

Phase 2 land quality assessment: Adwy Grange, Tanllan Lane, Coedpoeth, Wrexham

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Glossary and Abbreviations

This glossary includes definition of key technical terms and abbreviations that may be used within the report text.

ACM	Asbestos containing material
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BOD	Biological oxygen demand
BTEX	Benzene, toluene, ethylbenzene, xylene
C4SL	Category 4 Screening Level
DRO	Diesel range organics
EA	Environment Agency
EPH	Extractable petroleum hydrocarbons
GRO	Gasoline range organics
GAC	Generic assessment criterion
LOD	Limit of detection
MTBE	Methyl tertiary butyl ether
NGR	National Grid Reference
PAH	Polycyclic aromatic hydrocarbons
S4UL	Suitable for Use Level
SGV	Soil Guideline Value
SOM	Soil organic matter
SVOC	Semi-volatile organic compound
TPH	Total petroleum hydrocarbons
VOC	Volatile organic compound

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1 INTRODUCTION

1.1 Background

Planning approval has been granted by Wrexham County Borough Council (planning application reference: P/2019/0556) for the conversion of an existing stable block located adjacent to the Adwy Grange property on Tanllin Road in Coedpoeth. The approved development plans for the application site (herein referred to as the 'Site') allow for the 'conversion of an existing outbuilding to form a residential dwelling and the installation of mini sewage treatment plant to serve the new property'. The development plans include for the retention of existing soft standing including an area of orchard in the north-west of the Site.

The Site location is shown on Figure 1.1. The proposed development plans are presented on Figure 1.2 and Figure 1.3.

The planning permission includes the following condition relating to prevailing land quality:

3. *No development shall take place until a phased site investigation of the nature and extent of contamination has been carried out and submitted to and approved in writing by the Local Planning Authority. If any contamination is found during the site investigation, no part of the development shall commence until a scheme specifying the measures that will be taken to remediate the site to render it suitable for the development hereby permitted has been submitted to and approved in writing by the local planning authority. The site shall thereafter be remediated in accordance with the approved scheme. If during the course of development any contamination is found that has not been identified in the site investigation, no further development shall take place on those parts of the site where that contamination has been found until an additional scheme of remediation has been submitted to and approved in writing by the local planning authority for those parts of the site. The relevant parts of the site shall thereafter be remediated in accordance with the additional scheme of remediation.*

In response to planning condition 3, GeoSmart Information Ltd was commissioned in December 2019 to produce a Phase 1 contaminated land report for the Site (report ref: 72551R1 - see Appendix A). The Phase 1 report concluded that the prevailing ground conditions may pose a moderate to low health risk to future Site occupants, due to the potential for contamination associated with historical lead mining activities which are known to have taken place within the wider area.

The Phase 1 recommendations included the following:

- Given the Site is situated within a former lead mining area, there is potential for contamination to be present. It is recommended that a proportionate programme of site investigation works be undertaken in order to establish the presence or absence of contamination and to enable a quantitative assessment of the associated environmental risks.
- Given that the Site is located within an area more likely to have high levels of radon we recommend that either further Radon assessment is undertaken or that appropriate Radon mitigation measures are included in any future built structures.

In response to the findings of the Phase 1 report and also in line with the requirements of planning condition 3, Ground First has been commissioned to undertake a proportionate site investigation in order to quantify potential environmental risks associated with the prevailing land quality at the Site.

1.2 Instruction

Ground First was instructed by Michael Dixon (the Client) on 12th December 2019 to undertake a Phase 2 land quality assessment as outlined in proposal reference 4127P1G.

1.3 Objectives

The objective of the work was to undertake a proportionate programme of site investigation and environmental risk assessment in order to satisfy planning condition 3.

1.4 Scope of works

In order to ascertain the risks posed by any in situ ground contamination, a programme of investigative works was designed to address the following key uncertainties:

- The composition of near surface soils within the proposed orchard / garden area of the proposed development (see Figure 1.2), including the presence of any Made Ground or evidence of mining spoil.
- The chemical composition of the near surface soils.
- The presence of any asbestos containing materials within the sub surface.

