Monckton Coke and Chemical Limited

Monckton Production Facility

Data review and preliminary risk assessment

Report no. 321789(H)-R1 (00)

NOVEMBER 2014

RSK

RSK GENERAL NOTES

Project No.: 321789(H)-R1(00)

Title: Data Review and Preliminary Risk Assessment: Monckton Production Facility

Client: Monckton Coke and Chemicals Limited

Date: 25 November 2014

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Status: Final

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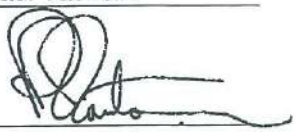
Signature		Signature	
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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Monckton Coke and Chemical Limited (MCCL) to carry out a preliminary geo-environmental risk assessment of the land at the Monckton production facility site. It is understood that consideration is being given to a change of use of the site following a possible future cessation of coke manufacturing activities. The site currently holds an environmental permit for these activities, and surrender of this will also be required.

This report is subject to the RSK service constraints given in Appendix A.

1.1 Objective

The objective of the work is to confirm the current knowledge of the ground conditions at the Monckton production facility in respect of contamination, and assess these with reference to the future environmental setting for the site, following a change of use from the current production activities.

1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2004) and guidance on land contamination reports issued by the Environment Agency (EA) (2010).

The scope of works for the assessment included:

- a site walkover of the accessible parts of the site
- a review of available data relating to ground conditions including previous intrusive investigations
- purchase and review of an environmental database report, historical mapping and coal mining data
- completion of a conceptual model and preliminary risk assessment (PRA) to identify and consider potentially complete contaminant linkages
- identification of outline development constraints and provision of recommendations for further work.

1.3 Existing reports

The following reports detailing previous works at the site were made available for review:

- Monckton Coke and Chemical: Phase 1a Site Report. Reference ILM081/1a, Issue 1. ABB Eutech, 22 August 2001
- Monckton Coke and Chemical: Phase 1b/2 Site Report. Reference ILM092/1b-2, Issue 1. ABB Eutech, 19 April 2002
- Environmental Due Diligence: Monckton Coke and Chemical Works. WSP Environmental UK, June 2005. (No document reference indicated, though a project number of 12022228 and a file reference of 001 are listed.)
- Environmental Assessment: Monckton Coke and Chemicals Limited. Reference 16492-R1(00). RSK STATS Geoconsult Limited, dated May 2011
- RSK letter report on groundwater sampling, reference 321453(H)L01(00), dated 19 August 2013.

These reports are discussed in Section 4.

1.4 Limitations

The comments given in this report and the opinions expressed are based on the available data reviewed by RSK. However, there may be conditions pertaining to the site that have not been disclosed by the data review and therefore could not be taken into account.

2 THE SITE

2.1 Site location and description

The site is located on Lund Hill Lane, Royston, north east of Barnsley, South Yorkshire, at National Grid reference 437460, 412020, as shown on Figure 1. The main operational site covers approximately 14 hectares, and is accessed via two gated entrances off the B6428 road (Lund Hill Lane). This road forms the southern and eastern site boundaries, with a railway in a cutting forming the western boundary. A further parcel of land to the south west of the main site, on the other side (to the west) of the railway is also part of the site. The entire land holding extends to approximately 18 hectares.

The operational site comprises a coke manufacturing plant with associated by-product manufacture and electricity generation. As such, areas of the operational site include a coal and coke stockpile yard area to the north, coke and by-products production area close to the site centre, a combined heat and power (CHP) plant to the south, and office building and messing facilities to the east. Outside the operational site are small areas of unused land to the north and south, as well as the parcel of land to the west of the railway, which is currently used for the grazing of horses.

The coke ovens are located in a battery close to the site centre. After being discharged from the oven, the hot coke is taken to a quencher tower, where process water is poured over to cool it. Flue gases from the coke ovens are piped to the by-products plant area where they undergo a series of production processes that produce tar, benzole, ammonia and residual coke oven gas.

The gas was formerly purified at the parcel of land to the west of the railway, before being sold off-site. Now the gas is used by the site's CHP plant (located to the south of the site centre) to generate electricity and steam.

There are two workshops on site. The main engineering workshop is located near the eastern boundary of the site and includes the site stores and a nearby area for waste collection. A substation is also located near here. The second workshop is for servicing mobile plant and is located adjacent to the coke stockpile area.

The main by-product production areas are in the centre of the site and consist of various tanks, pumps, vessels and interconnecting pipework. Combustion gases from the ovens are fed into the production area, which is generally divided into tar, benzole and ammonia production areas. Remaining gas after these processes is used as fuel for the CHP plant nearby to the south.

Ground levels at the site are generally highest to the south of the site centre (between the CHP plant and the by-products area) from where they fall gently to the north and steeply to the south.

The town of Royston lies immediately to the south west of the site, and in other directions the land use is largely recreational and commercial. Residential properties lie within 10m of the west of the western land parcel, and there is a single residential property on the other side of Lund Hill Lane to the south of the main site.

The extent of the site is shown in Figure 2.

2.2 Proposed development

The site in question is being considered for redevelopment in the future. The future use of the site is not currently known, but it may include a mix of residential and commercial properties and public open space.

3 DESK STUDY REVIEW

3.1 Site walkover

The site was visited on 3 November 2014 to undertake a site walkover. The findings are discussed below.

The operational site area occupies the centre and north of the main site. Coke and coal is stored in the stockyard located over the northern part of the site. Here the ground surface comprises predominantly sandy gravel of coal and coke, though it is understood that concrete hardstanding underlies this in many places. The stockyard extends to the centre of the northern boundary, and in the north eastern corner of the site is an area of unused, marshy land, with unmanaged vegetation including semi-mature trees. This area is not currently accessible by vehicles due to the presence of a soil bund (some 4m to 5m in height) that separates it from the rest of the site, and also runs along parts of the northern site boundary. Where the soil in this bund is exposed it can be seen to contain materials including broken brick and concrete.

At the north eastern corner of the site is an unused area of former rail track and surrounding land, with unmanaged vegetation, and, in places, rail ballast at the surface. This area was not accessed during the site walkover. In the area possible Japanese knotweed was noted, though positive identification was not made due to the restricted access and the walkover taking place outside of the growing season. Japanese knotweed is a non-native, highly invasive species, and as a result of controls to prevent its spread its presence can be a constraint to development works. It is recommended that the site be resurveyed during the growing season.

The two main workshops on site are located centrally in the stockyard area of the site and near the eastern boundary. Various oil containers are stored in both, sometimes not on drip trays, and the floors are heavily stained. There is a designated oil storage building in the north eastern corner that contained new drums of oil of various sizes. Immediately adjacent to the workshop in the coal stockyard is a large above-ground tank used for refuelling the site mobile plant.

The ground surface in the production area was observed to be heavily stained, with indications of recent diffuse and point releases. The condition of some plant in the area is poor with, for example, leaking pipework, leaking valves and pumps, leaking tanks and indications of severe corrosion. Surface water gullies in the area collect liquors that had escaped from the equipment, and in some cases did not appear to be in good condition. The ammonia production area was noted as being in particularly poor state of repair with vessels with exposed lagging and corroded interconnecting pipework. There was evidence of spillages having occurred in the vicinity of a number of the loading/unloading points and damage to the infrastructure (e.g. pipework supports, etc.) in several places. Concrete hardstanding in the area was damaged in many places (e.g.

uneven, cracked, etc.). Many containment bunds did not appear to be in good condition. Equipment and concrete at the western end of the by-products production area was noted to have blue staining in places, possibly associated with the presence of cyanide. It was noted that the steam-powered tar pump previously present has recently been replaced by electric pumps.

The CHP plant is relatively modern and in good condition, though ground staining was observed in the area. Bunding around hydrochloric acid and caustic soda tanks near the south west corner of the building was constructed in blockwork and there was evidence of staining within the bunded area. The exploration borehole drilled to investigate the possibility of extracting coal gas methane at the site is visible to the west of the CHP plant.

Site representatives indicated that pipework carrying effluent from the ammonia plant to the biological treatment plant had leaked on a number of occasions in the past, but that this had now been renewed. The southern part of the main site, outside of the biological treatment plant, comprises predominantly vegetated unused land with numerous semi-mature trees. A small compound is also present in this area where the biological effluent treatment plant discharges to the sewer network.

The western land parcel was noted to comprised entirely softstanding, with the majority of the area occupied by a paddock used for grazing horses. There is a small stable building on site. Apparently on site, and adjacent to the eastern and northern boundaries (although the exact position of the northern ownership boundary was unclear) the ground level rises steeply. Vegetation is present on the top of the slope, but the faces are exposed and appear to comprise colliery spoil, which is red in places.

During the walkover it was noted that the protective covers on the monitoring wells installed during the 2011 investigation were generally intact and in good condition, except that the cover of BH205 was missing and the installation is assumed lost.

In addition to the above, discussion with site representatives revealed the following:

- The positions of the three on-site mineshafts are well known. The shafts were initially capped in c.1966-1967. Following revision of the guidelines for shaft capping, all three were re-capped in c.1994 with a concrete slab 20m by 20m and 2m thick.
- The gas purification plant on the western land parcel was last used in 1996.

3.2 Ground conditions

3.2.1 Geology

According to information provided in the RSK report of 2011, the geology beneath the majority of the site consists of sandstone (i.e. Mexborough Rock) from the Bolsovian (Westphalian) geological age, overlying mudstone, siltstone and sandstone (i.e. Pennine Middle Coal Measures Formation from the Bolsovian to Duckmantian (Westphalian)

ages). The northern and south western parts of the site are shown to be underlain by the Pennine Middle Coal Measures, with the Mexborough Rock absent. There is little overlying superficial geology in the area with the exception of made ground, which is shown to cover the majority of the site. Based on the BGS map, the strata dip generally northwards or north eastwards at a shallow angle, shown nearby as 3 degrees.

Previous intrusive investigations undertaken at the operational area of the site by a third party (ABB Eutech) in 2002 and by RSK in 2011 have confirmed the presence of made ground across the site comprising coal, coke, clinker, sandstone, brick, concrete, ash, sand and clay. This generally overlies bedrock of sandstone and mudstone, which was often weathered in the upper surfaces, and was usually encountered at depths from between 1.0m and 3.0m below ground level (bgl). Superficial deposits of sandy gravelly clay or silt have been reported in the northern site areas.

