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GASCOYNE HOLDINGS LIMITED

COLE GREEN LANDFILL

EXPERT REPORT

OCTOBER 2017

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Wardell Armstrong
Sir Henry Doulton House, Forge Lane, Etruria, Stoke-on-Trent, ST1 5BD, United Kingdom
Telephone: +44 (0)1782 276 700 Facsimile: +44 (0)845 111 8888 www.wardell-armstrong.com

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GASCOYNE HOLDINGS LIMITED

COLE GREEN LANDFILL

EXPERT REPORT

OCTOBER 2017

PREPARED BY:

Luke Prazsky Technical Director

[redacted]

Chris Smith Technical Director

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APPROVED BY:

Mark Bedford Director

[redacted]

Recycled

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1 INTRODUCTION

1.1.1 Wardell Armstrong has been commissioned by Gascoyne Holdings Limited to undertake an initial review of the four reports prepared by Royal HaskoningDHV (RHDHV) consultants relating to land (the site) around the Cole Green area near Welwyn Garden City and to consider supplementary reports from The Welwyn Garden City Society and the Environment Agency.

1.1.2 Wardell Armstrong understands that the site, which is owned by Tarmac, includes, but is not limited to, an area subject to historical landfilling. This area of land will be incorporated into the proposed Birchall Garden Suburb development providing public open space as part of that development. The other parts of the site will be developed to include an employment area, a primary school, residential properties and a water body.

1.1.3 This report has two purposes. Section 2, prepared by Luke Prazsky (Technical Director, Regulatory Support), considers the suitability of the RHDHV reports in terms of their scope and approach considering the previous use of a significant portion of the land for waste disposal, which may present significant long-term risks to the environment and human health. Section 3, prepared by Chris Smith (Technical Director, Ground & Environmental Engineering) provides a high-level review of three Royal HaskoningDHV (RHDHV) reports. Each section includes a summary of that author's findings.

1.1.4 The reports considered in this section were produced by RHDHV and provided by Gascoyne Cecil Estates are listed below and cover the northern, central and western and southern parts of the site:

- WGC5 Site Characterisation Generic Quantitative Risk Assessment (April 2014). This report focusses on the western and southern areas of the site and is considered by RHVDV to not include areas of former landfill;
- Cole Green Site Characterisation Generic Quantitative Risk Assessment (October 2014). This report also focusses on the western and southern areas of the site and is considered by RHVDV to not include areas of former landfill;
- Birchall Farm Site Characterisation and Generic Quantitative Risk Assessment (October 2014). This report focusses on the northern area of the site and is considered by RHVDV to not include areas of former landfill; and

- Cole Green Former Mineral Workings Soil Survey and Generic Quantitative Risk Assessment (October 2014). This report focusses on the central area of the site and is considered by RHVDV to be the area subject to historical landfilling.

1.1.5 Four further reports have been provided by Gascoyne Holdings Limited and have been considered as part of the review:

- Gascoyne Cecil Technical Paper (October 2017);
- What Lies Beneath version V2.0 (November 2016), produced by The Welwyn Garden City Society;
- Environment Agency Local Plan Consultation Document January 2015; and
- Environment Agency letter to Welwyn Hatfield Borough Council re. EIA scoping request (9 February 2016).

2 ASSESSMENT OF ENVIRONMENTAL RISKS FROM HISTORIC LANDFILLING

2.1 General

2.1.1 This section of the report sets out the regulatory history that would have been applicable during the lifetime of the site, to give some historical context to the use of the site for waste disposal and the degree of environmental protection that would have been provided during the period in which waste was being deposited at the site. This report also considers evidence of the areas of the site that are considered to have been used as a landfill and these are compared to the areas assessed by RHDHV.

2.1.2 This report has identified a number of significant issues that have not been fully addressed in the reports reviewed and critical issues that remain unanswered but are necessary to inform the planning process.

2.1.3 It is considered that further works are required to quantify the actual risk from the site and the extent of landfilling in the southern part of the site.

2.2 Regulatory Background

2.2.1 From the reports provided it is understood and accepted that landfilling has taken place over many decades from 1920's through to the 1980's, potentially up to as late as 1990.

2.2.2 Landfill sites were only regulated from 1974 under the Control of Pollution Act (COPA) 1974 through a waste disposal licence. From 1974 until 1994, when the Waste Management Licensing Regulations (WMLR) came into force, these could simply be returned/surrendered to the regulator (the Waste Regulatory Authority (WRA), a department of the County Council) without question. Of indirect relevance are the Control of Pollution (Special Waste) Regulations 1980 that introduced the requirement to notify the WRA when Special Wastes were being sent for disposal. Any wastes deposited at the site before 1974 would not have been subject to any regulatory controls.

2.2.3 From the reports provided it is widely accepted that areas subject to landfilling were not engineered to provide any form of containment.

2.2.4 There was very little control over wastes deposited in the site and so it must be expected that all types of household, commercial and industrial wastes have been deposited at the site including wastes that we now consider to be hazardous to human health or the aquatic environment.

2.3 Environmental Setting and Considerations

2.3.1 The EA has confirmed the following with regards to the site location:

1. The site is located over a Secondary A Aquifer (chalk) which provides a pathway for the relatively swift migration of contaminants to groundwater.
2. Groundwater and surface water quality is poor.
3. The EA have also confirmed the site is within several groundwater source protection zones.
4. Part of the site are in flood risk zones 3a and 3b (Hatfield Hyde Brook).

2.3.2 RHDHV's reports also confirm the presence of landfill gas, which is generated from the waste deposits at the site. The EA have stated that the area used as a landfill site should be capped to prevent it from posing a risk to the environment or future inhabitants. This would create new routes for landfill gas migration. They also state that the landfill site needs formal management and control.

2.3.3 We have consulted the Environment Agency's map of historic landfill sites which suggests the following areas as having been used for waste disposal.