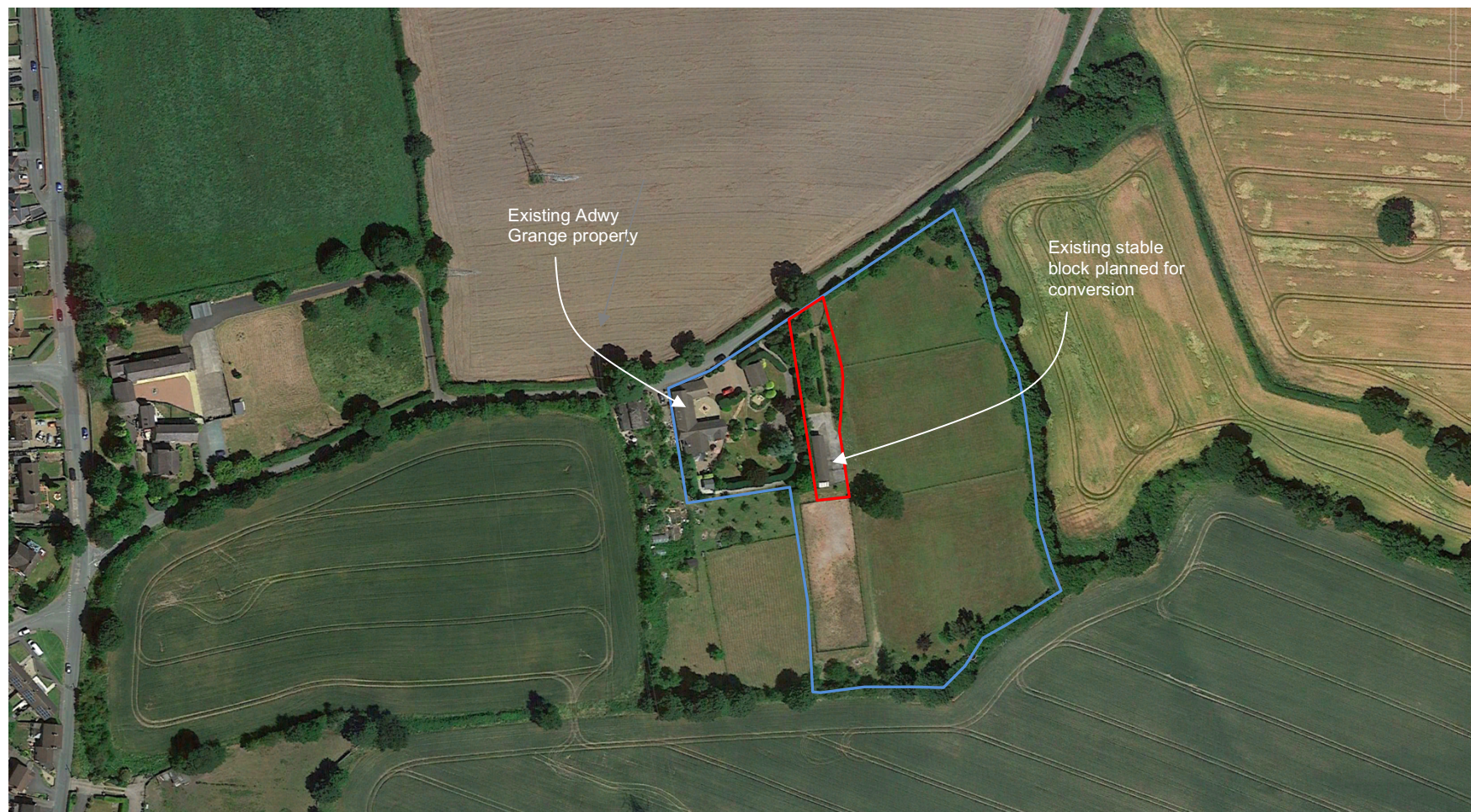
1.5 This report

This report provides factual records of all relevant fieldwork observations and analytical test results; it also presents a conceptual site model as well as the findings of appropriate risk assessments relating to relevant contaminant linkages.

1.6 Exclusions

It is noted that the findings presented in this report are in part based on information supplied by third parties. Whilst we assume that all information is representative of past and present conditions we can offer no guarantee as to its validity. This report excludes consideration of potential hazards arising from any activities at the Site other than normal use of the proposed development. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Figure 1.1 Site location plan

**Site location**

Planning application boundary shown in red; applicant land ownership shown in blue

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Figure 1.2 Proposed development plan