3.2.2 Radon

The environmental database report (Landmark, 2014) indicates that site is located within an area where more than 1% of homes are above the Action Level as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002). In affected areas radon concentrations are generally low in well-ventilated workplaces such as workshops, but problems have been found in some more confined workplaces, such as offices, where rates of ventilation are relatively slow. If the site is considered for future residential development, further assessment will be required, in line with the guidance provided in BRE publication 211 "Radon: Guidance on Protective Measures for New Dwellings (2007)".

3.2.3 Mining and quarrying

The site has formerly been occupied by a coal mine. In addition, a small area near the south eastern boundary and an area overlapping the northern boundary are shown on historical mapping to have formerly been occupied by a quarry and a clay pit, respectively. See historical data in Section 3.5 for more information.

A Coal Authority Report was obtained for the site (see Appendix C), and indicates the following:

- The site is within the likely zone of influence of 11 seams of coal at 90m to 520m depth that were last worked in 1982.
- Ground movement from past mining activities should by now have stopped.
- The site is within an area where shallow reserves of coal are believed to exist. As such there is potential that unrecorded coal workings are present at or close to the surface.
- The site is not in an area likely to be influenced by present underground coal workings.

- Within, or within 20m of, the site boundary there are three mine entries. All of these are located on site on the current coal and coke stockyard area. Records for the three are as follows:
    - 437412-001; filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal.
    - 437412-002; filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal in February 1989.
    - 437412-003; filled to the surface and capped (15m x 15m x 1.2m reinforced concrete) by British Coal.

For the above three mine entries, the mine entry data sheets (see Appendix D) were also obtained from the Coal Authority. These indicate the following additional information:

- 437412-001; named New Monckton Colliery No. 1 Shaft. 450.8m deep, 5.28m diameter.
- 437412-002; named New Monckton Colliery No. 2 Shaft. 446.2m deep, 5.28m diameter.
- 437412-003; named New Monckton Colliery No. 6 Shaft. 489.2m deep, 7.32m diameter.

The details provided by the Coal Authority differ slightly from those given by the site representative in Section 3.1. It is considered likely that the details from the Coal Authority represent the more accurate record.

3.2.4 Landfilling and land reclamation

There are a number of landfill sites in the area listed in the environmental database report, with the many clustered off site to the west on the land adjacent to the canal and railway line, including one in the area between the canal and railway line formerly used by the on-site colliery for tipping spoil from the mines. This landfill is listed as an on-site feature, although mapping shows it to occupy the area immediately to the north of the western land parcel, sharing a common boundary. There is little information for this closest landfill, which is named as Poplar Terrace. Other, overlapping, landfill sites are listed, predominantly located to the west of the canal, that received various commercial, domestic and liquid wastes. Another area of landfill is shown as little as 20m to the south of the western landfill parcel, on the other side of Lund Hill Lane, and an entry for this site indicates it to have received wastes including household waste.

A number of other entries refer to landfills further from the site, clustered to the south and south east. They also include another area apparently formerly used by the colliery for tipping spoil from the mines. One of the entries lists the operator as Monckton Coke and Chemical Limited. These landfills are all more than 250m from the site.

A Registered Waste Treatment or Disposal Site entry is listed, for a location 40m off-site to the south of the western land parcel, that relates to a licence held by Monckton Coke

& Chemicals Company Limited for materials generated through the desulphurisation and purification of coke oven gas.

Historical maps for the site show mounds of apparent colliery spoil, from the on-site colliery, to have formerly been present on the western land parcel. Such mounds also extended away from the site to the west, north, and east.

With reference to the historical data there have clearly been several phases of construction and demolition on the site and therefore the presence of made ground should be expected.

3.3 Hydrogeology

The underlying bedrock is designated by the Environment Agency (Landmark 2014) as a Secondary A aquifer (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). Due to the absence of overlying superficial deposits, there is no aquifer designation for them.

Groundwater vulnerability mapping indicates overlying soils to have a high (unknown) leaching potential.

The site is not in or near an area classified by the Environment Agency as a ground water source protection zone. There are no groundwater abstractions listed in the environmental database report (Landmark 2014) within 1km of the site.

The previous intrusive investigations of 2002 and 2011 did not positively determine a clear direction of groundwater flow.

3.4 Hydrology

There are a number of surface water features indicated in the environmental database report (Landmark 2014) in the vicinity of the site. A surface water feature is indicated alongside the western boundary of the main site (adjacent to the railway line), and this is shown in different places to be a tertiary and a secondary river. Another tertiary river is shown off-site close to the western boundary of the western land parcel. Both these water features are shown ultimately to connect Pools Dike, 500m south of the site, which flows to the south. In addition, the disused Barnsley Canal runs in a north south direction to the west of the site.

Several surface water abstractions are listed in the environmental database report (Landmark 2014) as held by Monckton Coke & Chemicals Company Limited for abstraction of water from the Barnsley Canal for industrial use. Site representatives have indicated that this abstraction is seldom used, and that most of the process water used by the site is groundwater abstracted from a former coal mine shaft (No. 4 shaft), located several kilometres from the site.

3.5 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on historic mapping provided in the environmental database report (Landmark 2014). The review is designed to identify potential historic sources of contamination that may have impacted soil or groundwater quality beneath the site and to identify any potentially contaminative land uses in the surrounding area that may have impacted the site. The findings are presented in Table 1, below.

Table 1: Review of historical mapping

Map Dates	Description
1854 (1:10,560)	The site and surrounding area is shown as undeveloped agricultural land. The railway that passes between the main site and the land parcel to the west is shown, as is the Barnsley Canal.
1893 (1:2,500)	The site is developed as Monckton Main Colliery from the centre to the north, with shafts shown in two places. Overlapping the northern end of the site a brickworks and clay pit and some apparent residential properties are shown. A network of railways is shown connecting the colliery and brickworks to the nearby main railway lines. The site has numerous railway tracks and sidings, three areas of coke ovens located to the north of the position of the existing ovens, a gas works located to the west of these, and two 'powder magazines' close to the site centre. One of the railway tracks crossing the site appears to be at a lower level, passing beneath other tracks. The southern end of the site is clear of colliery buildings and appears to be open land with terraced houses and a Methodist church at the southern most corner. At the south eastern side of the site, adjacent to Lund Hill Lane, a quarry is shown. The land parcel to the west of the railway is linked by a rail track from the colliery and is shown as a spoil heap. The offsite area immediately to the north of this (between the canal and the railway) is also shown as a spoil heap, and also a dock and a quarry.
1906 (1:2,500)	Generally as above, but with additional buildings, plant and rail tracks over the northern site area and in the site centre, in the location of the existing by-products area. The powder magazines are no longer shown. Filter beds are shown in two locations on the west of the main site, close to the railway. The area at the northern end of the site is not shown as a brickworks, though kilns are shown. A single gasholder is shown on the southern part of the parcel of land west of the railway.

Map Dates	Description
1917-1918 (1:2,500)	The coke ovens are indicated to be in a position consistent with their current location, and a number of the features in the existing by-products area are annotated as tanks. The apparent lower level railway track crossing the northern part of the site is indicated to be within a tunnel. In addition to the two shafts previously shown, an air shaft is shown close to the site centre. The gasometer is no longer shown on the western land parcel. The gas works is no longer shown on the main site area.
1932- 1933 (1:10,560)	Two circular features are shown on the southern part of the western land parcel. Spoil heaps apparently emanating from the colliery on site are shown extending off-site to the east, to Rabbit Ings, and to the north. The town of Royston is indicated to have expanded considerably with residential areas developed to the west of the canal.
1962 (1:2,500)	The northern part of the site is annotated as a mine, and the site centre as works. The configuration of buildings on the northern part is largely changed. A large building with a number of rail tracks is present on-site close to the northern boundary, and this appears to be linked by a linear structure to the works near the site centre. In the north western site corner are two rectangular features annotated with 'water', one of which is consistent with a current water tank. The mine is also linked to a further area of buildings on the other side of Lund Hill Lane. The western land parcel is annotated as works and a number of large rectangular buildings and two circular features occupy almost the entire area, with earthworks shown around along the northern and eastern boundaries.
1977 (1:1,250)	Only a small part of the site is shown on this map. This shows that the terraced houses on the southern part of the site are no longer present. The circular features on the western site area are annotated as gasholders.
1981 (1:10,000)	Much of the rail track on the site is gone, and the railway adjacent the northern site boundary is shown as dismantled. The building on site close to the northern boundary is annotated as 'Mine (dis)'. The area off site to the east formerly shown as a spoil heap for the on-site quarry bears the legend 'Tip (disused)'.
1990 (1:10,000)	Generally as above, but with further reduction in the number of buildings and features over the northern site are, including the absence of the building formerly located near the northern boundary.
1993 (1:2,500)	More of the buildings over the northern part of the site are no longer shown.
1994 (1:1,250)	Only a small part of the site is shown. The rail track looping on site to the south of the site centre is no longer shown. The current biological effluent treatment plant is shown on the southern part of the site.

Map Dates	Description
2006 (1:10,000)	Generally as today, with most of the railways and sidings not shown. Buildings on the site appear to be as they are today, with the CHP plant and office block added since the preceding map. Other than a slope, there are no features shown on the western land parcel. The former spoil areas off site to the west, north and east are mostly shown as woods. The current sewage works and coal yard off site to the north are indicated to be present.
2014 (1:10,000)	As today and generally as above, but with one of the buildings and one of the rectangular water features not shown on the northern part.

3.6 Sensitive land uses

Information in the environmental database report confirms that the property and surrounding area are not subject to sensitive land use designations such as SSSI (Sites of Special Scientific Interest). Areas of adopted green belt exist in the surrounding area and the area in general is in a nitrate vulnerable zone

4 PREVIOUS GROUND INVESTIGATION REPORTS

Available information from known phases of site investigation work undertaken at the site in relation to soil and groundwater contamination is summarised below:

4.1 ABB Eutech, 2001, Phase 1a Site Report

This Phase 1a investigation was commissioned in 2001 and the report is dated 22 August 2001. According to the introduction the report was prepared to support a pollution prevention and control (PPC) permit application by Monckton Coke & Chemical Limited, and the report looked at the operational area of the site.