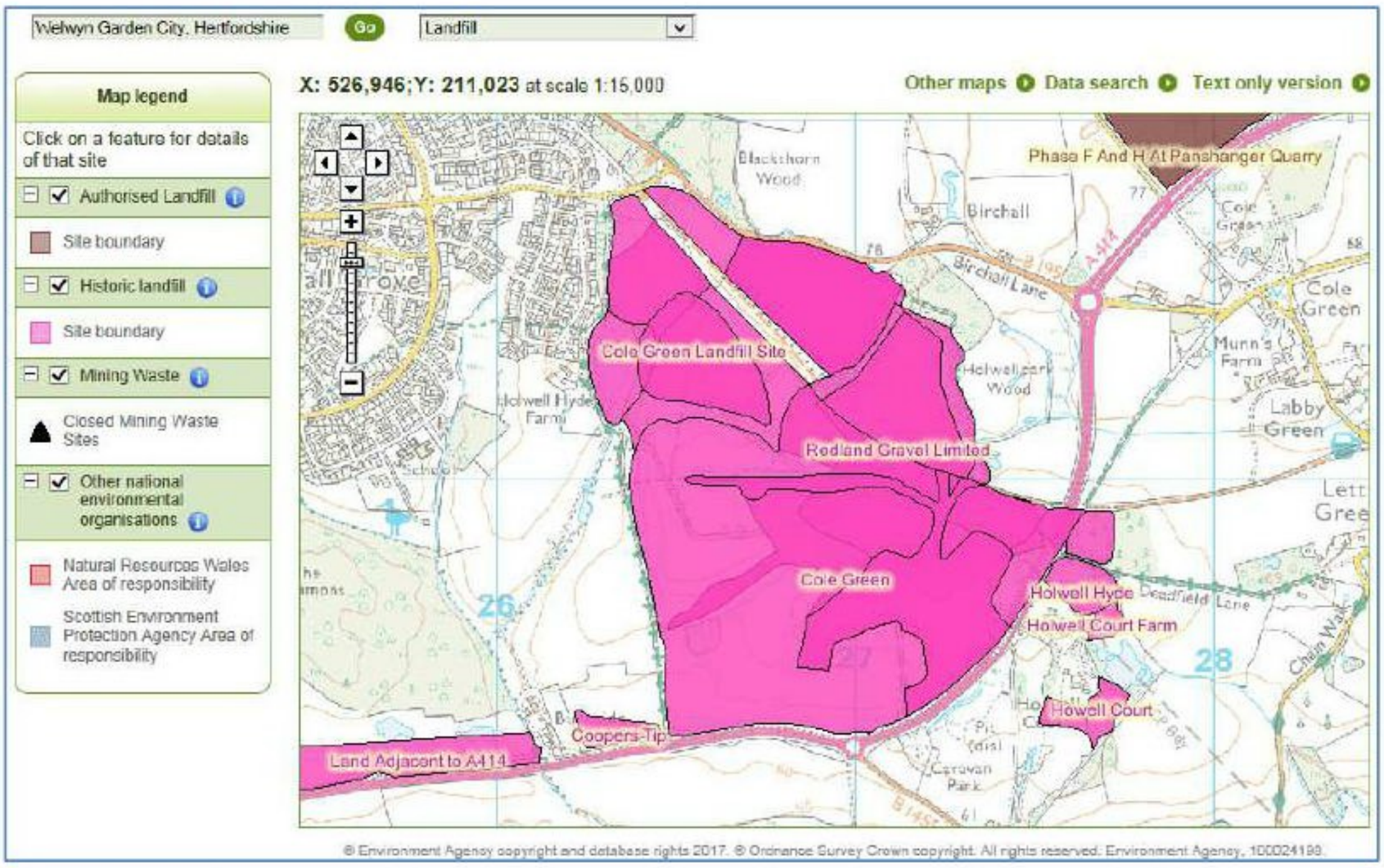


Figure 2-1 Environment Agency Map of Historic Landfills Across Site Area

2.3.4 It is considered that the southern area of the site as identified by the EA marries up with The Welwyn Garden City Society (WGCS)'s opinion but conflicts with RHDHV's understanding that it has no history of landfilling.

2.3.5 The WGCS produced an updated report '*What Lies Beneath'* in November 2016 which offers opinion on the potential contamination of land within WGC5. We note that WGCS's references the whole site as WGC5 however RHDHV's report only refers to the western and southern areas as WGC5. WGCS's report provides the plan below and photos purporting to be of the site. We have no reason to doubt the accuracy of the photo locations however we accept that they are estimated.

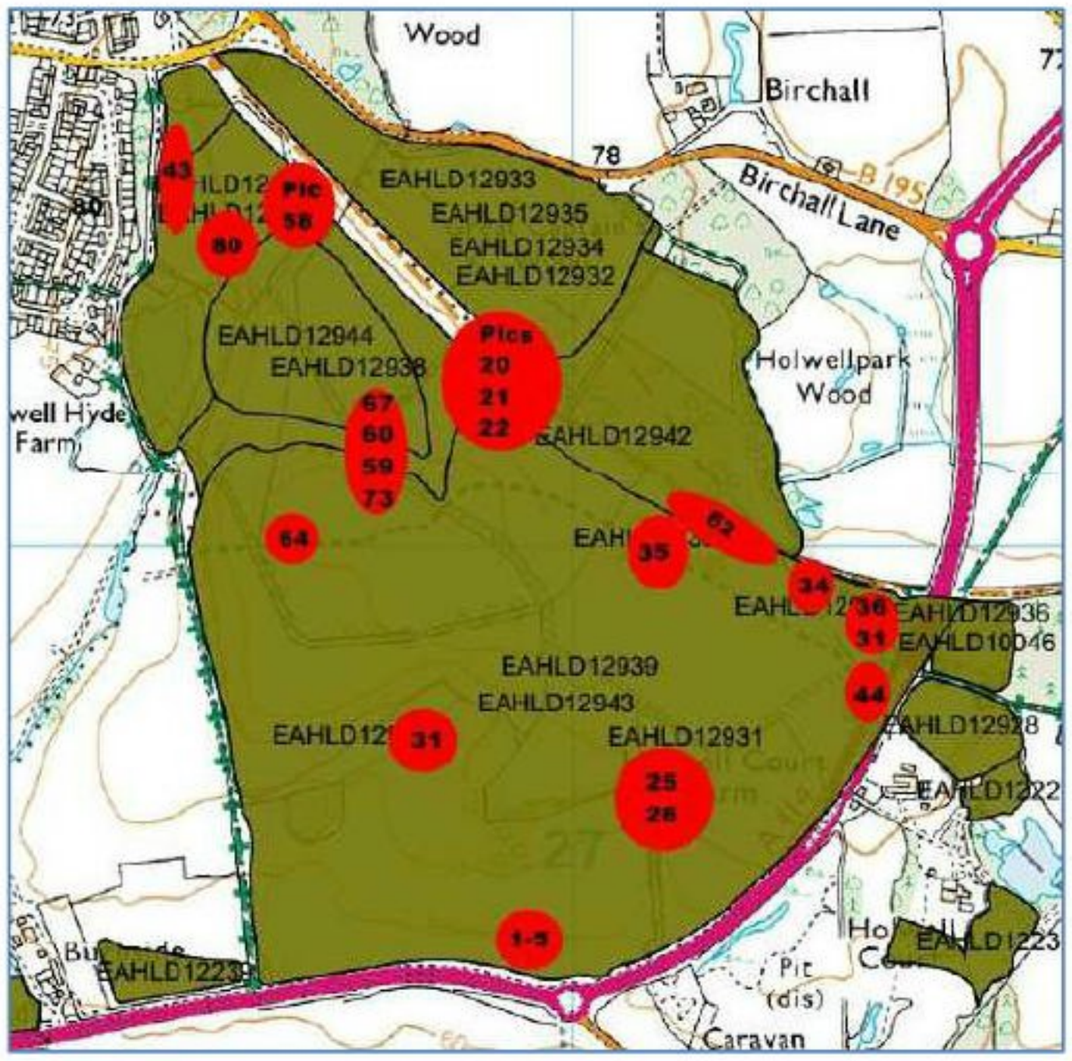
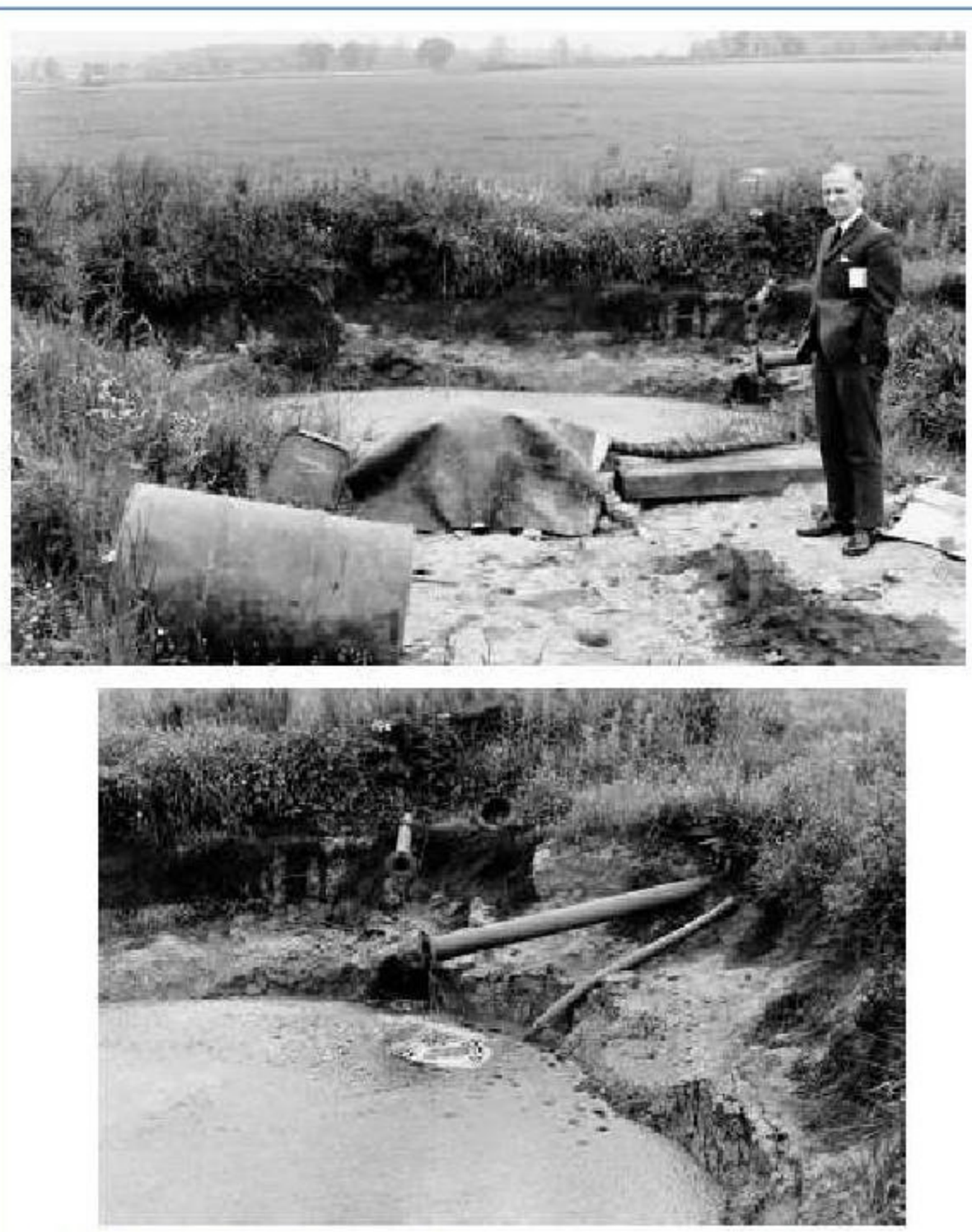