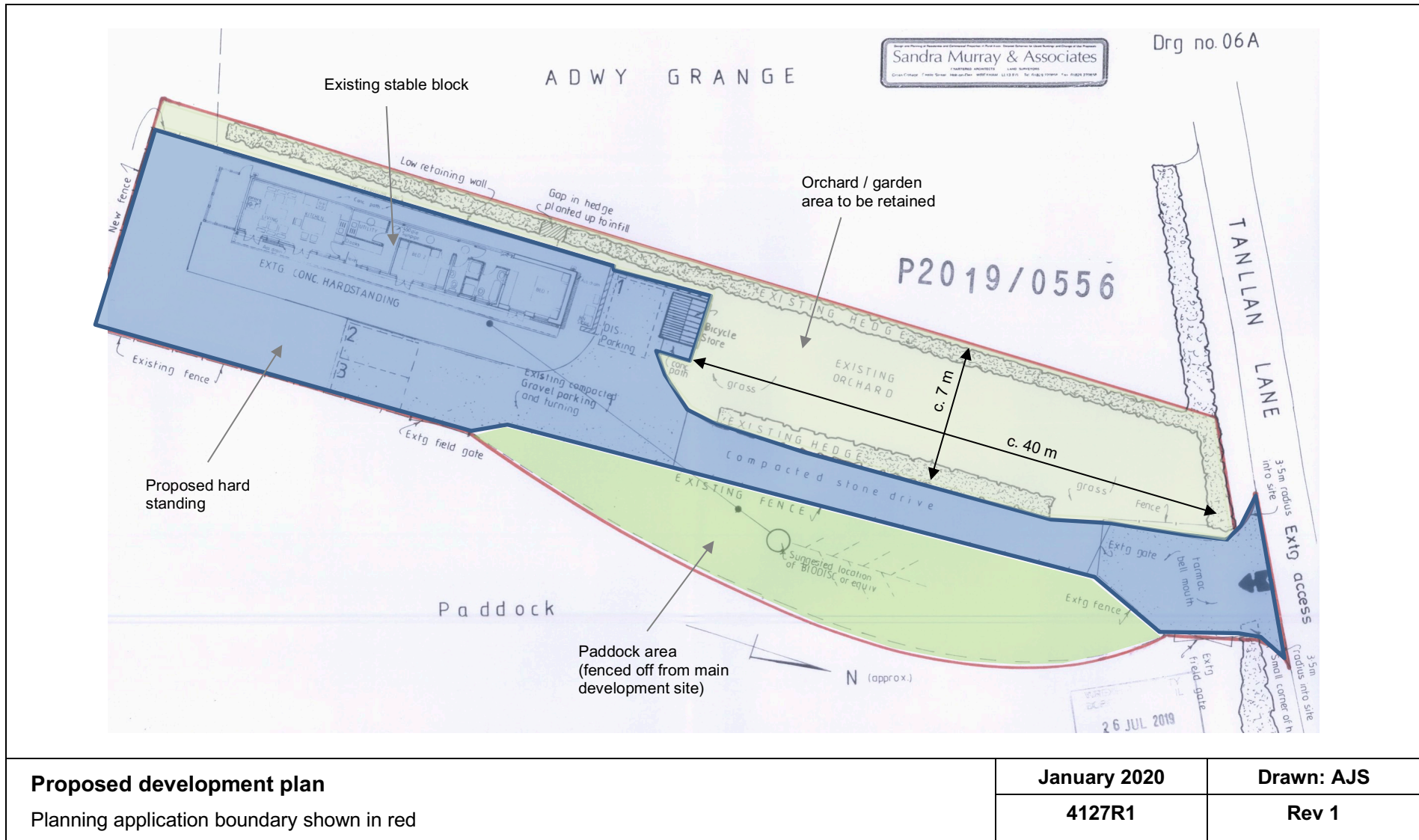
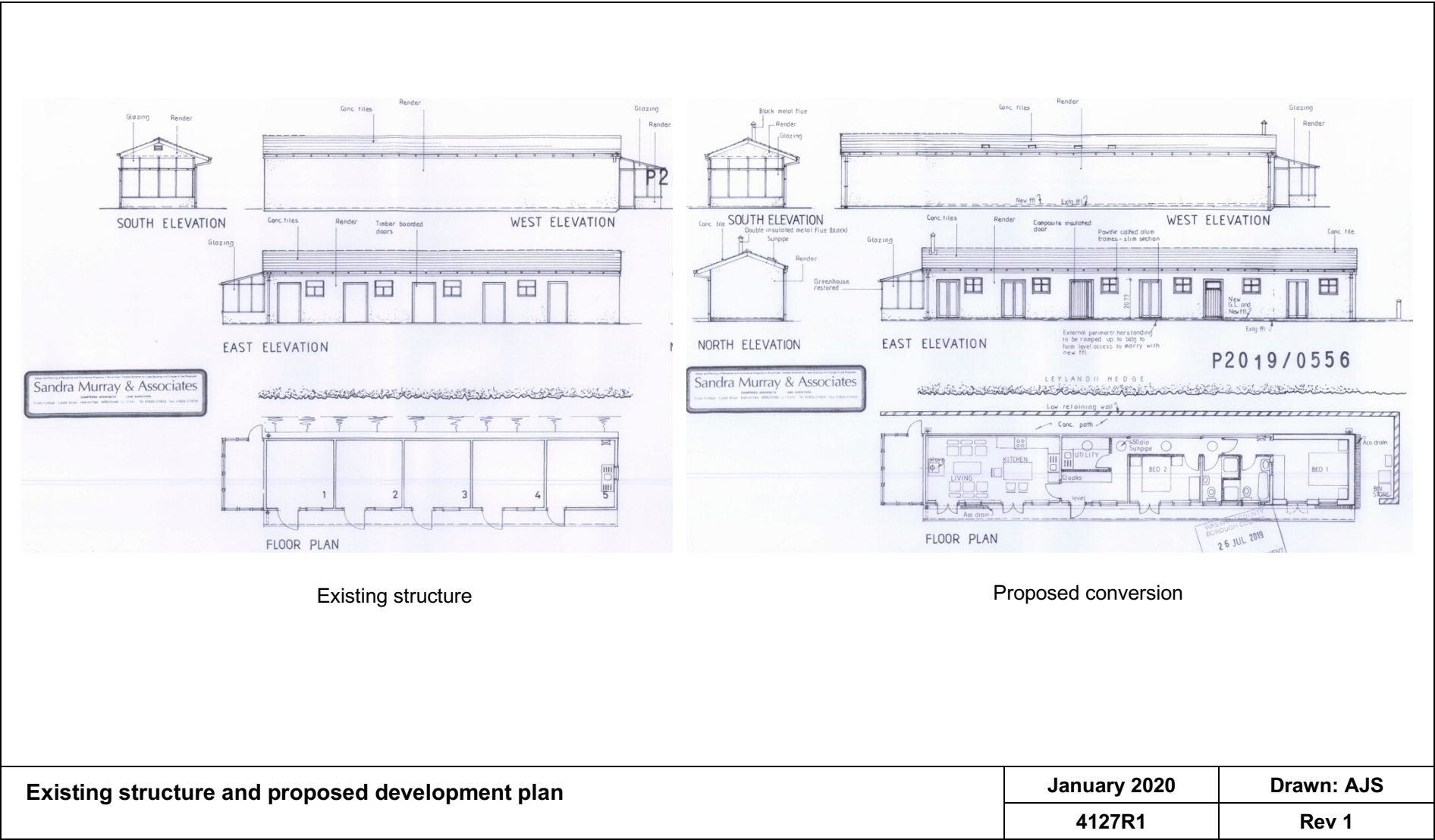