The site history and other details relevant to subsurface contamination are derived from sources including historic mapping and interviews with former site employees. The following points of interest are presented in the report:

- A mine-gas exploration borehole was recently drilled on the southern part of the site, close to the CHP plant, to a depth in excess of 500m, though no further information is available.
- An area to the south of the by-products area was historically used for the disposal of tar and associated liquids.
- There is evidence that the former quarry on the south eastern part of the site (shown on mapping of 1883) was partially infilled with waste material. (The report does not indicate the nature of the evidence.)
- Corrosion of the concrete floor has occurred as a result of leaks from the concentrated ammoniacal liquor (CAL) plant.
- Tar spills and leaks have coated the ground surface in the by-products area.
- Leaks from the CAL and benzole plants could overflow drainage channels and flow off-site to the west to the railway cutting. An area of vegetation in the railway cutting appeared to be showing stress as a result of this happening.
- Leaks of the effluent from the pipework carrying it to the biological effluent treatment plant have frequently occurred in the past, and have at times impacted the railway embankment to the west of the site. The site effluent lines were subsequently replaced.
- A leak of 600 litres of oil to Cudworth Dike occurred from the CHP plant, and frequent spillages of concentrated sulphuric acid occurred from the 'salt house and acid tanks'. (Cudworth Dike is not indicated on recent mapping for the area. As such it is unclear which watercourse this refers to.)

- Between 1960 and 1972 tar acid and benzole were regularly tipped next to the railway embankment, to the south of the benzole plant.

The report concludes that there is the potential for contamination to be present in the ground under specific areas of the site. Potential contamination could have resulted from loss of containment in process or storage areas, waste disposal and leakage or failure of drains and pipelines. As a result, a number of significant contaminant linkages to receptors are considered to be potentially present. An intrusive investigation was recommended.

4.2 ABB Eutech, 2002, Phase 1b/2 Site Report

The purpose of this report, which is dated 19 April 2002, was to establish the baseline site conditions in the operational area for the purpose of the PPC permit (now the environmental permit).

Intrusive investigations comprised the excavation of 33 trial pits and the drilling of six boreholes over the site. Trial pits were taken to a maximum depth of approximately 3.5m below ground level (bgl) using a mechanical backhoe excavator. Boreholes were drilled to a maximum depth of approximately 37m bgl using rotary open hole methods with air flush. Monitoring wells were installed in boreholes to facilitate subsequent groundwater monitoring.

Samples of soils were recovered for chemical analysis, as were groundwater samples, surface water samples from the Lineside Dyke (in the railway cutting to the west of the site) and samples of leachate from the side of the adjacent railway cutting. Field measurements of volatile organic compounds in soil headspace were made using a portable photo-ionisation detector (PID).

Ground conditions encountered comprised between 0.3m and 3.0m of made ground, including clay, sand, gravel, coke, concrete and bricks. Made ground was underlain by Coal Measures, outcropping as sandstone (Mexborough Rock) and undifferentiated mudstones. The upper horizons of the Coal Measures were found to be weathered in places to form sand and gravel to a maximum thickness of 1.1m (TP2). Groundwater was reportedly encountered during the drilling of boreholes BH1, BH2 and BH3 at depths of 8.5m, 14.1m and 20.6m bgl respectively.

Visual and olfactory evidence of contamination was encountered during the site works. Tarry products, hydrocarbon sheens and odours were recorded in several trial pits, particularly in the central portion of the site. The text of the report indicates that floating product was encountered at water strike in borehole BH5, and black tarry product was encountered at water strike in the second sandstone unit encountered in borehole BH6.

Chemical analysis identified elevated levels of inorganic and organic contaminants in some soil and groundwater samples. The maximum concentrations of contaminants in soil were generally encountered in trial pits in the by-products area. The maximum

concentrations in groundwater were generally encountered in monitoring well MW5, situated in the western portion of the by-products area, close to the western boundary of the site. Analytical results include the following maximum recorded values:

Soils:

- TPH (total petroleum hydrocarbons): 47,525mg/kg;
- BTEX (benzene, toluene, ethyl benzene and xylenes): 0.436mg/kg;
- PAH (polycyclic aromatic hydrocarbons): 16,200mg/kg;
- phenol Index: 21.5mg/kg; and
- sulphate: 17,100mg/kg

Groundwater:

- PAH: 1.35mg/l;
- BTEX total: 0.246mg/l;
- SVOC (semi-volatile organic compounds): 0.437mg/l;
- TPH: 26mg/l; and
- cyanide: 3.3mg/l.

Elevated concentrations of BTEX contaminants were also identified in the sample of leachate taken from the railway cutting, although the samples taken from the drainage ditch beneath recorded concentrations below laboratory detection limits.

The intrusive work identified considerable soil and groundwater contamination, predominantly concentrated under the by-products area.

4.3 RSK, 2011, Environmental Assessment

The purpose of the RSK investigation was to assess the contamination status of soil and groundwater beneath the operational site area to identify any resulting liabilities. The first part of the report comprised a desk study of the available information, including the ABB Eutech reports detailed above. A preliminary risk assessment (PRA) undertaken using the existing data identified a number of potentially complete contaminant linkages, including risks to site workers as a result of both contact with any contaminated soils and migration of ground gases, and mobilisation and migration of contaminants to surface waters and deep groundwaters.

Twelve windowless-sample boreholes were attempted and five deep boreholes were drilled by rotary means. The rotary drilling adopted re-circulated water flush drilling methods due to the possibility of hydrocarbon vapours within the subsurface. Monitoring wells for groundwater were installed in the rotary boreholes, and ground gas and

groundwater monitoring wells were installed in most of the windowless-sampling boreholes.

Investigation locations were selected to provide a general coverage of the site, but with a focus on the areas where potential sources of contamination were identified. As such, most of the shallow, windowless-sample boreholes were located in and around the by-products area in the site centre.

Groundwater samples were recovered from all of the wells installed within the deep, rotary boreholes, as well as from one of the shallow window-less sampling boreholes. A sample of the groundwater was also collected from the inspection pit of borehole BH204, before the borehole was drilled, by direct filling of the sample containers. Ground gas monitoring of the installed wells was carried out on one occasion.

The ground conditions encountered comprised concrete hardstanding at the surface at four locations. Made ground was encountered across the site in all locations, to depths of between 0.2m bgl in the site centre and 2.9m bgl on the northern part of the site. Made ground materials generally comprised a dark brown, grey or black silty gravelly sand, the gravel comprising of clinker, ash, coal and brick fragments. At one location close to the western boundary, a borehole refused on a hard obstruction at a depth of 2.0m bgl, without having proved the base of made ground materials.

In the majority of locations, sandstone bedrock was encountered directly beneath the made ground, and this was mostly weathered to a gravelly sand at its upper surface. At its shallowest, the (weathered) sandstone bedrock was recorded from 0.2m bgl, at a location in the centre of the site. In locations over the northern part of the site, superficial deposits of sandy gravelly clay or silt were found to lie beneath the made ground, and these were reported to a maximum depth of 4.0m bgl. In two of the five deep boreholes, grey mudstone bedrock was encountered beneath the sandstone.

Shallow, perched, groundwater was encountered in the inspection pits of three of the boreholes, all located in the by-products area. Due to the use of water flush during the rotary drilling, groundwater strikes within the underlying bedrock could not be recorded.

Whilst drilling through the made ground, contamination consisting of tar and petrol odours was recorded in two locations in the by-products area, and another on the northern part of the site close to the settlement pond. A slight chemical odour was noted in a location close to the existing gasholder. Drilling returns from the sandstone bedrock were noted to have a strong hydrocarbon odour and dark staining in a number of the boreholes around the by-products area. In one location such contamination was also observed in the underlying mudstone.

Samples of soil and groundwater were analysed for a range of organic and inorganic determinants, and the results were compared to RSK's human health generic acceptance criteria (GAC) for a commercial end-use. A number of the soil and groundwater samples were found to contain concentrations of hydrocarbons, PAHs and VOCs above these GAC. These samples were predominantly from locations in the by-products area, but also from areas to the west and north.

The results of analyses of groundwater samples were also compared against RSK's GAC for controlled waters. A number of the determinants were recorded at concentrations above the GAC. In particular, groundwater samples from locations in and around the by-products area recorded elevated concentrations of a number of organic compounds.

The report concludes that there is significant contamination of soil and groundwater beneath the site, and a number of complete contaminant linkages that have been assigned a moderate risk. The receptors considered to be at risk are site operatives and nearby controlled waters, and the controlled water receptors are considered to be of generally low sensitivity. The report also indicates that remedial works would be required to address soil and groundwater contamination prior to any future change of use of the site.

4.4 RSK, 2013, Groundwater Sampling

RSK returned to site in 2013 to recover and analyse samples of groundwater from the monitoring wells installed in 2011. In one of the monitoring wells located to the east of the by-products area a significant thickness of dense non-aqueous-phase liquid (DNAPL) was recorded. This DNAPL was reportedly not expected given the observations made in 2011, and the reason for its presence was unknown. Analysis of the product indicated it to be possibly largely composed of PAHs, which may be consistent with coal tar, a common contaminant of coal carbonisation sites. Apart from this presence of DNAPL, groundwater conditions in the other monitoring wells were found to be generally consistent with those from the investigation of 2011.

4.5 WSP Environment Limited, 2005, Environmental Due Diligence

RSK understands that there are numerous documents relating to the former gas purification site located on the western land parcel. RSK has not had sight of these, and full review of them is beyond the scope of this report, but a review carried out by WSP Environment Limited as part of their 2005 report has been made available and is discussed below.

There have apparently been two intrusive investigations of the western land parcel, in 1997 and 2003. Visual and olfactory evidence of contamination of soils was encountered in both, which is consistent with the previous use of the site. The investigation identified contamination of the soil with metals, cyanide, sulphates and phenol, and of the groundwater with cyanide, phenols, metals and PAHs.

Remediation of the former gas purification site was apparently proposed that included removal and off-site disposal of certain soils, followed by engineering methods to provide containment for the remainder of the site. According to a site representative interviewed for the report the containment comprised installation of low permeability

grout walls in the subsurface to restrict lateral groundwater migration, along with a low permeability capping layer over the ground surface to limit infiltration of rainwater. The site representative indicated that remediation was approved by the Local Authority and the Environment Agency. It was also indicated by the site representative that although the remediation was completed, the proposed validation works – to include installation of a number of groundwater monitoring boreholes – were not.

5 SITE ZONING AND CONTAMINATION SOURCES

For further assessment of the site it may be appropriate to consider four separate areas, being different parts of the site that have been subject to different historical and current activities. The sources of contamination and the level of knowledge of ground conditions are different for each area. They are discussed in more detail below.