Figure 2-2 WGCS Plan Showing Extent of Waste Disposal, Including Photographic Evidence Locations



Map location 1. Pictures taken January 1978. Unknown official at sludge pool

Figure 2-3 Photo of Sludge Pool in Southern End of Site Near A414

2.4 Summary of Four RHVDV Reports

WGC5 Site Characterisation Generic Quantitative Risk Assessment (April 2014)

2.4.1 This report presents, "The findings of an intrusive ground investigation and assessment at the proposed development site to develop an understanding of the potential risks to sensitive receptors as a result of the potential contaminants migrating from the landfill."

2.4.2 It covers the western and southern areas of the site as shown below.

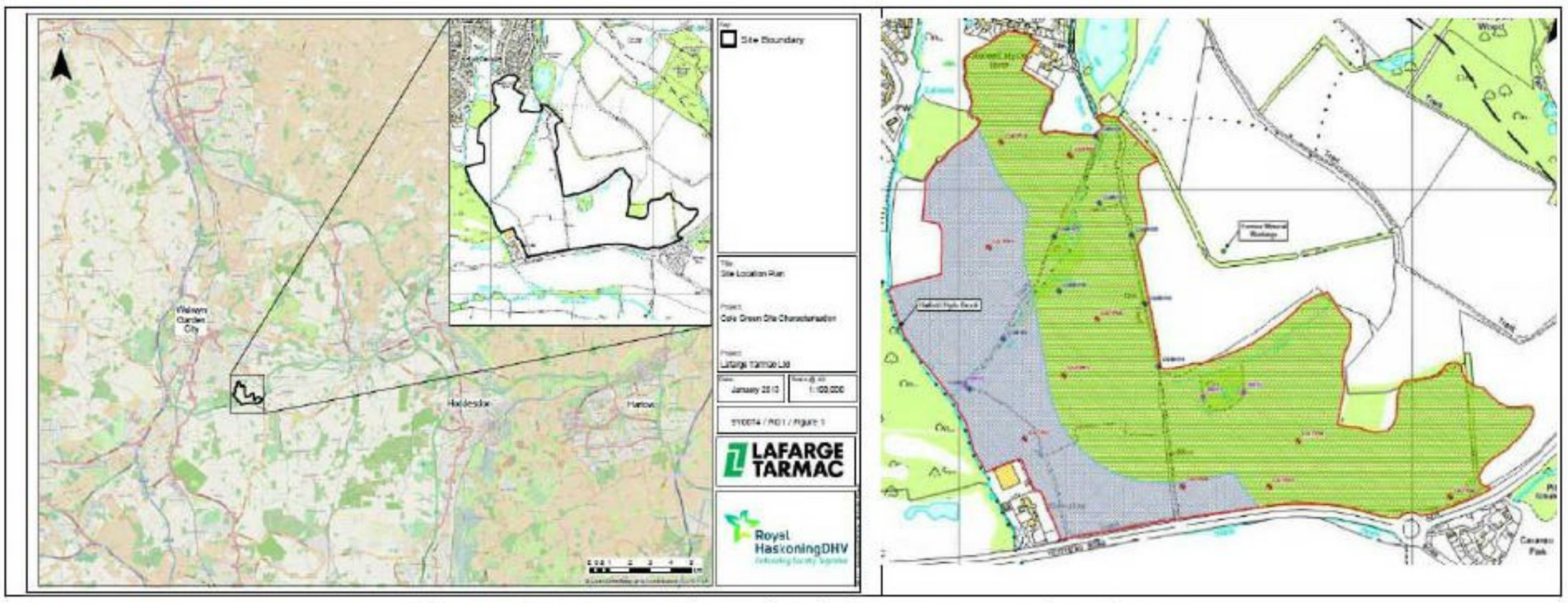


Figure 2-4 Area of Land Subject to Investigation

2.4.3 We note that this report was produced as a result of previous reports, copies of which we have not been provided with. We also note that works planned for January 2014 were delayed until May 2014 after this report was issued.

2.4.4 Findings of the report include comments that made ground was encountered and this contained asbestos and hydrocarbons. This would suggest this area has had wastes spread across it to produce a uniform landform.

2.4.5 The report acknowledges that surface water quality is a possible (unacceptable) risk to human health. The main finding is that engineering solutions are required at the site however no commentary is provided on the type or extent of these.

2.4.6 Given the EA and WGCS maps in Figures 2-1 and 2-2 above it is considered that the scope and extent of the site investigation in the southern part of the site should be reviewed by a contaminated land expert to determine if it remains appropriate. [Note: a review has subsequently been undertaken Chris Smith, Technical Director. Please see section 3]

Cole Green Site Characterisation Generic Quantitative Risk Assessment (October 2014)

2.4.7 This report is an updated version of the April 2014 report and includes the results of site investigation work undertaken in May 2014.

2.4.8 Additional site investigation works comprised the installation of boreholes and groundwater and gas monitoring wells.

2.4.9 The Executive Summary has been updated from the previous report to say that further groundwater and surface water monitoring will be undertaken to corroborate results found from the site investigation. No timetable is provided nor have the results of any additional monitoring.