Figure 1.3 Proposed development plan – building conversion



2 SITE SETTING AND HISTORY

The following section provides a summary of the Site setting and land use history.

2.1 Basic site information

Information relating to the Site location is summarised in Table 2.1.

Table 2.1 Site details

Site Address	Adwy Grange, Tanllan Lane, Coedpoeth, Wrexham, LL11 3EL
Site area	c. 0.13 hectares
General setting and Ground coverage	The Site is located within a rural setting directly to the east of Coedpoeth. The local topography slopes gradually down to the east. The Site is at an elevation of c. 175 m AOD. The southern half of the Site is largely covered by the existing stable block and associated gravel driveway (see Figure 1.2). The gravel drive runs through the northern part of the Site. The north-western part of the Site comprises a grassed orchard area. The north-east of the Site (which will accommodate the package water treatment plant) comprises a small section of the adjoining paddock area. This area will remain fenced off from the main Site area post development. The existing Adwy Grange property is located directly to the west of the Site; a grassed paddock occupies the land to the south and east. Tanllan Lane forms the northern Site boundary, beyond which is agricultural land. Photographs of the current Site condition are included in Appendix C.

2.2 Site history

Salient aspects of the Site's historical land use are shown in Table 2.2 below, as derived from the recent Phase 1 report (see Appendix A).

Table 2.2 Site land use history

Date	Land use
1873	The Site appears to be undeveloped and is assumed to be in agricultural use. Adwy Farm is evident c. 45 m to the west.
1912 - 1964	No obvious land use changes at the application Site. Additional structures are mapped as part of the nearby Adwy Farm development.
1984	No obvious land use changes at the application Site. Several previous structures associated with the Adwy Farm development appear to have been removed.
1993	A building is evident in the south-west of the Site (assumed to be the current on-Site structure). The existing Adwy Grange property has been constructed directly to the west of the Site.
2006 - 2018 Aerial imagery	Aerial imagery shows the Site layout to be similar to the present day.

In summary, the Site is understood to have been developed in the mid to late 1980s including the construction of a stable block / tack room and associated driveway. The main area of soft standing, occupying the north-western part of the Site, is understood to have been used for vegetable cultivation and more recently as an orchard. The known Site land use activities during the last 35 years are considered unlikely to have given rise to any significant land contamination. However, the Council has reported land quality issues within the wider

Coedpoeth area associated with historical lead mining activities. As such, the main potential source of land contamination relates to any legacy mining spoil which may be present on-Site.

2.3 Environmental setting

Information relating to the environmental Site setting is summarised in Table 2.3, as obtained from the Phase 1 report plus publicly available environmental data sets.

Table 2.3 Environmental Site setting

Topic	Description
Geology and groundwater	British Geological Survey (BGS) mapping indicates that the underlying superficial geology comprises of Till deposits (classified as a Secondary undifferentiated Aquifer). BGS mapping indicates that the bedrock geology consists of Cefn Rock, which comprises of sandstone and is classified as a Secondary A Aquifer. According to the Phase 1 report (see Appendix A) the Site does not lie within a groundwater Source Protection Zone (SPZ) and there are no groundwater abstraction licences within 1 km of the Site.
Surface water and flooding	There are no surface water features within 150 m of the Site. According to the Phase 1 report (see Appendix A) there are no surface water abstraction licences within 1 km of the Site.
Landfill	According to the Phase 1 report (see Appendix A) there are no recorded operational or historical landfill sites within a 500 m radius of the Site.
Radon	According to the Phase 1 report (see Appendix A), the Site is within an area where between 3% and 5% of homes are at or above the radon action level (200 Bq/m³). A property Radon Report for the Site address is included in Appendix B; this report confirms that the Site is situated within a radon affected area where the estimated probability of the property being above the Action Level for radon is 3% to 5%.
Environmental designations	According to the Phase 1 report (see Appendix A) the only designated site within a 500 m radius is an unnamed ancient woodland located c. 280 m to the south-west of the Site.