5.1 Production and by-products area

The production and by-products area occupies the centre of the site, from (and including) the CHP plant in the south to the coke ovens and conveyor in the north. This area has apparently been used for the production of coke and associated products for over a century. The current usage also includes the CHP plant. In addition to the coke and by-products production activities that still take place in this area, historical use includes a gas works located to the north west, filter beds to the west, and rail tracks to the south.

It is assumed that over that time period various leaks and spillages of tars and liquors have occurred, and waste disposal practices that would not be acceptable today will have taken place. Small scale leaks and spillages are likely to be ongoing. Contaminants associated with coal carbonisation include cyanide, arsenic, ammonia, phenols, and hydrocarbons including coal tar, PAHs and BTEX compounds. Various lubricating and fuel oils and other chemicals will also have been used on this part of the site. Made ground materials including ash, clinker and demolition wastes are known to be present over this area, although not generally as thick as on other parts of the site. There have been a number of phases of development, and there are likely to be remnant structures in the subsurface and locally thicker areas of made ground, possibly including former tanks containing residual product.

A number of trial pits, deep rotary boreholes and shallow boreholes have been drilled across the production and by-products area during the intrusive investigations of 2002 and 2011. These have generally confirmed typically shallow made ground overlying sandstone bedrock. Significant hydrocarbon contamination has been encountered both within the made ground and in the underlying bedrock. Groundwater encountered in this area has included limited shallow perched water within made ground, as well as deeper groundwater lying at between 8m and 22m bgl in the underlying bedrock. Significant hydrocarbon contamination of the groundwater within the bedrock has been identified through laboratory analyses.

5.2 Stockyard and former colliery

The area currently occupied by the coke and coal stockyard extends north from the production area to the northern site boundary, and includes currently unused areas of the site to the north west and north east. This area was formerly the hub of the colliery operations, historically including numerous buildings and rail tracks. In addition, a brickworks, clay pit, filter beds and residential properties once overlapped the far northern part, and coke ovens were formerly located to the south and east of this area. The three mineshafts on site are located to the centre of this area. As well as coal/coke storage, the ongoing use of the site includes workshops, mobile plant refuelling and effluent handling and storage.

Contamination of soil and groundwater is likely to have occurred as a result of the historical colliery and other operations over the stockyard and former colliery area. The presence of made ground is known across the area, associated with the various phases of development that have taken place here. There are likely to be remnant structures in the subsurface and locally thicker areas of made ground, including possibly in the area of a former rail 'tunnel' that is shown on historic plans. At the northern end of this area a clay pit and water reservoir may also result in locally deeper made ground. Waste disposal practices would have taken place in the past that would not be acceptable today, and small scale leaks and spillages of lubricating and fuel oils may be ongoing from current activities.

A number of trial pits, deep rotary boreholes and shallow boreholes have been drilled across the stockyard and former colliery area during the intrusive investigations of 2002 and 2011. These have generally confirmed made ground to maximum depths in excess of 3m overlying sandstone bedrock. The contamination of soils and groundwater beneath this part of the site is generally much less significant and widespread than in the production and by-products area, although elevated concentrations of contaminants have been identified in some locations. The currently unused areas to the north west and north east have not been investigated.

The three mineshafts located in the coal stockyard are likely to represent a constraint to future development, as a 'no-build' zone will be required above each. As well as buildings, roads and other infrastructure would not be expected to be permitted in this no-build zone. The size of the no-build zones will depend on the diameter of the shaft and the depth of superficial material overlying rockhead. It is anticipated that given the relatively shallow depth to rockhead on this site the no-build zones will only extend a few metres from the shaft. Prior to development it will be necessary to positively locate each shaft, and the Coal Authority may insist that investigation of the shaft caps be undertaken to demonstrate that they are suitable for use.

5.3 Southern site section

The southern site section incorporates the area from the south of the CHP plant to Lund Hill Lane, and west to the adjacent railway line. From review of historical mapping,

contaminative previous uses of this area have generally not been identified. Residential properties were formerly present, as was a quarry. Prior to the installation of the current biological effluent treatment plant there appears to have been little operational activity. Today, apart from the effluent plant, this area remains largely unused. The topography of this area slopes steeply down to the south, terraced in places, and it is considered likely that the area (particularly the elevated ground level near to the railway line to the west and the former quarry to the east) has previously been used for the deposit of colliery spoil and other waste materials.

Contamination is considered likely to be present as a result of made ground materials, possibly including ash and clinker and demolition wastes. As well as such materials coming from elsewhere on the wider site, demolition wastes are likely from the former houses, and there may be remnant structures in the subsurface. There is the possibility of contamination as a result of leaks from the biological effluent treatment plant and associated pipework. It is also considered likely that migration of contamination from the by-products area and CHP plant following the topography of the site would have occurred. In addition, rail tracks were historically present up-gradient.

Intrusive site investigations carried out in this southern site area are restricted to a trial pit (TP30) and a borehole (MW3) advanced during the investigation in 2002, close to each other and adjacent to the effluent treatment plant. The site plan presented in the report of the 2002 investigation indicates a second trial pit (TP29) in the area, but there are no further records for this and it is assumed not to have been undertaken. In the two completed investigation locations 1.3m and 1.8m of made ground was reported, and no visual or olfactory evidence of contamination is indicated. Limited laboratory analyses of soil and groundwater samples from these locations did not identify significantly elevated concentrations of the contaminants tested for. The depth of groundwater reported in the borehole is some 20m bgl.

5.4 Western land parcel

The western land parcel has historically been used for the deposit of colliery spoil, and more recently for the purification, storage and distribution of gas produced as a by-product from the manufacture of coke. Contamination of soil and groundwater at the site is likely to have resulted from the gas purification activities.

RSK understands that remediation of this land parcel was undertaken some ten years ago to address soil and groundwater contamination. There are apparently numerous documents relating to the site available, including reports detailing site investigations undertaken and remediation requirements. RSK has not had sight of these reports, and full review of them is beyond the scope of this report. Information provided to RSK indicates that remediation of the former gas purification site was proposed that included removal and off-site disposal of certain soils, followed by engineering methods to provide containment for the remainder of the site. The containment apparently comprised installation of low permeability grout walls in the subsurface to restrict lateral groundwater migration, along with a low permeability capping layer over the ground

surface to limit infiltration of rainwater. Information presented in the WSP Environment Limited report of 2005 indicates that remediation was completed, but that the proposed remediation validation was not.

6 CONCEPTUAL MODEL

The information presented in Sections 2, 3, 5 and 5, has been used to compile a conceptual model. The identified potential sources of contamination, associated contaminants and receptors have been considered, together with plausible pathways that may link them. The resulting potential contaminant linkages are considered in Section 6.5. The risk classification has been estimated in accordance with information in Appendix E.

As this report looks to the possibility of future redevelopment of the site the current site operatives are not considered as a receptor.

6.1 Potential contaminant sources

The potential sources of subsurface contamination at the site are discussed in Section 5. In some parts of the site there is data available that confirms that contamination has occurred, in other parts the current contamination status is unknown.

Chemicals which have been found to be present in soil and groundwater in some parts of the site and may be present in others include petroleum hydrocarbons (including BTEX), PAH compounds, phenols, sulphates (and other sulphur-containing compounds), ammonia compounds, cyanide and other heavy metals, and VOCs and SVOCs.

It is likely that asbestos was widely used for insulation purposes in former buildings on site and therefore residual asbestos may be present in made ground, resulting from the use of demolition materials as hardcore following previous phases of demolition. Also, uncontrolled disposal of asbestos waste could have taken place in the infilled quarry and brickpits known to be present on site. Although there has been no testing for the presence of asbestos in soils it is highly likely to be present in made ground on site, because historically its use was widespread, but no care was taken regarding its disposal.

Although the materials and products stored and handled at the site may be considered to be the source element of the contaminant linkage, in this case the conceptual model considers contamination within the sub-surface (by the materials and products). This is done in anticipation of the site being cleared prior to redevelopment, with the potentially contaminating equipment and materials having been removed from the site.

The following contaminants are identified on the site:

- C1: Soil contamination as a result of historic and current operations on site;
- C2: Groundwater contamination as a result of historic and current operations on site;

- C3: Hazardous ground gases generated from made ground materials and underlying former coal workings; and
- C4: Asbestos in made ground.

6.2 Sensitive receptors

Potential receptors identified for the site are:

- R1: Future site users/residents;
- R2: Controlled waters – groundwater in the permeable horizons of the underlying bedrock;
- R3: Controlled waters – surface waters in the area, including drainage ditches linking to Pools Dike;
- R4: Users/occupants of surrounding land/properties; and
- R5: proposed buildings and infrastructure on site.

6.3 Plausible pathways

The routes by which potential sources of contamination could come into contact with the sensitive receptors are:

- P1: Direct contact/ingestion;
- P2: Gas/vapour migration;
- P3: Diffusion through drinking water pipes;
- P4: Mobilisation of soil-borne contamination;
- P5: Groundwater migration (lateral and vertical); and
- P6: Inhalation of airborne asbestos fibres.

Run-off of surface waters and trade effluents from the site to surface water receptors in the area is not included in the above list of plausible pathways, as this is not considered to be a sub-surface contamination issue, and is not considered further.

Risks to operatives involved in the redevelopment or maintenance of the site are not considered here as these should be controlled by the workplace risk assessments adopted for the work. Risk to off-site receptors from the migration of dust is also not considered here, as this should be controlled during development work. Following development it is anticipated that the potential for dust generation will be low as the entire site surface will comprise hardstanding or vegetation. If this turns out not to be the case then the risks from dust generation should be considered.

6.4 Data gaps and uncertainties

As discussed above, intrusive investigations undertaken at the site have been limited, and data is not currently available for all site areas.

Although remediation of the western land parcel appears to have been completed, documentary evidence to confirm this has not been reviewed by RSK, and the proposed remediation validation report was not completed.

6.5 Conceptual model

The conceptual model and an estimate of the risk associated with each linkage is summarised in **Table 2**. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in Appendix E.