2.4.10 The Executive Summary also suggests that ground gas mitigation measures may be required. No further commentary on the extent of mitigation design is provided.

Birchall Farm Site Characterisation and Generic Quantitative Risk Assessment

(October 2014)

2.4.11 This report provides a "Site characterisation strategy and generic quantitative risk assessment advising on the suitability of the site for mixed use including residential properties."

2.4.12 It covers the northern area of the site as shown below.

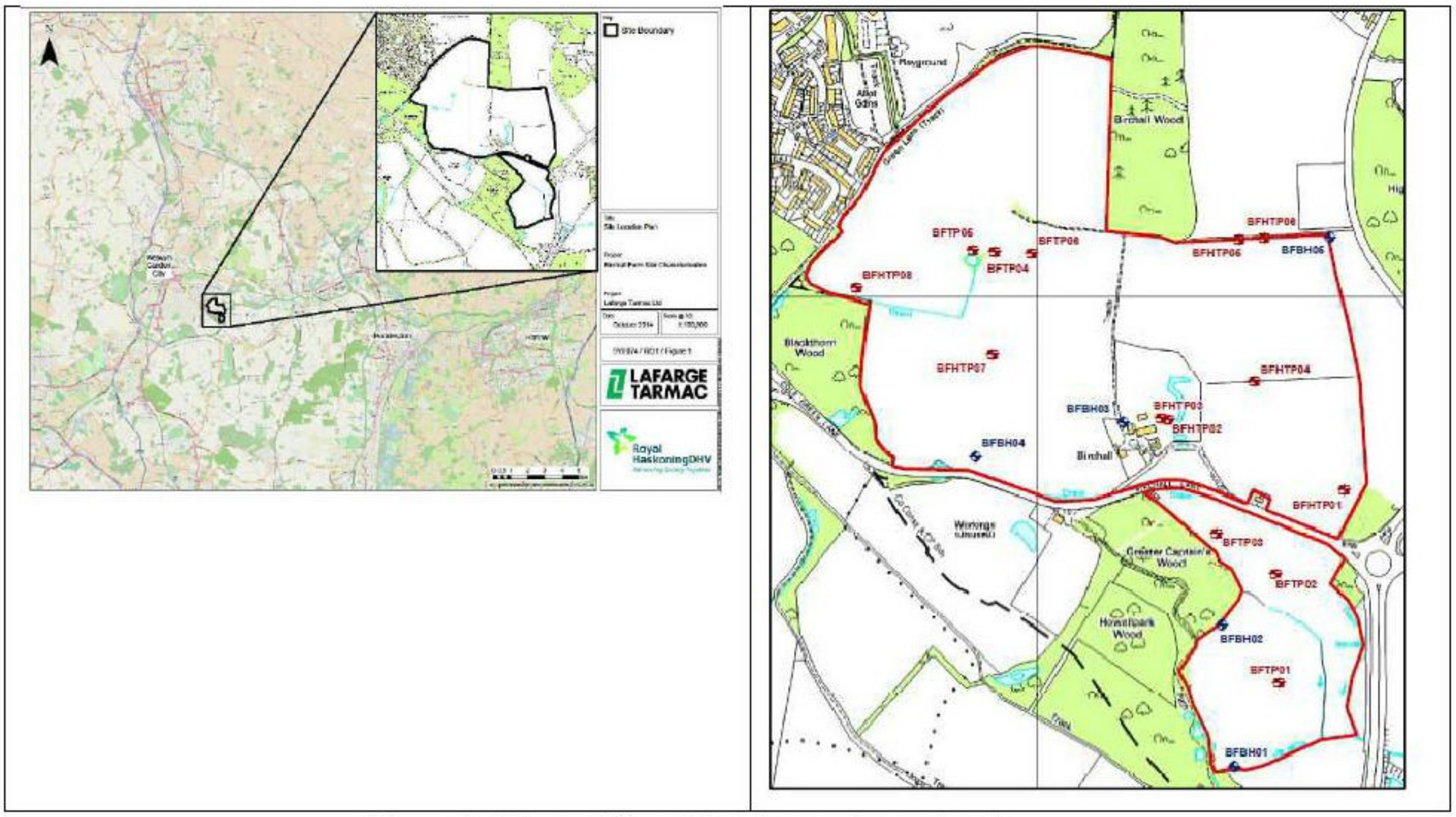


Figure 2-5 Area of Land Subject to Investigation

2.4.13 The Executive Summary plays down the materials found but concludes that PCOC found on site at levels harmful to human health which require some excavation and removal from site.

2.4.14 The report also confirms a medium level risk from unexploded ordnance.

2.4.15 The main finding is that engineering solutions are required at the site however no commentary is provided on the type or extent of these.

Cole Green Former Mineral Workings Soil Survey and Generic Quantitative Risk Assessment (October 2014)

2.4.16 This report provides "A soil survey at the site and subsequent data assessment and advise on the suitability of the site for proposed public open space end use"