2.4 Client consultations

The Client has provided the following information regarding the Site history and current condition:

- The Site is understood to have been used for cattle grazing in the 1970s and early 1980s.
- The driveway was constructed by the current Site owners in the mid 1980s. The material that was excavated as part of the driveway construction was placed across the north-western part of the Site, creating a narrow terrace/plateau (i.e. the current orchard area). The change in level between the driveway and the adjacent plateau is typically of the order 0.8 m.
- No material is understood to have been imported onto the Site by the current Site owners.
- The orchard area in the north-west of the Site was used as a vegetable plot between the mid 1980s and the late 2000s. Rotted horse manure was regularly used as a

fertiliser on the vegetable plot. Note: horses were kept on the adjoining paddock (to the east of the Site) for many years.

- The current orchard area was planted in c. 2009 including a range of apple, pear and plum trees. No pesticides or artificial fertilisers are understood to have been used on the orchard.
- The current Site owners have no knowledge of any historical mining activity within the immediate area. No evidence of any mining spoil has been observed on-Site during the last 35 years.

The Client has provided the following information regarding the proposed development plans:

- The current driveway and areas of hard standing will be retained.
- The orchard area in the north-west of the Site will be retained.
- There are no proposals for any bulk material movements as part of the redevelopment works.
- The existing fencing between the main Site area and the adjoining paddock will be retained.

3 SITE INVESTIGATION WORKS

3.1 Site investigation programme

A programme of intrusive site investigations was coordinated by Ground First on 18th December 2019.

A summary of the site investigation activities undertaken is presented in Table 3.1. Hand pit locations are shown on Figure 3.1 with hand pit soil descriptions provided in Appendix D. A photographic record of the Site works is provided in Appendix C.

Table 3.1 Site investigation activities

Element of investigation	Details	Rationale
Hand pitting	10 hand pit locations (HP01 to HP10) were excavated at the study Site by hand (using a spade, pincer shovel and hand auger – see Photograph 12 in Appendix C). The pits were distributed across the orchard/garden area in the north-west of the Site. The hand pit locations are shown on Figure 3.1. The pits were excavated to depths of between 0.35 m and 0.75 m bgl. All pits were backfilled on completion. The excavated spoil was replaced in broadly the same order as it was excavated. All excavated materials were logged by an experienced site supervisor.	To characterise existing ground conditions across the main area of soft standing to be retained as part of the Site redevelopment. To assess the extent, thickness and composition of any Made Ground, including the presence of any possible mining spoil. To assess the composition of the natural superficial geology. To make a visual assessment of any ground contamination. To facilitate environmental soil sampling of the near surface soils.
Soil sampling	12 soil samples were taken from the trial pits at depths of between 0.1 m bgl and 0.6 m bgl (see Photograph 54 in Appendix C). Soil samples were typically taken from the upper 0.4 m in order to adequately characterise the chemical composition of those soils most accessible to human receptors.	To provide appropriate samples for chemical laboratory analysis (analytical suite described below) in order to inform the subsequent environmental risk assessment.
In situ soil testing	A hand-held PID meter was used during the site works to provide an indication of the presence of volatile organic compounds (VOCs) within the sub surface materials (i.e., through soil headspace testing). One composite soil sample was taken from each hand pit. All samples were placed in a clean zip-lock plastic bag, agitated and left for several minutes, after which the bag was pierced with the end of a PID meter and the peak and steady PID readings recorded. Photographs of the headspace testing are included in Appendix C.	To indicate the distribution and concentration of any VOCs within the sub surface.

Element of investigation	Details	Rationale
Laboratory analysis	All samples collected on-Site were submitted to the UKAS and MCERTS accredited i2 Analytical laboratories for analysis.	To allow assessment of potential land quality risks to identified receptors.