Table 2: Risk estimation for potentially complete contaminant linkages

Potential Contaminant	Potential receptor	Possible pathway	Probability	Consequence	Risk and justification
C1: Soil contamination as a result of historic and existing operations on site	R1: Future site users/residents	P1: Direct contact/ingestion	Highly likely	Medium	**High:** Presence of contamination at concentrations in excess of GACs confirmed over much of site.
		P2: Gas/vapour migration (followed by accumulation in buildings)	Highly likely	Medium	**High:** Presence of contamination at concentrations in excess of GACs confirmed over much of site.
		P3: Diffusion through drinking water pipes	Highly likely	Medium	**High:** Presence of contamination confirmed over much of site.
	R2: Groundwater in the underlying bedrock	P4: Mobilisation of soil-borne contamination	Highly likely	Mild	**Moderate:** Contamination in deep groundwater confirmed, but aquifer not particularly sensitive.
	R3: Surface waters in vicinity of site	P4: Mobilisation of soil-borne contamination	Highly likely	Mild	**Moderate:** Contamination in groundwater confirmed, but surface waters not particularly sensitive.
	R4: Users/occupants of surrounding land/properties	P2: Gas/vapour migration (followed by accumulation in buildings)	Unlikely	Medium	**Low:** Sensitive receptors not generally nearby (except for western land parcel).
	R5: proposed buildings and infrastructure on site	P1: Direct contact/ingestion	Highly likely	Mild	**Moderate:** Potential for aggressive ground conditions to concrete as a result of historic use of site.
C2: Groundwater contamination as a result of historic and existing operations on site	R1: Future site users/residents	P2: Gas/vapour migration (followed by accumulation in buildings)	Highly likely	Medium	**High:** Presence of contamination at concentrations in excess of GACs confirmed over much of site.
		P3: Diffusion through drinking water pipes	Low Likelihood	Medium	**Moderate/low:** Groundwater not generally encountered at shallow depth.
	R2: Groundwater in the underlying bedrock	P5: Groundwater migration	Highly likely	Mild	**Moderate:** Contamination in deep groundwater confirmed, but aquifer not particularly sensitive.

Potential Contaminant	Potential receptor	Possible pathway	Probability	Consequence	Risk and justification
	R3: Surface waters in vicinity of site	P5: Groundwater migration	Highly likely	Mild	**Moderate:** Contamination in groundwater confirmed, but surface waters not particularly sensitive.
	R4: Users/occupants of surrounding land/properties	P5: Groundwater migration, then P2: Gas/vapour migration (followed by accumulation in buildings)	Low Likelihood	Medium	**Moderate/Low:** Sensitive receptors only nearby to west and south.
	R5: proposed buildings and infrastructure on site	P1: Direct contact/ingestion	Low Likelihood	Mild	**Low:** Potential for aggressive ground conditions, but structures unlikely to be as deep as groundwater table.
C3: Hazardous ground gases generated from made ground materials and underlying former coal workings.	R1: Future site users/residents	P2: Gas/vapour migration (and accumulation in buildings)	Likely	Severe	**High:** Significant hazardous ground gas potential from made ground and underground workings.
	R4: Users/occupants of surrounding land/properties	P2: Gas/vapour migration (followed by accumulation in buildings)	Unlikely	Severe	**Moderate/Low:** Off-site sources of ground gas likely to be of more significance to off-site receptors.
C4: Asbestos in made ground.	R1: Future site users/residents	P6: Inhalation of airborne asbestos fibres	Likely	Medium	**Moderate:** Presence of asbestos in soil likely due to previous phases of development.

The potential contaminant linkages with a risk of moderate or above that may need to be further assessed or mitigated are:

- Impact to future users/residents from direct contact with site soils
- Impact to future users/residents from inhalation of vapours emanating from soils having migrated into buildings
- Impact to future users/residents from contaminants of soil having permeated water supply pipes
- Impact to groundwaters in the underlying Secondary A bedrock aquifer from soil-borne contamination
- Impact to surface waters in the vicinity of the site from soil-borne contamination
- Impact to future users/residents from inhalation of vapours emanating from groundwater having migrated into buildings
- Impact to groundwaters in the wider underlying Secondary A bedrock aquifer from contaminated groundwater at the site
- Impact to surface waters in the vicinity of the site from contaminated groundwater
- Impact to future site residents from migration and accumulation of hazardous ground gases into buildings.
- Impact to future users/site residents by inhalation of asbestos fibres from disturbed soil.
- Impact on concrete in foundations and infrastructure by chemical attack from sulphates and acids.

7 CONCLUSIONS AND RECOMMENDATIONS

The site has a history of contaminative use, and two intrusive site investigations have revealed that soil and groundwater contamination resulting is significant, particularly beneath the production and by-products area. The conceptual site model has identified a number of potentially complete contaminant linkages between contaminated soils and groundwater and future site users/residents and controlled water receptors. For some parts of the site the previous investigations undertaken have confirmed that these linkages will require remedial measures prior to any change of use, for other parts the data currently available is insufficient to rule them out.

Further intrusive works are required to build a fuller preliminary picture of the contamination status of the site. It is expected that the investigations would be an iterative process, with a number of phases required to fully understand the ground conditions. It is likely that full investigation of the entire site will not be possible until production operations have ceased and constraints can be removed. In addition, the proposed uses of the site, and the areas where each use will apply, need to be established, so that the sensitivity of the receptors that will be introduced to the site can be assessed.

Regardless of the future change of use of the site, to facilitate surrender of the environmental permit held a closure assessment (intrusive investigation) would need to be undertaken to compare with the original Application Site Report (ASR) to assess any deterioration. The design of the required final site ground contamination testing would have to be agreed with the EA in advance and the findings of this may, in part, assist in determining the requirements for the long-term site remediation in respect of contamination. The closure assessment investigation would be expected to be completed following removal of any above ground potentially polluting infrastructure, to demonstrate that the site is left in a state no worse than when the permit was issued.

Recommendations for further investigation of each of the four zones of the site are discussed in further detail below.

7.1 Production and by-products area

In this area significant contamination of soil and groundwater has been encountered, principally from hydrocarbons including tar and PAHs. The data obtained from intrusive investigations previously undertaken at the site are considered largely sufficient for a preliminary assessment of the production and by-products area. Further investigation works will be required in the future to fully assess the ground conditions, but the operational nature of the area is currently acting as a constraint to these. The only additional element of investigation work that is currently recommended in this area is the installation of a deep monitoring well close to the eastern site boundary, to investigate

groundwater here and the possibility of on or off-site migration of contamination to/from the east.

7.2 Stockyard and former colliery

In general, contamination of soil and groundwater in this area is less significant than in the production and by-products area. Again, the data obtained from intrusive investigations previously undertaken at here are considered largely sufficient for a preliminary assessment. Further investigation works will be required in the future to fully assess the ground conditions, but the operational nature of the area is currently acting as a constraint to these. In particular for this area, buried structures and locally deeper made ground (possibly including waste materials) are likely. Whilst the site remains operational further intrusive works are recommended in the north western and north eastern corners of the site, in the currently unused areas that have not previously been investigated. Also recommended, if access can be achieved in parts of the operational site area, are further boreholes to install groundwater monitoring wells to improve the understanding of the groundwater conditions.

7.3 Southern site section

There is little data from the previous ground investigations for the southern site section, so to complete a preliminary assessment of this area intrusive works are recommended. These intrusive works should include a spread of locations across the site, as well as being targeted to investigate the positions of the former quarry and residential properties, the current effluent treatment plant (and associated pipework) and the elevated land adjacent to the railway line. Also to be investigated in this area is the migration of contamination from the production and by-products area to the north, and deep groundwater monitoring wells are likely to be required for this.

7.4 Western land parcel

The western land parcel has historically been used for the deposit of colliery spoil and for gas purification. Intrusive investigations of this area have been completed, and previous reports indicate that remediation has been undertaken, although documentary evidence of this has not been reviewed by RSK. A detailed review of the data for this area is required to confirm the likely current contamination status and resulting risks to any sensitive receptors. Depending on the findings of the review further intrusive investigations may be required.

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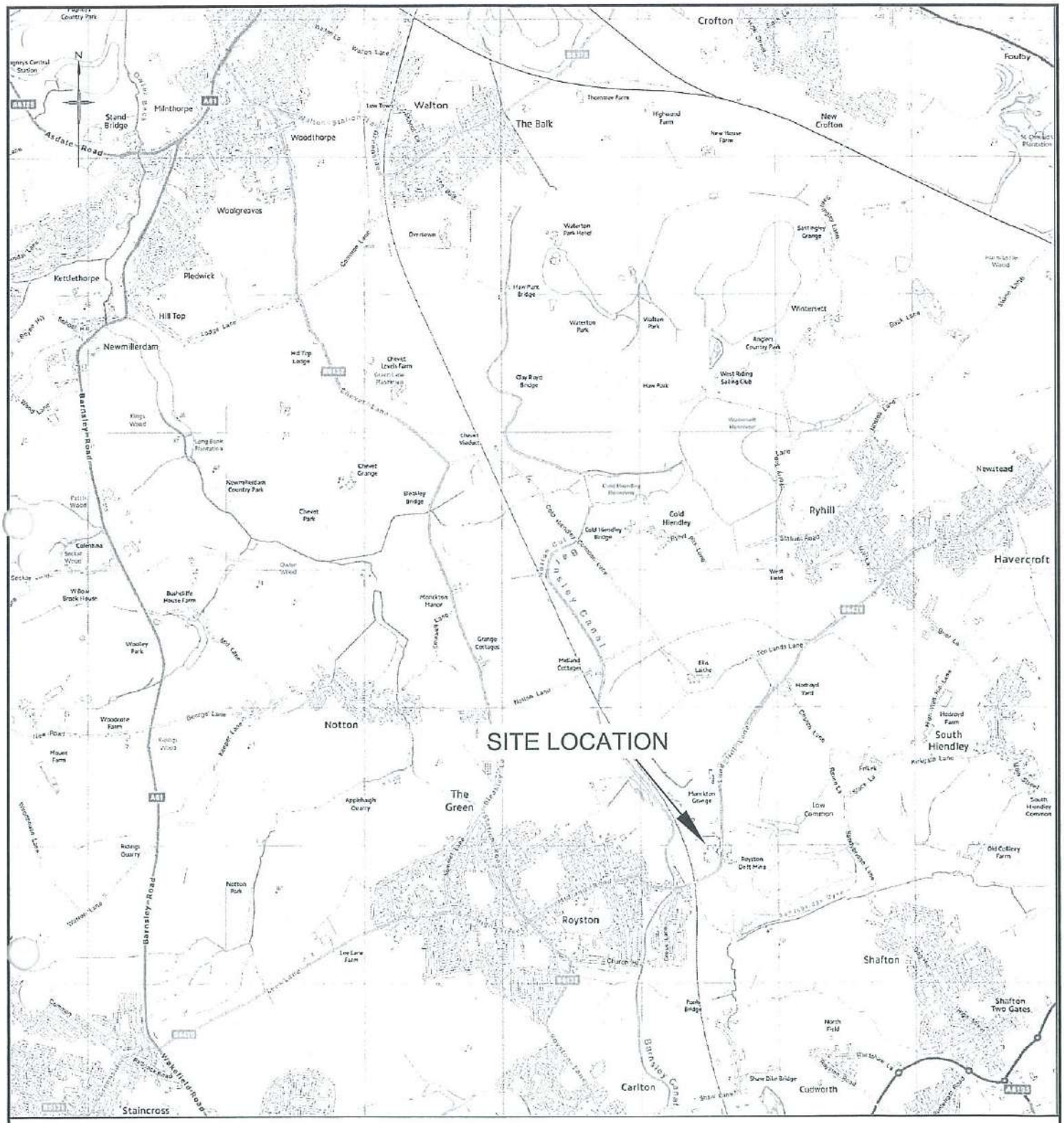
FIGURES