2.4.17 It covers the central area of the site as shown below.

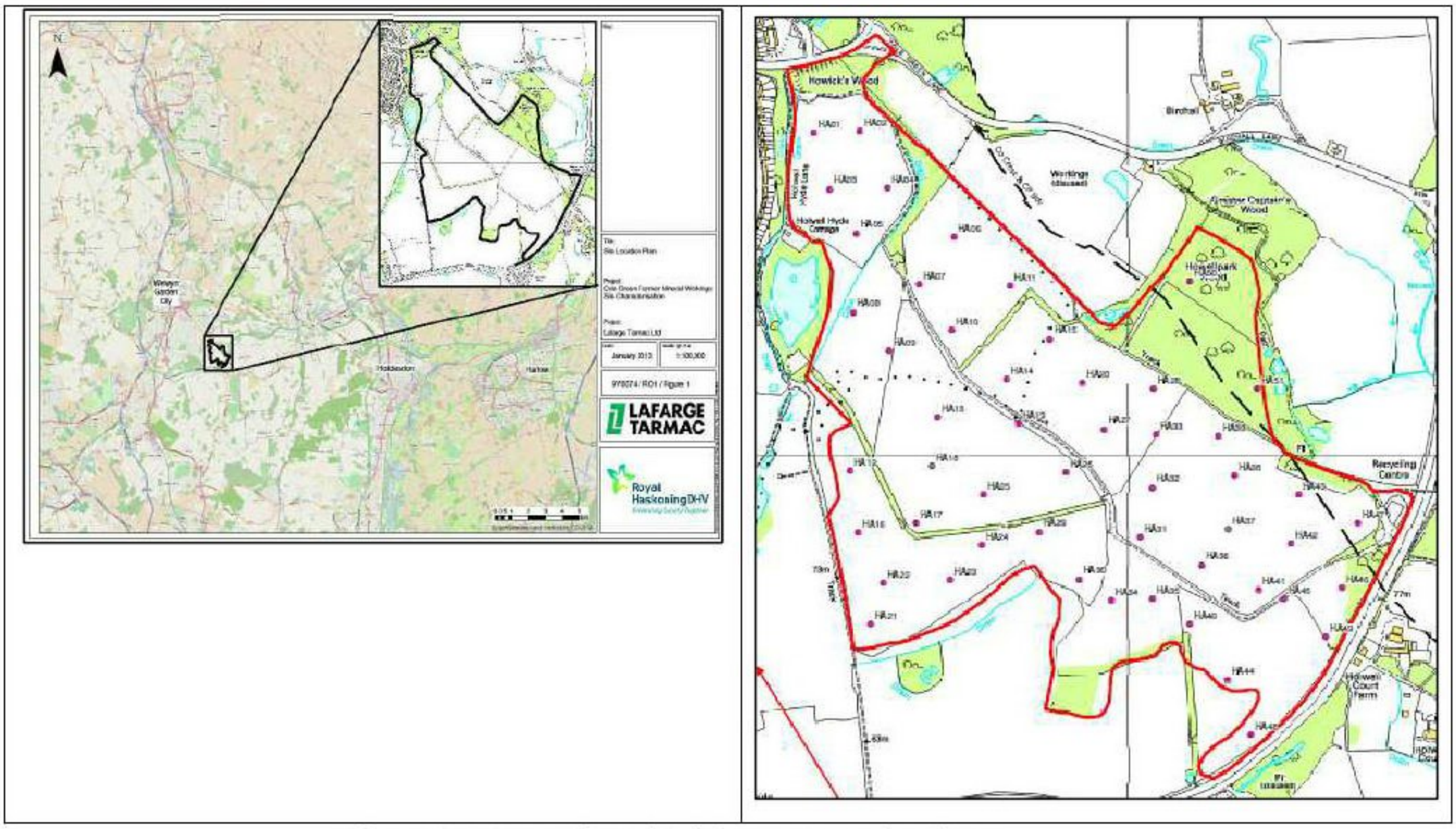


Figure 2-6 Area of Land Subject to Investigation

2.4.18 The report states that the site has been subject to monitoring for over 30 years but no review of this data has been provided. No groundwater or surface water monitoring was undertaken in this investigation.

2.4.19 The investigation only focusses on shallow soil contamination and ground gas, noting that ground gases are passively vented. Whilst the report concludes that design and remedial measures required but there are no details as to what these should be.

2.4.20 No information is provided to enable the deduction of waste depths, which will be necessary as part of any work to cap the site because any scheme will need the gas yield will need to be estimated such that proposed measures can be reviewed for robustness.

2.4.21 The report makes several claims regarding the results that show some degree of contamination. Not all exploratory holes had topsoil and topsoil did not exceed 5cm depth and the report comments that asbestos and elevated PCB results are not indicative of widespread contamination. Furthermore, Benzo(a)Pyrene results were

reconsidered to make the statistical analysis less conservative and then the results showed they were not an unacceptable risk.

2.4.22 We note the report states on page 30 that, "a review of the ongoing results of gas monitoring undertaken by Tarmac will be undertaken to corroborate the results". This information has not been made available nor is there any confirmation that it has been done.

2.5 General Observations

2.5.1 In addition to the points raised above we would conclude that the information provided in these reports is insufficient and inadequate for anyone to draw conclusions from them. Additional information is required to enable a full understanding of the proposals.

2.5.2 Further information is required to demonstrate that the site is suitable for inclusion in a strategic housing location as there has to be a question over deliverability. The author's comment on the suitability of the site and residual risk in partnership with engineering measures is completely without basis because it is purely a subjective statement in the absence of a proposed design. Further design information would be required including proposed engineering measures; the assessment of which should be done by suitably qualified engineers.

2.5.3 Reports are either lacking or additional work is required to address the following issues:

1. Depth profile of landfilled wastes across the central and southern areas is not defined.
2. Gas generation potential/profile of landfilled wastes needs to be understood.
3. Design of a cap required, including long term stability assessment and an assessment of migration pathways to understand the gas control measures that would be required.
4. The environmental impact on the flood risk zone from development in areas which include contaminated made ground or where wastes may be deposited needs to be considered further.

5. Detailed engineering solutions need to be reviewed to determine if they would be appropriate.
6. EA incident reports have identified some pollution occurrences. Detail included is currently insufficient to determine whether there is a causation link with the site.
7. Tarmac's gas monitoring results should be assessed to identify trends.
8. Tarmac's groundwater and surface water monitoring data should be assessed.

3 GROUND AND ENVIRONMENTAL ENGINEERING

3.1 General

3.1.1 This section of the report represents a high-level review of the four Royal HaskoningDHV (RHDHV) reports, referred to in section 1. Specifically, this section considers:

- The general suitability of the stated objectives of the RHDHV reports;
- Whether the investigations broadly comply with key relevant industry standards and practice;
- The scope and spatial coverage of each of the three reports; and
- Whether the reports identify risks that may not be compatible with the proposed end use.

3.1.2 It is understood that the RHDHV reports relate to land around the Cole Green area, near to Welwyn Garden City, and are prepared and submitted to the Local Planning Authority by Lafarge Tarmac, in order to support the entry of the land in to the forthcoming Local Plan.

3.1.3 The National Planning Policy Framework (NPPF) states that planning policies and decisions should ensure that a site is suitable for the proposed use, taking account of the condition of the site in terms of land stability and pollution/environmental status. In order to satisfy this requirement, it is expected that an adequate level of site investigation information would be provided, commensurate with the perceived risks associated with the site. The NPPF states that the Local Plan should be based on adequate, up-to-date and relevant evidence regarding the environmental characteristics and prospects of the area and that Plans should be deliverable. To ensure viability, the costs of any requirements likely to be applied to a development should, when taking account of the normal cost of development and mitigation, provide competitive returns to a willing land owner and willing developer to enable the development to be deliverable.

3.1.4 Furthermore, advice published by the Department for Communities and Local Government (DCLG), provided with respect to land affected by contamination, states that it can be helpful to allocate land which is known to be affected by contamination

only for appropriate development, and to be clear on the approach to remediation. The DCLG advice continues to state that it can be helpful for Local Plans to have regard to the possible impact of land contamination on neighbouring areas (e.g. by polluting surface water or groundwater).

3.1.5 As referred to in section 2, Wardell Armstrong understands that the site includes an area subject to quarrying and, latterly, landfilling. It is understood that this area of land will be incorporated into the proposed Birchall Garden Suburb development, to provide public open space. The remainder of the site is understood to be proposed to be developed to include an employment area, a primary and secondary school, residential properties and water bodies associated with sustainable urban drainage and flood mitigation systems. The area is identified within the draft Welwyn Hatfield Local Plan as Strategic Development Site SDS2, Urban Open Land UOL230, Employment Area EA11 and Wildlife Site WS77 and is a joint allocation with East Herts District Council (EHDC), identified as EWEL1 within the EHDC Local Plan.

3.1.6 In the context of the sensitivity of the proposed end uses, in order to ensure viability (deliverability) of the project, a proportionate level of intrusive investigation would be anticipated to be required. In the absence of a suitable level of investigation, it would be difficult to reliably quantify risks to groundwater, human health and possible land instability issues associated with the presence of the landfill or features such as any infilled former pits etc. These risks could have potentially onerous mitigation requirements in order to facilitate the safe development of the site for the proposed end uses, and these requirements could jeopardise the viability of the development. Furthermore, if the scope/influence of these risks is poorly defined and understood, there could be a risk that aspects of the development are not possible.

3.1.7 Guidance on the appropriate level of intrusive investigation for sites potentially affected by contaminated land is given in British Standard, BS10175:2013. Whilst this Standard is not specific to the level of investigation required in order to demonstrate suitability for allocation within a Local Plan, and there are a number of additional British Standards and codes of practice applicable to the investigation of soil, gas and groundwater risks (notably, BS1997-2:2007, BS5930:2015, BS8485:2015 and CIRIA report C665), the general principles are considered to be valid.

3.1.8 It would be expected that, as a minimum, sites would benefit from a desk study and site reconnaissance / walkover survey. As part of the desk study, a conceptual site model (CSM) should be prepared to consider the geological and environmental setting, potential nature and sources of contamination and instability, potential migration pathways and potential receptors. This CSM can then be used to target and direct intrusive investigation in order to quantify the risks to development.

3.1.9 In order to answer the question of development viability, it would be anticipated to be necessary to consider whether remediation of land instability or contamination risks was likely to be required, and what the broad scale of any such remediation could be. This would necessitate some understanding of the prevailing ground conditions and a basic quantification of the sources and pathways of those risks.