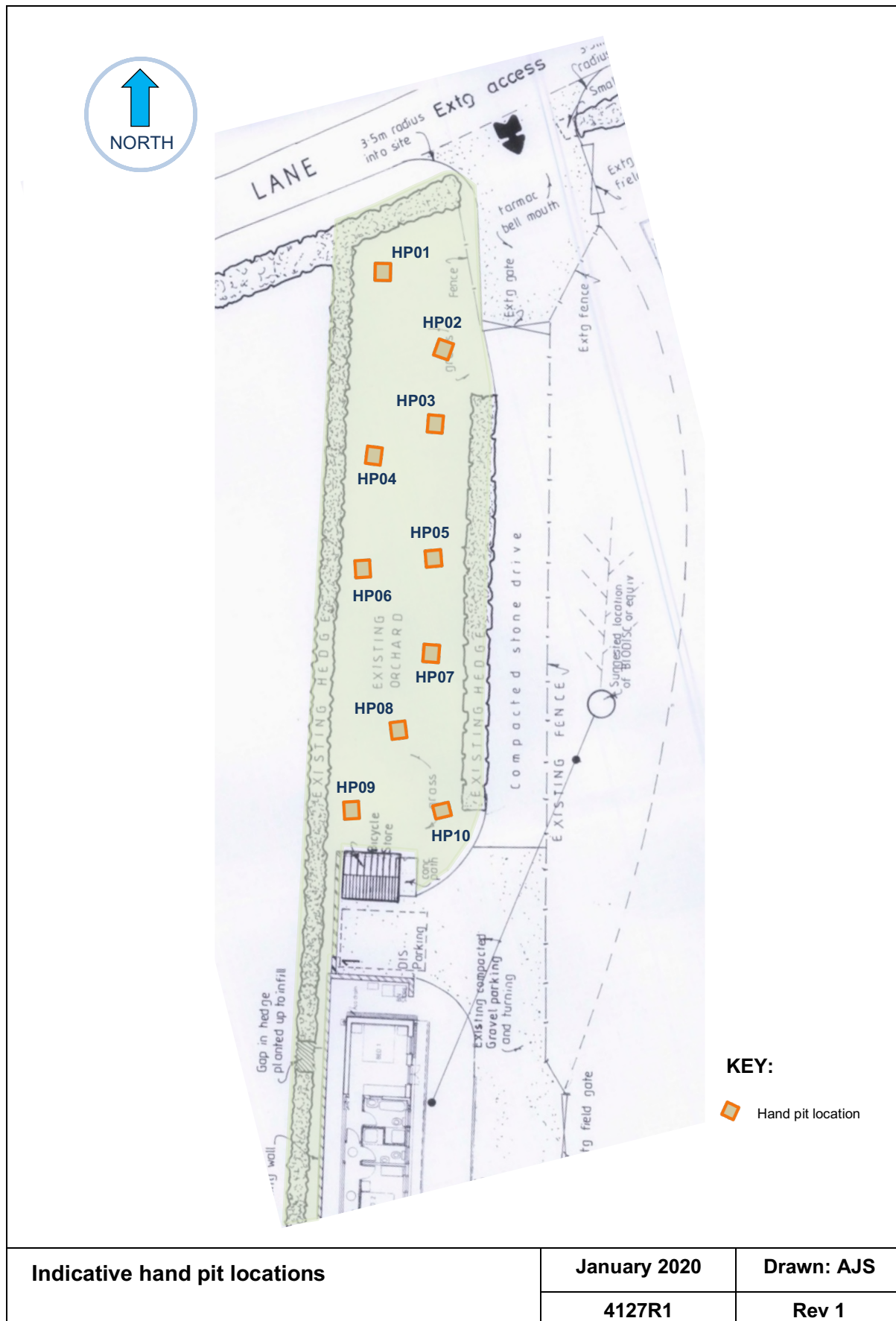
3.2 Chemical laboratory testing

Representative soil samples were obtained from each of the hand pits excavated at the Site.

12 soil samples were scheduled for chemical analysis performed by i2 Analytical (i2 is an approved Ground First supplier). Where possible UKAS and MCERTS certified tests were used. Ten of the samples were analysed for a metal test suite including As, Ba, Be, B, Cd, Cr, Cu, Ni, Pb, Se, Zn, V and Hg.

The remaining two samples (taken from HP02 and HP09) were analysed for a more comprehensive suite, including:

- As, Be, B, Cd, Cr (III and VI), Cu, Ni, Pb, Se, Zn, V and Hg.
- Water soluble sulphate
- Free cyanide
- Fraction of organic carbon (foc)
- pH
- Speciated TPH
- Speciated PAHs
- MTBE
- BTEX
- Total phenols
- Asbestos in soil screen
- Moisture content

Figure 3.1 Site investigation location plan

4 SITE INVESTIGATION RESULTS

4.1 Encountered ground conditions

The sequence of strata encountered within each of the hand pits is described in full in Appendix D and summarised below.

- Ground conditions were observed to be relatively consistent across the orchard area in the north-west of the Site, typically comprising a mixed soil and reworked till layer (of thickness c. 0.3 m to 0.55 m) over a distinct reworked till material (over 0.4 m thick).
- A darker brown, organic-rich silty sand and gravel topsoil horizon was evident in the northern part of the orchard area (as encountered in HP01 and HP02). Elsewhere the upper silty sand and gravel soil / till horizon was slightly lighter in colour with moderately less organic matter.
- Occasional man-made material, including isolated brick remains, was observed within a number of the hand pits (including HP02, HP04, HP08 and HP09).
- The reworked till layer was characterised by a tan brown slightly gravelly silty clay with grey sand inclusions.

There was no obvious ingress of shallow groundwater into any of the hand pits during the site works.

4.2 Visual and olfactory evidence of contamination

The following site observations were recorded in relation to potential ground contamination:

- Only very modest amounts of man-made material were observed within the hand pits.
- No obvious asbestos containing material (including any fragments of suspected cement-bound asbestos) were observed within any of the hand pits.
- No significant staining or odours were recorded in any of the trial pits.

4.3 Chemical testing results

Full laboratory certificates of the soil test results are presented in Appendix E.1. A summary of all analytical data is also shown in Appendix E.2.

4.4 Other site observations

Salient observations made during the site investigation works included:

- The Site was well maintained and orderly.
- The ground surface across the orchard area was relatively flat and level; no signs of differential settlement were observed.
- The Site driveway was observed to comprise compacted gravel with a grass covering (see Photograph 2 in Appendix C).
- No signs of any vegetation stress were observed (although given the timing of the Site investigation any such signs are unlikely to have been readily detected).
- There was no evidence of any past or present bulk fuel or chemical storage at the Site.

5 CONTAMINATION ASSESSMENT

The following section identifies potential contaminants of concern (COC) associated with encountered ground conditions beneath the Site. The outputs of this process will be used to refine the conceptual site model which will in turn provide the technical basis for an assessment of contamination risks in Section 6.