SITE LOCATION
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Foulby
Walton
The Balk
New Crofton
Stanley Ferry Country Park
Stanley Ferry Station
Stanley Ferry Aqueduct
Stanley Ferry Marina
Stanley Ferry Flood Channel
Stanley Ferry Flood Channel Overflow
Stanley Ferry Flood Channel Outfall
Stanley Ferry Flood Channel Inlet
Stanley Ferry Flood Channel Bridge
Stanley Ferry Flood Channel Footbridge
Stanley Ferry Flood Channel Culvert
Stanley Ferry Flood Channel Weir
Stanley Ferry Flood Channel Pumping Station
Stanley Ferry Flood Channel Control Gate
Stanley Ferry Flood Channel Control Valve
Stanley Ferry Flood Channel Control Building
Stanley Ferry Flood Channel Control Room
Stanley Ferry Flood Channel Control Tower
Stanley Ferry Flood Channel Control Cabin
Stanley Ferry Flood Channel Control Hut
Stanley Ferry Flood Channel Control Shed
Stanley Ferry Flood Channel Control Kiosk
Stanley Ferry Flood Channel Control Box
Stanley Ferry Flood Channel Control Panel
Stanley Ferry Flood Channel Control Unit
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Stanley Ferry Flood Channel Control Sewage
Stanley Ferry Flood Channel Control Waste
Stanley Ferry Flood Channel Control Recycling
Stanley Ferry Flood Channel Control Environmental
Stanley Ferry Flood Channel Control Safety
Stanley Ferry Flood Channel Control Security
Stanley Ferry Flood Channel Control Access
Stanley Ferry Flood Channel Control Parking
Stanley Ferry Flood Channel Control Signage
Stanley Ferry Flood Channel Control Landscaping
Stanley Ferry Flood Channel Control Boundary
Stanley Ferry Flood Channel Control Fencing
Stanley Ferry Flood Channel Control Gate
Stanley Ferry Flood Channel Control Barrier
Stanley Ferry Flood Channel Control Bollard
Stanley Ferry Flood Channel Control Kerb
Stanley Ferry Flood Channel Control Pavement
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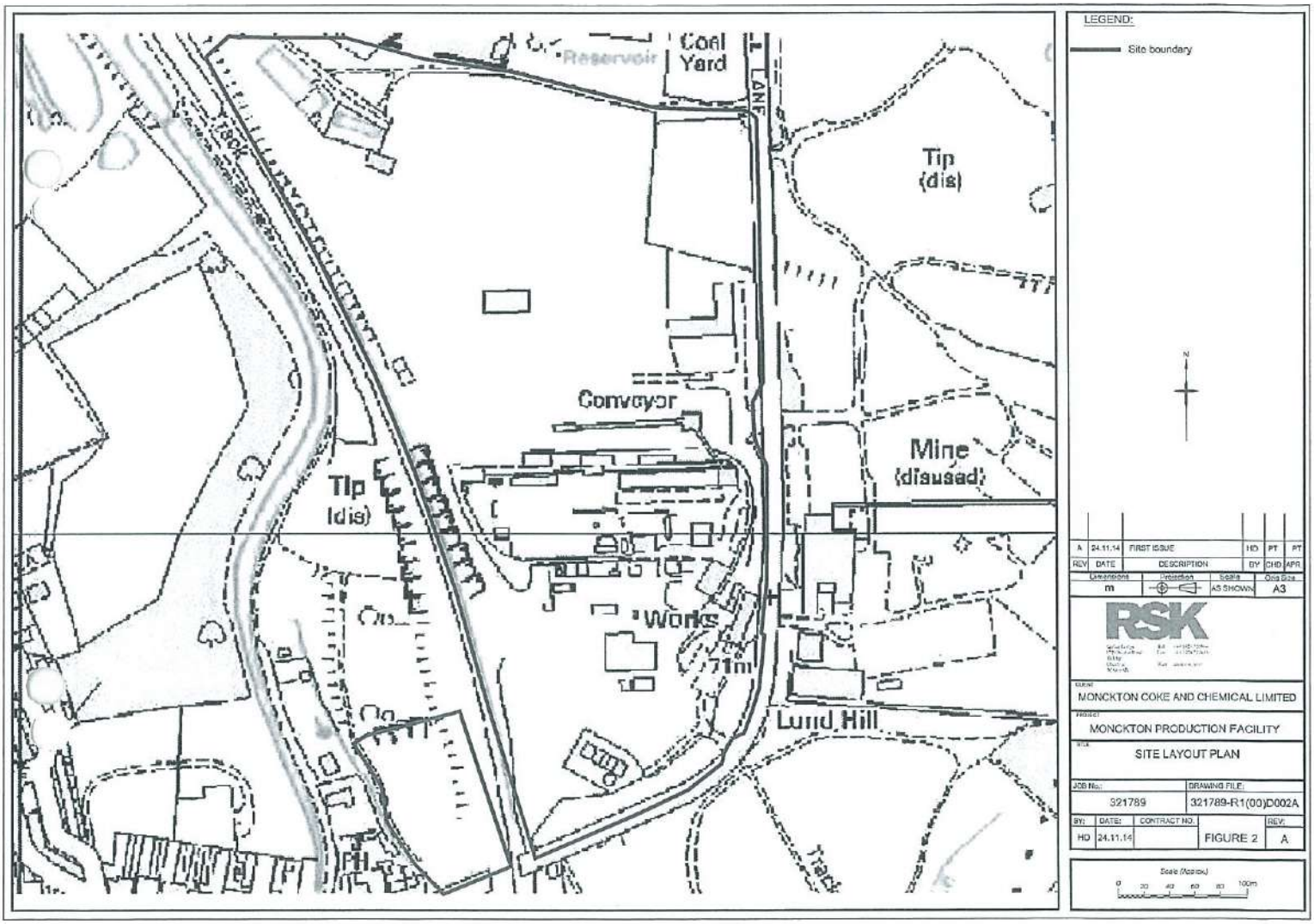
Stanley Ferry Flood Channel Control Culvert
Stanley Ferry Flood Channel Control Weir
Stanley Ferry Flood Channel Control


Reservoir
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LANE
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Conveyor
Mine (disused)
Tip (dis)
Works
Lund Hill
Track
LEGEND:
Site boundary
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MONCKTON PRODUCTION FACILITY
SITE LAYOUT PLAN
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BY: HD DATE: 24.11.14 CONTRACT NO.
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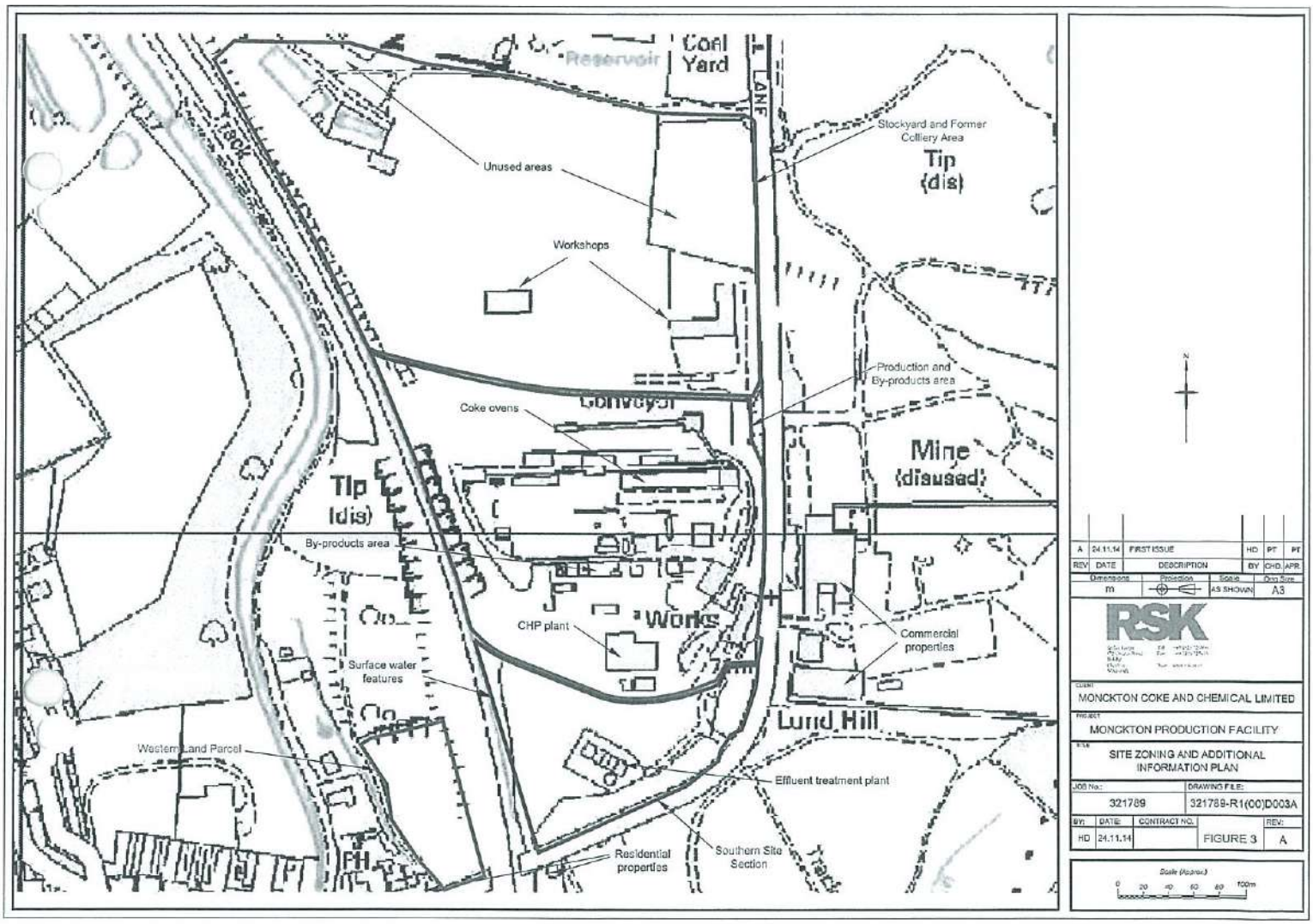
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Unused areas
Workshops
Production and By-products area
Coke ovens
Mine (disused)
Tip (dis)
By-products area
Works
CHP plant
Commercial properties
Surface water features
Lund Hill
Western Land Parcel
Effluent treatment plant
Residential properties
Southern Site Section
PH
N
A 24.11.14 FIRST ISSUE HD PT PT
REV DATE DESCRIPTION BY CHD APR
Dimensions Projection Scale Orig Size
m AS SHOWN A3
RSK
CLIENT
MONCKTON COKE AND CHEMICAL LIMITED
PROJECT
MONCKTON PRODUCTION FACILITY
TITLE
SITE ZONING AND ADDITIONAL INFORMATION PLAN
JOB No.: 321789
DRAWING FILE: 321789-R1(00)D003A
BY: HD DATE: 24.11.14 CONTRACT NO.
FIGURE 3
REV: A
Scale (Approx)
0 20 40 60 80 100m

APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Monckton Coke and Chemical Limited (the "client") in accordance with the terms of a contract between RSK and the "client", dated 8 October 2014 The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B
SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use.

PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

The new framework has only limited guidance on contaminated land, as follows:

- *"planning policies and decisions should also ensure that:*
    - *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
    - *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
    - *adequate site investigation information, prepared by a competent person, is presented".*

APPENDIX C
COAL AUTHORITY MINING REPORT

The Coal Authority

Issued by:
The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG
Website: www.groundstability.com Phone: 0845 762 6848 DX 716176 MANSFIELD 5

LANDMARK INFORMATION GROUP LIMITED
SOWTON INDUSTRIAL ESTATE
ABBEY COURT
UNIT 5/7 EAGLE WAY
EXETER
DEVON
EX2 7HY

Our reference:	**51000659183001**
Your reference:	**61687740_2|**
Date of your enquiry:	**31 October 2014**
Date we received your enquiry:	**31 October 2014**
Date of issue:	**31 October 2014**

This report is for the property described in the address below and the attached plan.

Non-Residential Coal Authority Mining Report

SITE AT MONCKTON COKE & CHEMICAL CO LTD, LUND HILL LANE, ROYSTON, BARNSLEY, SOUTH YORKSHIRE,

This report is based on and limited to the records held by, the Coal Authority, and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Coal mining	See comments below
Brine Compensation District	No

Information from the Coal Authority

Underground coal mining

Past

The property is in the likely zone of influence from workings in 11 seams of coal at 90m to 520m depth, and last worked in 1982.

Any ground movement from these coal workings should have stopped by now.

In addition the property is in an area where the Coal Authority believe there is coal at or close to the surface. This coal may have been worked at some time in the past. The potential presence of coal workings at or close to the surface should be considered prior to any site works or future development activity. Your attention is drawn to the Comments on Coal Authority Information section of the report.

Present

The property is not in the likely zone of influence of any present underground coal workings.

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Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

The property is not in an area for which a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area that is likely to be affected at the surface from any planned future workings.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

Mine entries

Within, or within 20 metres of, the boundary of the property there are 3 mine entries, the approximate positions of which are shown on the attached plan.

Our records disclose the following information:

437412-001. has been filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal.
437412-002. was filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal in February 1989.
437412-003. has been filled to the surface and capped (15m x 15m x 1.2m reinforced concrete) by British Coal.

Records may be incomplete. Consequently, there may exist in the local area mine entries of which the Coal Authority has no knowledge.

For an additional fee, the Coal Authority will provide a supplementary Mine Entry Interpretive Report. The report will provide a separate assessment for the mine entry (entries) referred to in this report. It will give details based on information in the Coal Authority's possession, together with an opinion on the likelihood of mining subsidence damage arising from ground movement as a consequence of the existence of the mine entry/entries. It will also give details of the remedies available for subsidence damage where the mine entry was sunk in connection with coal mining.

Please note that it may not be possible to produce a report if the main building to the property cannot be identified from Coal Authority plans (ie. for development sites and new build).

For further advice on how to order this additional information visit www.groundstability.com or telephone 0845 7626 848.

Coal mining geology

The Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.

Opencast coal mining

Past

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

Present

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

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Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31st October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

Withdrawal of support

The property is in an area for which notices of entitlement to withdraw support were published in 1947, 1953, 1957.

The property is not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.

Working facilities orders

The property is not in an area for which an Order has been made under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

Payments to owners of former copyhold land

The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Comments on Coal Authority information

The attached plan shows the approximate location of the disused mine entry/entries referred to in this report. For reasons of clarity, mine entry symbols may not be drawn to the same scale as the plan.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence act 1991*). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A leaflet setting out the rights and the obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by telephoning 0845 762 6848 or online at www.coal.decc.gov.uk/en/coal/cms/services/claims.

If you wish to discuss the relevance of any of the information contained in this report you should seek the advice of a qualified mining engineer or surveyor. If you or your adviser wish to examine the source plans from which the information has been taken these are normally available at our Mansfield office, free of charge, by prior appointment, telephone 01623 637235. Should you or your adviser wish to carry out any physical investigations that may enter, disturb or interfere with any disused mine entry the prior permission of the owner must be sought. For coal mine entries the owner will normally be the Coal Authority.

The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries). Our emergency telephone number at all times is 01623 646333.

*Note, this Act does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester.

© The Coal Authority

In view of the mining circumstances a prudent developer would seek appropriate technical advice before any works are undertaken.

Therefore if development proposals are being considered, technical advice relating to both the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas. No development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without the permission of the Coal Authority. Developers should be aware that the investigation of coal seams/former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional Remarks

This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions 2006.

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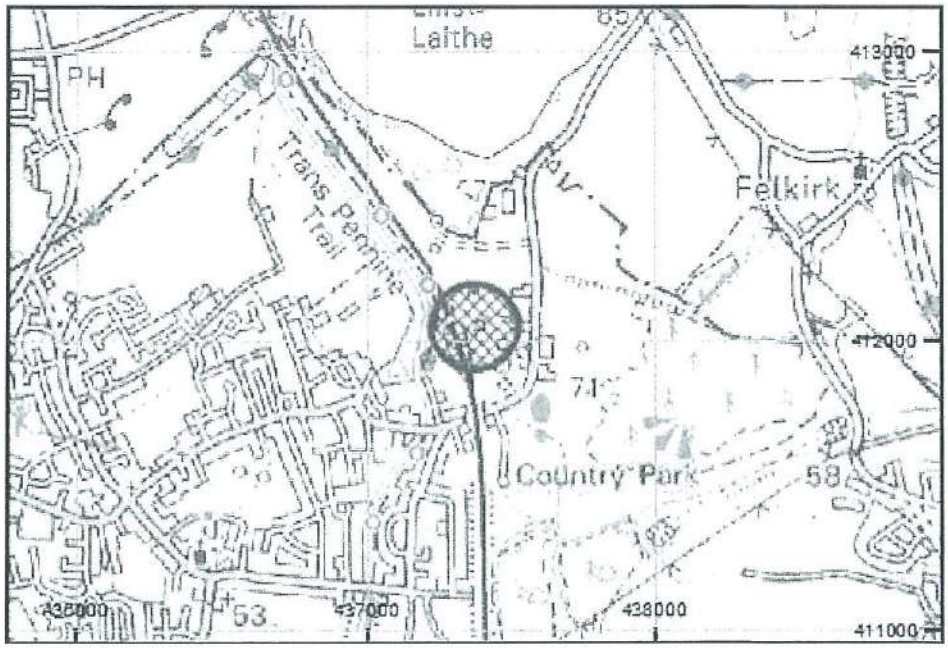
Location map

Approximate position of property



Enquiry boundary

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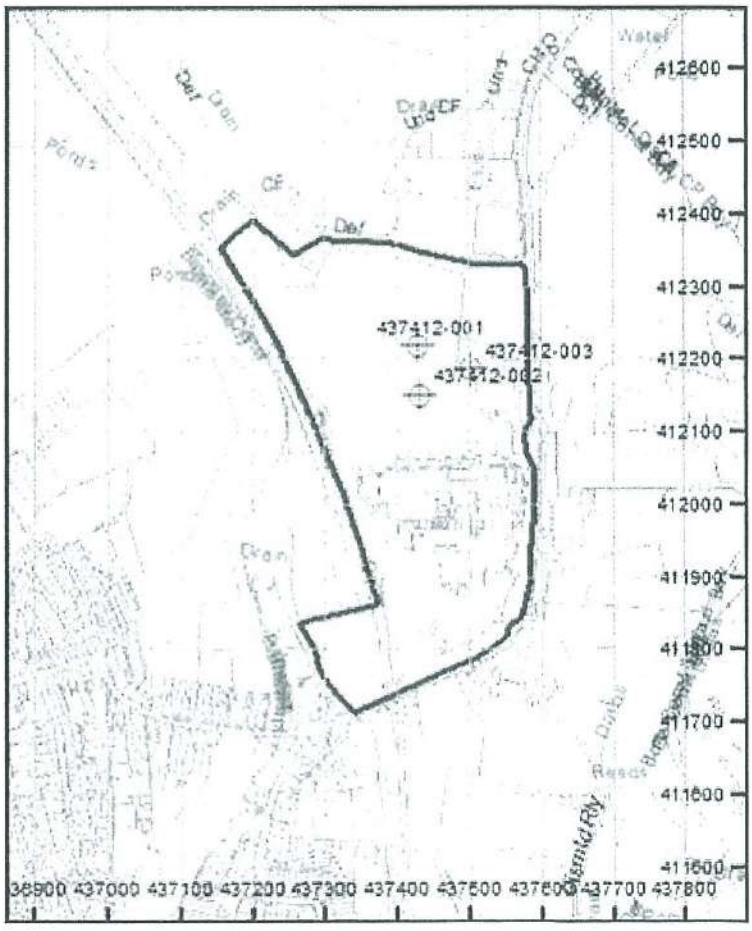

Key

Approximate position of enquiry boundary shown

Disused Adit or Mineshaft

Mapping sourced from Ordnance Survey

APPENDIX D
COAL AUTHORITY SHAFT PLAN AND DATA SHEETS

The Coal Authority

Issued by:
The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG
Website: www.groundstability.com Phone: 0845 762 6848 DX 716176 MANSFIELD 5

RSK
GREYSTONES
CROOK
KENDAL
CUMBRIA
LA8 8JZ

Our reference:	**51000695382001**
Your reference:	**321789**
Date of your enquiry:	**19 November 2014**
Date we received your enquiry:	**19 November 2014**
Date of issue:	**20 November 2014**

This report is for the property described in the address below and the attached plan.