3.2 Cole Green Site Characterisation & Generic Quantitative Risk Assessment (October 2014)

3.2.1 This report focusses on the western and southern areas of the site and is considered by RHDHV to not include areas of former landfill. This report appears to be a final version of the '*WGC5 Site Characterisation Generic Quantitative Risk Assessment*' April 2014 report, and the following commentary is therefore provided with respect to the more recent document only.

3.2.2 The report refers to a previous desk based study and preliminary risk assessment, prepared in 2013, although a copy has not been made available to us for consideration in the preparation of this supplementary note. The report states that it builds upon the content of the 2013 study and is based on intrusive site investigation which included collection of soil and water samples and ground gas monitoring. The report is stated to provide an assessment of the potential risks to receptors as a result of potential contaminants migrating from the former landfill located to the north of the parcel of land covered by the report.

Ground Gas Risks

3.2.3 Whilst all boreholes installed as part of the investigation are reported to have been fitted with ground gas monitoring standpipes, the report states that ground gas

monitoring was only undertaken at selected monitoring points. The report identifies 23 ground gas monitoring points across the area, of which, four have only been monitored for ground gas on one occasion and the remaining 19 have been monitored on two occasions. The approximate spacing between adjacent monitoring points is between 150-250m.

3.2.4 Published industry guidance (CIRIA C665), which is referred to in the report, provides information on the spacing of ground gas monitoring wells and the typical/idealised frequency and period of a ground gas monitoring programme. Residential development is regarded to be a high-risk receptor and a former landfill site (to the north) would be regarded to offer a moderate potential for gas generation. On this basis, in order to characterise the ground gas risks at the site, it would be anticipated that gas monitoring installations would be constructed at a c25-50m spacing and twelve monitoring rounds would be conducted over a period of six months.

3.2.5 The scope of the ground gas investigation discussed within the report, therefore, should be regarded to only be sufficient to convey a very preliminary assessment of the ground gas risks at the site. Nonetheless, on the basis of the information available, it is not anticipated that ground gas risk will preclude residential development of the site. However, further monitoring will be required and it is considered likely that new built development will require the design and installation of suitable gas protection precautions. It should be noted that there remains a level of uncertainty in this assessment (and therefore the potential effects on the economic deliverability of development) whilst the extent of the landfill deposits on the adjacent land, and their gas generation characteristics, is largely unquantified (as discussed later in this report).

Soils & Groundwater Contamination Risks

3.2.6 The report identifies a number of potential contamination risks present within the near surface soils at the site, albeit, the report concludes that none of the contaminants are considered to represent a significant constraint to the redevelopment of the site. The density of the sample/investigation locations across the site is, in general, greater than 100m centres. Published industry guidance

(BS10175:2013) indicates that, whilst the density of sampling grids can vary, the range anticipated for exploratory investigations may be 25m to 50m centres.

3.2.7 The report refers to the presence of a strong 'landfill/hydrocarbon' odour in the vicinity of surface water sample CGSW01, located at a field drain within the centre of the site. The source of this is not reported, but on the basis that the site is not indicated to have been subject to a past landfilling operation, may indicate the presence of contaminants migrating from the landfill to the immediate north. Alternatively, it may indicate that the landfilled deposit is more extensive than referred to by RHDHV, and that it persists in to the area of proposed residential development.

3.2.8 On the basis of very limited monitoring of ground and surface waters at the site, the report concludes that, whilst there are a number of instances of elevated concentrations of contaminants within the ground and surface waters at levels above acceptance criteria, including perched groundwater that may be in continuity with the underlying Secondary A Aquifer (which supports a potable groundwater abstraction to the south of the site), ground and surface water contamination is not considered to represent a significant constraint to the redevelopment of the site. The report does, however, refer to the need for further monitoring of ground and surface waters in order to corroborate the conclusions of the report.

3.2.9 The report indicates that groundwater flow is to the south and west (i.e. across this site from the recorded landfill, immediately to the north, and towards the groundwater abstraction, near to Essendonbury Farm, to the south).

3.2.10 The extreme south of the site lies within a groundwater Source Protection Zone 1 (SPZ1). The report confirms the presence of contaminants in exceedance of the Drinking Water Standards (DWS) within the Secondary A Aquifer (superficial deposits – likely to be sand and gravels of the Kesgrave Catchment Subgroup). However, inspection of the borehole records drilled at the southern boundary of the site confirm that the Kesgrave Gravels directly overlie chalk of the Lewes Nodular Chalk Formation and Seaford Chalk Formation. The chalk represents a Principal Aquifer and is likely to represent the source of the groundwater abstraction near to Essendonbury Farm.

3.2.11 The Kesgrave Gravels are not considered likely to offer any significant restriction to the vertical (downward) migration of contaminants and, therefore, could be regarded to be in direct continuity with the Principal aquifer.

3.2.12 By virtue of the proximity of SPZ1 to the boreholes identifying contamination above the DWS, and the likely absence of any meaningful or effective barrier to the flow of contaminants in to the Principal Aquifer, it is considered possible that the Environment Agency will object to the allocation of this site in the Local Plan. An objection to allocation of this site may be on the grounds that development may alter or enhance the movement of contaminants within the Secondary A Aquifer and Principal Aquifer (e.g. through activities such as piling or infiltration drainage), which has the potential to adversely affect the public water supply abstraction within the SPZ1.

3.2.13 It should be noted that, in their consultation responses to Welwyn Hatfield Borough Council, dated 20th March 2015 and 9th February 2016, the Environment Agency raise a number of matters related to flood risk, water quality and contamination. Within these matters, the Environment Agency do refer to their interest in any development that negatively impacts upon water quality or waterbodies, with a specific focus around contaminated sites, due to their potential to mobilise contaminants and cause pollution. They indicate that planning permission ought not be granted for development that poses a threat to the quality of surface and/or groundwater.

3.2.14 The consultation responses from the Environment Agency include comment that the Local Planning Authority should seek to secure the naturalisation of culverted watercourses, where possible. As referred to above, in respect of piling and infiltration drainage, this may introduce enhanced infiltration and percolation of water through contaminated soils, causing the leaching and downward migration of contaminants to the aquifer, or may otherwise place surface waters in direct contact with contaminants within the near surface soils, with the capacity to degrade the quality of waterbodies. In respect of the latter, the consultation responses identify that none of the watercourses within the Borough complied with the requirements of the Water Framework Directive (good ecological status) at the time of the responses and the Environment Agency make further comment that Welwyn Hatfield Borough Council

should be seeking to improve this status in order to comply with the Thames River Basin Management Plan.

3.2.15 The Environment Agency also refer to the presence of a significant ongoing contamination risk to groundwater in the Welwyn and Hatfield area, represented by a plume of Bromate (a known carcinogen), that is known to extend within the Chalk Aquifer, from a former chemical works at Sandridge, c9km to the west of the site.

Ground Stability

3.2.16 The report does not contain reference to ground conditions or geotechnical constraints, however, on the basis of a cursory review of the site investigation logs, the RHDHV investigation identifies a general absence of significant deposits of Made Ground and presence of superficial deposits (glacial till and fluvial sand and gravel). The ground conditions encountered are not considered likely to represent any significant challenge or limitation with respect to the proposed redevelopment. However, the density of the site investigation locations is limited and it is possible that the full extent of the landfill deposit has not been identified. The presence of a degradable or liquid waste mass would present a geotechnical constraint to built development and it is generally regarded that a residential development is incompatible with the presence of any significant thickness of degradable waste.

