to the environment and human health.
- 8.1.2. The available information indicates that part of the site and surrounding area was subject to coal mining activity up to 1878, although most of the site appears to have remained undeveloped and appears to be uncontaminated.
- 8.1.3. A possible mine shaft is recorded within the eastern part of the site although the evidence for this is contradictory; two known shafts are present within the small former colliery and spoil tip to the north of the site. Exploratory drilling will be undertaken to investigate parts of the site where old shallow mine workings or coal seams could be present.
- 8.1.4. The preliminary site conceptual model and environmental risk assessment has identified the following potential issues for human health and the environment:
- risks to construction workers, future maintenance engineers and future residents from exposure to any contaminated soils and fills associated with previous garage, scrapyard and coal mining uses;
 - risks to future residents from exposure to toxic and explosive ground gases, including mine gas and radon, from mine wastes and old mineworkings; risks from ground combustion appear to be minimal but will require investigation;
 - risks to built development from the accumulation of potentially explosive ground gas underneath building foundations;
 - risks to concrete from sulphates and acidity associated within mine wastes;
 - risks to water supply pipes from hydrocarbon residues associated with the former garage and scrapyard uses;
 - risks to plants from contaminated soils (no evidence was seen of existing plant injury or death).
- 8.1.5. In conclusion, the Phase 1 Contamination Investigation found no evidence to suggest that the site cannot be developed for a residential end-use, subject to the use of normal remediation techniques where required. However, further

investigations will be required in order to determine the scope and design of appropriate remediation measures, as specified below. The septic tank that is present and which serves an adjacent house will need to be removed or incorporated within the proposed new development.

8.2. Recommendations

- 8.2.1. Further (Stage 2) investigations should include soil sampling, gas and groundwater monitoring, and exploratory drilling of the potential mineshaft location and potential shallow coal workings / seams.
- 8.2.2. Trial pits should be excavated across the site and into the side of the mound of colliery spoil on the northern side of the site. Typical maximum spacings of entries should 20m in areas of made ground, and 50m in areas of natural, uncontaminated strata. Trial pits should be dug using a mechanical excavator, 1m into natural strata where possible. A qualified and experienced environmental consultant should attend the site to log the strata and collect representative samples for laboratory analysis. As a minimum, one sample should be collected from each trial pit. Samples should be analysed for an appropriate range of contaminants given the former site uses, including pH, soil organic matter, metals, metalloids, sulphate, sulphur and sulphide, hydrocarbons, polyaromatic hydrocarbons and asbestos fibres. Calorific values should be measured on selected samples of colliery spoil.
- 8.2.3. Basic radon protection measures are required for the construction of the proposed residential development. However, additional protection measures may be necessary due to other potential sources of gas identified during the investigation. To fully characterise the gas regime of the site, it is recommended that 6 boreholes are installed (approximate 50m grid), drilled to approximately 5m depth or to the full depth of the made ground, whichever is greater, and equipped for monitoring gas and groundwater.
- 8.2.4. Using the criteria set out in CIRIA C665, 'Assessing risks posed by hazardous ground gases to buildings', the gas generation potential at the site is considered to be 'low' and the sensitivity of the development is 'high'. On this basis, it is recommended that gas monitoring is carried out over a period of 3 months, with monitoring on at least 6 occasions. The monitoring should include periods when atmospheric pressure is low and falling, under which conditions gas is most likely to migrate to the ground surface.
- 8.2.5. The monitoring should be undertaken for flammable gas (calibrated for methane), carbon dioxide, oxygen, carbon monoxide, hydrogen sulphide, borehole pressure

and gas flow. Volatile organic compound (VOC) vapours should also be monitored in each borehole. Following the completion of monitoring, a gas risk assessment should be carried out and gas protection measures for built development recommended accordingly.

- 8.2.6. It is also recommended that groundwater sampling is carried out from selected boreholes on at least 2 occasions. Each borehole should be purged of water prior to sampling, with samples analysed for a comprehensive range of contaminants including dissolved phase metals, hydrocarbons and polyaromatic hydrocarbons. In-situ water monitoring should also be carried out during the sampling for: pH, temperature, dissolved oxygen, electrical conductivity, redox potential, total dissolved solids and salinity.
- 8.2.7. The general litter and debris across the site surface is not a significant source of contamination. However, any asbestos containing materials observed at the site surface should be collected, securely bagged and disposed of at a waste management facility licensed to accept such waste. All appropriate health and safety measures should be adopted during the collection and removal of asbestos containing materials from the site. In addition, a suitably qualified and experienced environmental consultant should be consulted if any suspect materials are encountered during any site clearance works.
- 8.2.8. Exploratory drilling of mineshafts and into the Coal Measures will require prior authorisation from the Coal Authority to ensure that measures are taken to avoid creating risks to neighbouring development (from the pressurisation of gases in underground voids). Such drilling will need to cover all parts of the site due to the complexity of faulting and variations in seam positions and depths. Typically drilling will be carried out to 30m depth to ensure that all shallow workings capable of causing surface instability are investigated. If voids are detected then grouting is likely to be required below and adjacent to house plots.
- 8.2.9. Mine shaft treatment, if required, will require Coal Authority approval and will typically involve the grouting of the shaft and construction of a reinforced concrete cap at the bedrock surface. Alternatively, lesser treatment may be carried out if a stand-off for development from the shaft is adopted. This will typically be defined by a 45° slope from the shaft side at rockhead up to ground level. Thus for a 2m diameter shaft below 5m of glacial drift, the stand-off will have a radius of 6m from the shaft centre.

8.3. Limitations

- 8.3.1. This report has been prepared by SGP for the sole and exclusive use of Freedom Land Developments Ltd. Reasonable skill, care and diligence has been exercised within the timescale and budget available, and in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team in undertaking the assessment and preparing this report, it is possible that other ground conditions and contamination as yet undetected may exist. In particular, SGP has described the findings of third party reports and information sources. Whilst we are not aware of any inaccuracies in the information from third parties, SGP cannot be held liable for any inaccuracies that may exist.
- 8.3.2. Reliance on the findings of this report must therefore be limited accordingly. Such reliance must be based on the whole report and not on extracts which may lead to incomplete or incorrect conclusions when taken out of context.
- 8.3.3. SGP reserves the right to alter any of the foregoing information in the event of new information being disclosed or provided and in the light of changes to legislation, guidelines and responses by the statutory and regulatory authorities.

FIGURES