Shaft Plan and Data Sheets

MONCKTON COKE AND CHEMICAL LIMITED, LUND HILL LANE, ROYSTON, SOUTH YORKSHIRE,

I refer to the enquiry dated 19 November 2014, received 19 November 2014, in connection with the above.

As requested I enclose the mine entry data sheet(s) held for the mine entry/entries referred to.

© The Coal Authority

Mine Entry Data

Shaft/adit:	Shaft
Reference:	437412-002
Source:	OS:1/2500 Scale 263/9 1st 2nd 4th ed Ab plans NE545 NE920 NE197 NE190/6 NE547 NE577 NE157 NE224 S75 Geol:1/10560 263SW 2nd ed
Colliery name:	Unknown
Entry name:	New Monckton Colliery No.2 Shaft
Date abandoned:	5-Dec-1965
Depth of superficial deposits (m):	Unknown
Depth of shaft (m):	446.2
Diameter of shaft (m):	5.28
Probable adit azimuth:	Not Applicable
Treatment details:	was filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal in February 1989
Conveyance:	Not Applicable
Easting:	437433
Northing:	412149
Other information:	Yes

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Mine Entry Data (continued)

Shaft/adit:	Shaft
Reference:	437412-003
Source:	Ab Plan:NE545 NE920 NE197 NE190/6 NE547 NE577 NE224
Colliery name:	Unknown
Entry name:	New Monckton Colliery No.6 Shaft
Date abandoned:	5-Dec-1965
Depth of superficial deposits (m):	Unknown
Depth of shaft (m):	489.2
Diameter of shaft (m):	7.32
Probable adit azimuth:	Not Applicable
Treatment details:	has been filled to the surface and capped (15m x 15m x 1.2m reinforced concrete) by British Coal
Conveyance:	Not Applicable
Easting:	437505
Northing:	412185
Other information:	Yes

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Mine Entry Data (continued)

Shaft/adit:	Shaft
Reference:	437412-001
Source:	OS:1/2500 Scale 263/9 1st 2nd 4th ed Ab plans NE545 NE920 NE197 NE190/6 NE449 NE547 NE577 NE157 NE224 S75 Geol:1/10560 263SW 2nd ed
Colliery name:	Unknown
Entry name:	New Monckton Colliery No.1 Shaft
Date abandoned:	5-Dec-1965
Depth of superficial deposits (m):	Unknown
Depth of shaft (m):	450.8
Diameter of shaft (m):	5.28
Probable adit azimuth:	Not Applicable
Treatment details:	has been filled to the surface and capped (12m x 12m x 1m reinforced concrete) by British Coal
Conveyance:	Not Applicable
Easting:	437431
Northing:	412216
Other information:	Yes

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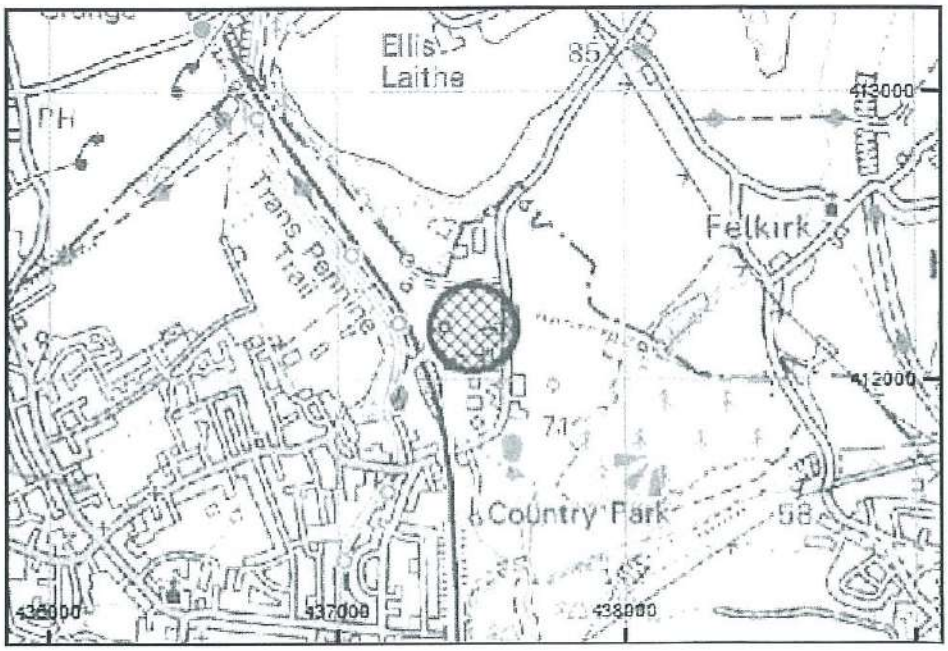
Issued by:	The Coal Authority, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG
Tax Point Date:	19 November 2014
Issued to:	RSK GREYSTONES CROOK KENDAL CUMBRIA LA8 8JZ
Property Search for:	MONCKTON COKE AND CHEMICAL LIMITED, LUND HILL LANE, ROYSTON, SOUTH YORKSHIRE,
Reference Number:	51000695382001
Date of Issue:	20 November 2014
Cost:	£35.00
VAT @ 20%:	£7.00
Total Received:	£42.00
VAT Registration	598 5850 68

Location map

Approximate position of enquiry



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This plan shows the approximate location of the disused mine entry / entries referred to in the attached mining report. For reasons of clarity, mine entry symbols may not be drawn to the same scale as the plan.

Property owners have the benefit of statutory protection (under the Coal Mining Subsidence Act 1991). This contains provision for the making good, to the reasonable satisfaction of the owner, of physical damage from disused coal mine workings including disused coal mine entries. A DTI leaflet setting out the rights and obligations of either the Coal Authority or other responsible persons under the 1991 Act can be obtained by telephoning 0845 762 6848.

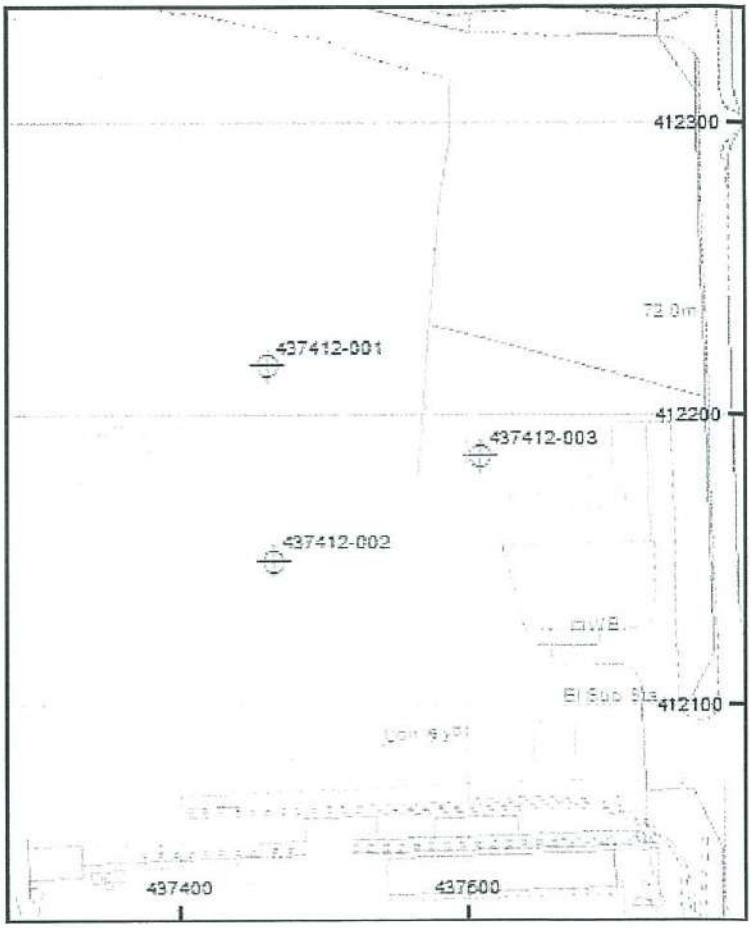
If you wish to discuss the relevance of any of the information contained in the attached report you should seek the advice of a qualified mining engineer or surveyor. If you or your advisor wish to examine the source plans from which the information has been taken these are available at our Mansfield office, free of charge by prior appointment, telephone 01623 637235. Should you or your advisor wish to carry out any physical investigations that may enter, disturb or interfere with any disused mine entry the prior permission of the owner must be sought. For coal mine entries the owner will normally be the Coal Authority.

The Coal Authority, regardless of responsibility and in conjunction with other public bodies, provide an emergency call out facility in coalfield areas to assess the public safety implications of mining features (including disused mine entries).

Our emergency telephone number at all times is 01623 646333.

Key

Disused Adit or Mineshaft



Mapping sourced from Ordnance Survey

APPENDIX E
RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) contaminant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution
- likely: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in 'Draft Circular on Contaminated Land', DETR 2000)
- medium: chronic damage to human health ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem

- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment
- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

		Consequences			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly likely**	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.