3.3 Cole Green Former Mineral Workings Soil Survey & Generic Quantitative Risk Assessment (October 2014)

3.3.1 This report focusses on the central area of the site and is considered by RHVDV to be the area subject to historical mineral workings and subsequent landfilling.

3.3.2 The report refers to a previous desk based study and preliminary risk assessment, prepared in 2013, although a copy has not been made available to us for consideration in the preparation of this supplementary note. The report states that it builds upon the content of the 2013 study and is stated to convey the findings of a soil survey and provide an assessment of the suitability of the site for the proposed public open space end use.

Ground Gas Risks

3.3.3 The report refers to the monitoring of a variety of installations undertaken by Tarmac during the period 2011-2013. No plans are appended to the RHDHV report to illustrate the location of these monitoring points so, on the basis of the RHDHV report alone, it is impossible to be assured of the efficacy of any spatial distribution of monitoring at the site.

3.3.4 The report refers to the monitoring of a number of different installations, including manhole chambers, passive gas venting boreholes, drains and utilities boxes, in addition to 'gas monitoring boreholes'. The monitoring dataset does not include measurement of gas flow rates.

3.3.5 The report identifies a range of methane and carbon dioxide concentrations having been detected at the site. Concentrations of up to 58.5% methane and 32.4% carbon dioxide have been reported at passive gas venting boreholes and concentrations of 20.1% methane and 21.7% carbon dioxide have been recorded at gas monitoring boreholes.

3.3.6 As the majority of the monitoring points are not specifically constructed for the purpose of reliable and accurate determination of ground gases, they cannot, particularly in the absence of flow measurement, be used in a quantified ground gas risk assessment. Data acquired from these monitoring points could only be used qualitatively. However, on the basis of the gas concentrations detected (and reference to 'passive gas venting boreholes', implying the presence of some form of landfill gas management system), it would be reasonable to assume that the landfill deposit does present a source of ground gases and that these gases may provide a risk to the safe occupation of the development site.

3.3.7 It is considered that the ground gas aspect of this investigation is not in accordance with published industry guidance. The scope of the ground gas investigation discussed within the report, therefore, is regarded to be insufficient with respect to determining both the ground gas risks at the site, the nature of the gas source and the risk of ground gas migration to off-site receptors.

3.3.8 Whilst it is considered unlikely that ground gas risk will preclude the use of the site for public open space/amenity purposes, the monitoring dataset demonstrates the presence of carbon dioxide and methane and the prevailing geology of sand and gravel deposits in the vicinity of the site (established within the other reports prepared by RHDHV) may provide opportunity for off-site migration. Further monitoring and targeted assessment of the landfill deposits (source) and sand and gravel deposits (pathway) will be required in order to determine whether the site presents a risk to adjoining built development.

Soils & Groundwater Contamination Risks

3.3.9 The RHDHV report presents a Conceptual Site Model (CSM) that identifies landfill deposits (capping, potentially putrescible/degradable materials and liquid fills) to present a source of contamination. The CSM also refers to pathways and receptors including the Secondary A Aquifer and underlying Principal (chalk) Aquifer.

3.3.10 However, the report details the findings of an intrusive investigation comprised of a series of 51 hand auger boreholes. The deepest of these boreholes extended to a depth of 1.16m below ground level. All but one of the boreholes (CGHA50) were terminated within Made Ground and did not prove the full thickness or character of the landfill deposit. No groundwater monitoring was undertaken as part of this investigation. The density of the sample/investigation locations across the site is, in general, greater than 100m centres. Published industry guidance (BS10175:2013) indicates that, whilst the density of sampling grids can vary, the range anticipated for exploratory investigations may be 25m to 50m centres.

3.3.11 Accordingly, it is clear that the investigation scope is insufficient so as to confirm the nature of the source identified within the CSM or to determine the presence and viability of the pathways identified within the CSM. Whilst very shallow soils chemical analysis was undertaken, and provides some indication as to the potential immediate risks to human health, in the absence of any information regarding the nature, extent and condition of the landfill deposit, it is not possible to quantify the risks to human health or controlled water receptors.

3.3.12 The landfill deposit potentially presents a significant source of contamination that may adversely impact the suitability of the site for use as public open space and may also migrate to the adjoining land proposed to be developed for residential use and, further, towards the potable groundwater abstraction at Essendonbury Farm.

3.3.13 The report does identify a number of potential contamination risks present within the near surface soils at the site, albeit, the report concludes that none of the contaminants are considered to represent a significant constraint to the redevelopment of the site.

3.3.14 Amongst other contaminants, the report identifies asbestos (loose fibres and asbestos containing materials), within near surface soils. It would ordinarily be regarded that, where present at or near surface, asbestos is not compatible with use of the land as public open space and would require remediation (removal or capping) in order to facilitate safe occupation of the land. The scope and scale of any such remediation is not defined by the RHDHV report and the report recommends further investigation in order to quantify the extent and further assessment of the contamination risks identified.

3.3.15 There is no assessment of surface or groundwater chemistry and the risks to surface and groundwater are not quantified or investigated. The historical landfill is understood to have infilled the quarried void left by the removal of sand and gravel deposits. This is likely to be the gravels of the Kesgrave Catchment Subgroup, demonstrated by investigation on adjoining land to be directly underlain by chalk. The Kesgrave gravels are considered to represent a Secondary A Aquifer and the chalk is regarded to be a Principal Aquifer. It is therefore probable that the landfilled deposit is in direct continuity with, at least, the Secondary A Aquifer, and most likely, both the Secondary A Aquifer and the Principal Aquifer.

3.3.16 Proposals to develop adjoining sites, potentially partly above or within the landfilled deposit (as the boundary of such is not currently defined), would be anticipated to require the use of flood mitigation measures and sustainable drainage solutions, such as attenuation ponds and infiltration drainage. These solutions could provide point or

focussed infiltration at areas around (and potentially within) the landfill deposit and may greatly increase the amount of infiltration through the landfilled materials, leading to the exacerbation of contaminant leaching, stronger groundwater flows and the promotion of contaminant migration through the aquifer(s), potentially increasing the risk on vulnerable groundwater receptors.

3.3.17 The comments in paragraphs 3.2.13 to 3.1.15 inclusive, with respect to the Environment Agency local plan consultation response, remain valid with respect to the area covered by the RHDHV report for the former mineral workings.

3.3.18 As these matters are presently not quantified, and the scale and scope of any remediation required to make the site suitable for use as public open space is unknown, it is unclear how the site can be determined to be deliverable on the basis of the data reviewed.

Ground Stability

3.3.19 The report does not contain reference to ground conditions or geotechnical constraints, however, whilst a landfill deposit can give rise to significant total and differential settlements as a result of the degradation of the waste mass, it is unlikely that such settlements would preclude the use of the site for public open space. Settlement may, however, adversely affect the ability to construct and maintain a surface water body.

3.4 Birchall Farm Site Characterisation & Generic Quantitative Risk Assessment (October 2014)

3.4.1 This report focusses on the northern area of the site and is considered by RHDHV to not include areas of former landfill.

3.4.2 The report refers to a previous desk based study and preliminary risk assessment, prepared in 2013, although a copy has not been made available to us for consideration in the preparation of this supplementary note. The report states that it builds upon the content of the 2013 study and is based on intrusive site investigation which included collection of soil and water samples and ground gas monitoring. The report

is stated to provide an assessment of the potential risks to receptors as a result of potential contaminants migrating from the former landfill located to the south of the parcel of land covered by the report.

Ground Gas Risks

3.4.3 Five boreholes installed as part of the investigation are reported to have been fitted with ground gas monitoring standpipes, the report states that ground gas monitoring was undertaken at each monitoring point on one occasion. The approximate spacing between adjacent monitoring points is generally in excess of 300m.