5.1 Assessment of soil data (human health)

5.1.1 Contaminant screen (soil quality)

An initial soil screening exercise involved comparing observed soil quality data with a set of generic human health screening values (commonly referred to as Generic Assessment Criteria (GAC)). GACs have been compiled from various published sources, based on the following hierarchy:

- Suitable for Use Levels (S4ULs) derived by a consortia of industry professionals and published by LQM and CIEH.
- Category 4 Screening Levels (C4SL) published by Defra.

The available soil quality data have been assessed against GACs representative of a typical residential land use, with a sandy loam soil type and a soil organic matter (SOM) content of 2.5% (note: the average observed SOM was 4.7%). The adopted GACs are listed in Appendix F.

All analytes were observed at concentrations below the adopted screening values indicating that these substances are unlikely to pose any future health risks under the proposed residential development scenario.

5.1.2 Contaminant screen (asbestos)

Two samples of the Made Ground were screened by i2 Analytical for the presence of asbestos containing materials (ACM). No asbestos was detected in either of the samples.

5.2 Preliminary assessment of ground gases

In general, hazardous ground gases may pose a variety of risks to human health and built structures including acute effects such as asphyxiation and explosion, as well as on-going physiological effects (CIRIA, 2007).

The most common hazardous ground gases in the context of risks to built structures and Site occupants are methane and carbon dioxide, radon and hydrocarbon vapours.

Available soil quality data and field observations (including PID headspace testing results) suggest an absence of any appreciable vapour source within the sub surface.

Methane and carbon dioxide are common gases generated through the degradation of organic material that can be present in both natural and Made Ground materials. Based on the known Site history and also the observed ground conditions at the Site (including the absence of any appreciable quantities of Made Ground beneath the proposed development area), Site conditions are considered unlikely to give rise to a significant source of ground gas.

A radon report supplied by Public Health England and the Geological Society (see Appendix B) indicates that the Site is located within a radon affected area (defined as where the radon level in at least one property in every hundred is estimated to exceed the Action Level of 200 Bq/m³). The estimated probability of the property being above the Action Level for radon is 3-5%. As such the basic radon protection measures are likely to be required within the redeveloped structure under Building Regulations.

6 CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

6.1 Conceptual model

The recent site investigation was designed to inform the conceptual site understanding by providing reliable information relating to the physical ground model and associated plausible contaminant linkages. The prevailing conceptual model is described below.

6.1.1 Sources

The potential contaminant sources are summarised as follows:

- Reworked soils present in areas of soft standing which could potentially contain localised soil contamination. *It is noted that no such contamination was observed during the recent soil sampling exercise.*
- Radon gas (naturally occurring).

6.1.2 Pathways

It is possible that future construction workers and Site occupants may be exposed to any Site contaminants via one or more of the following exposure pathways:

- Dermal contact with in situ soils.
- Accidental ingestion of in situ soils.
- Inhalation/ingestion of soil dust.
- Consumption of home grown produce and any attached soil.
- Ingress of any localised organic contaminants into water supply pipework.
- Inhalation of any radon gases which may enter the proposed residential structure.

6.1.3 Receptors

Based on the prevailing conceptual model, the following receptors have been identified for further consideration:

- Future construction workers.
- Future Site occupants.

Note: no relevant controlled water receptors have been identified.

6.2 Risk assessment

A summary of the revised potential contaminant linkages associated with the Site is presented in Table 6.1, alongside a judgement of the risks posed by each linkage.

The contaminant linkages have been assessed using the risk assessment methodology described in CIRIA C552 (2001). As such, risk is considered to be a function of both the probability (likelihood) of contamination occurring at the study site and also the potential severity (consequence) of the environmental impacts associated with any such contamination. The classification system used to define contaminant probability, consequence and risk is described in Appendix G.

Table 6.1 Risk assessment

	Sources	Pathways	Receptors	Consequence	Probability	Risk classification	Comment / <i>risk mitigation</i>
1	Reworked soils potentially containing localised contaminant residues <i>Note: no such contamination was observed during the recent site investigations</i>	Dermal contact, soil ingestion and dust ingestion/inhalation	Construction workers	Minor	Unlikely	Very Low Risk	Risk rating reflects the absence of any significant contamination identified during the recent site investigations plus the limited anticipated exposure durations during the construction phase of works.
2		Dermal contact, soil ingestion, dust ingestion/inhalation and consumption of home grown produce plus any attached soil	Future Site occupants	Medium	Unlikely	Low Risk	Risk rating reflects the absence any significant contamination identified within the sub surface during the recent site investigations.
3		Ingress of any localised organic contaminants to drinking water pipework and subsequent human ingestion	Future Site occupants	Medium	Unlikely	Low Risk	Risk rating reflects the absence any significant Made Ground or any organic contamination identified within the sub surface during the recent site investigations.
4	Radon gas (naturally occurring)	Migration of any radon gases into the converted structure and subsequent inhalation	Construction workers	Mild	Unlikely	Very Low Risk	Risk rating reflects the limited exposure frequencies and exposure durations associated with construction workers.
5			Future Site occupants	Medium	Low likelihood	Moderate / Low Risk	Risk rating reflects the assessment that between 3% and 5% of local properties are at or above the radon action level (200 Bq/m³).
	OVERALL RISK RATING					Moderate / Low Risk	

7 RISK ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS

7.1 Environmental conclusions

The 0.13 ha Site appears to have been in agricultural use (including cattle grazing) prior to the development of the current stable block / tack room and associated driveway in the mid to late 1980s. Cut and fill activities were used to create the existing driveway and adjacent garden terrace in the north-western part of the Site. The terraced area is understood to have been used for vegetable cultivation and as an orchard since c. 2009. No artificial pesticides or fertilisers are understood to have been used at the Site.