3.4.4 Published industry guidance (CIRIA C665), which is referred to in the report, provides information on the spacing of ground gas monitoring wells and typical/idealised frequency and period of a ground gas monitoring programme. Residential development is regarded to be a high-risk receptor and a former landfill site, present to the south, would be regarded to offer a moderate potential for gas generation. On this basis, in order to characterise the ground gas risks at the site, it would be anticipated that gas monitoring installations would be constructed at a c25-50m spacing and twelve monitoring rounds would be conducted over a period of six months.

3.4.5 The scope of the ground gas investigation discussed within the report, therefore, should be regarded to only be sufficient to convey a very preliminary assessment of the ground gas risks at the site. Nonetheless, on the basis of the information available, it is not anticipated that ground gas risk will preclude residential development of the site. However, further monitoring will be required and it is considered likely that new build development will require the design and installation of suitable gas protection precautions. It should be noted that there remains a level of uncertainty in this assessment (and therefore the potential effects on the economic deliverability of development) whilst the extent of the landfill deposits on the adjacent land, and their gas generation characteristics, is largely unquantified (as discussed later in this report).

Soils & Groundwater Contamination Risks

3.4.6 The report identifies a number of potential contamination risks present within the near surface soils at the site, albeit, the report concludes that none of the contaminants are considered to represent a significant constraint to the redevelopment of the site.

3.4.7 Groundwater is reported to have been encountered at investigation locations to the south of Birchall Lane and the report indicates that one round of groundwater monitoring has been undertaken. However, no monitoring records are provided.

3.4.8 On the basis of laboratory chemical data appended to the RHDHV report, groundwater samples from four monitoring installations have been analysed on one occasion. The report concludes that, whilst there are a number of instances of elevated concentrations of contaminants within the groundwater at levels above acceptance criteria, groundwater contamination is not regarded to represent a significant constraint to the redevelopment of the site. The report does, however, refer to the need for further monitoring of groundwater in order to corroborate the conclusions of the report.

Ground Stability

3.4.9 The report does not contain reference to ground conditions or geotechnical constraints, however, on the basis of a cursory review of the site investigation logs, the RHDHV investigation identifies a general absence of significant deposits of Made Ground and presence of superficial deposits (glacial till and fluvial sand and gravel). The ground conditions encountered are not considered likely to represent any significant challenge or limitation with respect to the proposed redevelopment.

Unexploded Ordnance

3.4.10 Reference is made within the Birchall Farm report (northern site) to risks associated with Unexploded Ordnance (UXO). The report refers to the record of the site having been bombed during World War II and that the risk presented by UXO can be zoned across the site from low to moderate. Unfortunately, the appendices to the Birchall

Farm report are incorrectly referenced against the report text and a copy of the UXO desk based study (understood to have been prepared by Zetica) is not provided and the UXO risk zoning at the site is therefore not clear on the basis of the information provided.

3.4.11 The presence of UXO risk is not anticipated to preclude development per se, but could reasonably introduce additional costs associated with appropriate mitigation measures, which would need to be considered prior to determining a development strategy. No reference to a UXO risk assessment or desk based study having been undertaken for the Cole Green site, or former mineral workings/landfill site, is provided by RHDHV.

3.5 Summary

3.5.1 A high-level review of the three RHDHV reports, detailing the findings of an investigation at the three parcels of land forming the proposed Birchall Garden Suburb development, has been completed with respect to ground and environmental engineering risks.

3.5.2 The review considers whether the reports have identified any headline matters that may question the potential viability of the land for incorporation within the Local Plan as allocated residential or public open space.

3.5.3 In general, whilst the investigations do not provide the requisite sampling density to satisfy published industry guidance, the scope of the investigations as undertaken are likely to be suitable to identify, in broad terms, whether significant constraints are likely to be present. The exception to this the investigation of the area of historical landfilling (former mineral extraction area), which fails to reliably determine the extent, depth or nature of the landfill deposit.

3.5.4 The historical landfill represents a potentially significant source of land instability and contamination, and provides opportunity for ground gases, vapours and leachates to migrate beneath the proposed residential development area, at concentrations that

may present a significant risk to human health. Furthermore, the extant investigations have not conclusively determined the nature of any risk to the potable groundwater abstraction, to the south of the site, and there remains a risk that disturbance due to construction activity may adversely impact on established groundwater and contaminant flow so as to impair the quality of the abstraction for drinking water purposes.

3.5.5 As the historical landfill remains, largely, as an unquantified risk, it is impossible to reliably determine the scope and scale of any required remediation or intervention. However, there are likely to be abnormal engineering constraints to the proposed development of the site, which would bear associated costs and could mean that the site is not deliverable. In the absence of quantification of the risk, it is unclear how the site can be demonstrated to be suitable for the proposed end use. There is also considered to be a risk that the condition of the site (particularly where landfill deposits may be present within the central and southern parcels of land) may be incompatible with the presumption in favour of the use of sustainable drainage solutions, in particular, infiltration drainage.

3.5.6 This high-level review has identified a number of omissions and potential errors within the RHDHV reports, but has not included a detailed review of the philosophy, data or acceptability criteria used by RHDHV in their assessment. It is recommended that a more detailed review of the datasets obtained and used by RHDHV is undertaken, to consider the findings and validity of their interpretation of the investigation.

3.5.7 RHDHV have prepared desk study reports for the site and reference is made to additional information and records held by Tarmac. It would be appropriate to seek to obtain this information, insofar as it forms part of the rationale behind the RHDHV reports, and to undertake a further appraisal of this high-level review with the benefit of the complete information.

wardell-armstrong.com

STOKE-ON-TRENT
Sir Henry Doulton House
Forge Lane
Etruria
Stoke-on-Trent
ST1 5BD
Tel: +44 (0)178 227 6700

BIRMINGHAM
Two Devon Way
Longbridge Technology Park
Longbridge
Birmingham
B31 2TS
Tel: +44 (0)121 580 0909

CARDIFF
22 Windsor Place
Cardiff
CF10 3BY
Tel: +44 (0)292 072 9191

CUMBRIA
Marconi Road
Burgh Road Industrial Estate
Carlisle
Cumbria
CA2 7NA
Tel: +44 (0)122 856 4820

EDINBURGH
Great Michael House
14 Links Place
Edinburgh
EH6 7EZ
Tel: +44 (0)131 555 3311

GLASGOW
2 West Regent Street
Glasgow
G2 1RW
Tel: +44 (0)141 433 7210

LONDON
46 Chancery Lane
London
WC2A 1JE
Tel: +44 (0)207 242 3243

MANCHESTER (City Centre)
76 King Street
Manchester
M2 4NH
Tel: +44 (0)161 817 5038

MANCHESTER (Greater)
2 The Avenue
Leigh
Greater Manchester
WN7 1ES
Tel: +44 (0)194 226 0101

NEWCASTLE UPON TYNE
City Quadrant
11 Waterloo Square
Newcastle Upon Tyne
NE1 4DP
Tel: +44 (0)191 232 0943

SHEFFIELD
Unit 5
Newton Business Centre
Newton Chambers Road
Thorncliffe Park
Chapeltown
Sheffield
S35 2PH
Tel: +44 (0)114 245 6244

TRURO
Baldhu House
Wheal Jane Earth Science Park
Baldhu
Truro
TR3 6EH
Tel: +44 (0)187 256 0738

International offices:
ALMATY
29/6 Satpaev Avenue
Regency Hotel Office Tower
Almaty Kazakhstan
050040
Tel: +7(727) 334 1310

MOSCOW
21/5 Kuznetskiy Most St.
Moscow
Russia
Tel: +7(495) 626 07 67

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