The known Site land use activities during the last 35 years are considered unlikely to have given rise to any significant land contamination. However, Wrexham Council has reported land quality issues within the wider Coedpoeth area associated with historical lead mining activities.

Geological mapping indicates the presence of Till deposits (classified as a Secondary undifferentiated Aquifer) beneath the Site and surrounding area. The bedrock geology comprises Cefn Rock (sandstone) which is classified as a Secondary A Aquifer.

The recent site investigations suggest that ground conditions are relatively consistent across the orchard area in the north-west of the Site, typically comprising a mixed soil and reworked Till layer (of thickness c. 0.3 m to 0.55 m) over a distinct reworked slightly gravelly silty clay Till (in excess of 0.4 m thick). No significant staining or odours were observed within the sub surface soils.

the Site does not lie within a groundwater Source Protection Zone and there are no groundwater abstraction licences within 1 km of the Site.

The recent ground investigations have indicated the absence of any shallow groundwater within the upper 0.75 m of the soil profile.

There are no surface water features within 150 m of the Site. Furthermore, there are no licensed surface water abstractions within 1 km of the Site.

There are no relevant environmental designations recorded within 250 m of the Site.

There are no recorded operational or historical landfill sites within a 500 m radius of the Site.

Laboratory testing of the in situ soils has identified an absence of any significant chemical or asbestos contamination across the area of soft standing in the north-west of the Site. PID headspace testing results suggest an absence of any appreciable vapour source within the sub surface. Site conditions are also considered unlikely to give rise to a significant source of bulk gas (including methane and carbon dioxide), although the Site is within an area where between 3% and 5% of homes are at or above the radon action level.

7.1.1 Risks to construction workers

The health risks posed to future construction workers by the in situ ground conditions are considered to be low, based on the site investigation findings and also the nature of the development activities (which comprise conversion works rather than wholesale construction works and will limit the duration of any soil or gas exposures).

7.1.2 Risks to future Site occupants

The health risks posed to future Site occupants by in situ soil quality are considered to be low based on the recent site investigation findings.

The risks posed by potential exposure to radon gas are considered to be moderate to low based on the published background radon levels.

7.1.3 Risks to the water environment

No significant pollution risks have been identified to the local water environment.

7.2 Recommendations

Based on observed ground conditions and the prevailing environmental risk assessments described in this report the following recommendations are made:

- Basic radon protection measures should be considered for the converted building. These may include:
 - o Construction of a radon sump beneath the concrete flooring (see: https://www.ukradon.org/information/reducelevels_sump).
 - o Use of a radon protection membrane within the residential structure fitted by an experienced installer in line with prevailing industry guidance.
- In order to verify the requirement for, and specification of, any radon protection measures it may be prudent to undertake one or more in situ radon measurements (see: <https://www.ukradon.org/information/measuringradon>). It is noted that in order to provide reliable results, Public Health England recommended any radon detectors are left in situ for c. 3 months.

8 REFERENCES

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GeoSmart, 2019. EnviroSmart report: Adwy Grange, Tanllan Lane, Coedpoeth, Wrexham, LL11 3EL. Report ref: 72551R1.

APPENDICES

APPENDIX A

Phase 1 report

The Phase 1 report can be accessed using the following link:

https://storage.googleapis.com/client_reports/72551R1.pdf

APPENDIX B

Radon report



Radon Risk Report for addresses in England and Wales

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Address searched: Adwy Grange, Tanllan Lane, Coedpoeth, Wrexham, LL11 3EL

Date of report: 6 January 2020

Guidance for existing properties

Is this property in a radon Affected Area? - Yes

A radon Affected Area is defined as where the radon level in at least one property in every hundred is estimated to exceed the Action Level.

The estimated probability of the property being above the Action Level for radon is: 3-5%

The result may not be valid for buildings larger than 25 metres.

If this site is for redevelopment, you should undertake a GeoReport provided by the British Geological Survey.

This report informs you of the estimated probability that this particular property is above the Action Level for radon. This does not necessarily mean there is a radon problem in the property; the only way to find out whether it is above or below the Action Level is to carry out a radon measurement in an existing property.

Radon Affected Areas are designated by the Public Health England. PHE advises that radon gas should be measured in all properties within Radon Affected Areas.

If you are buying a currently occupied property in a Radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were above the Radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and the results of re-testing confirmed the effectiveness of the measures.

Further information is available from PHE or <https://www.ukradon.org>

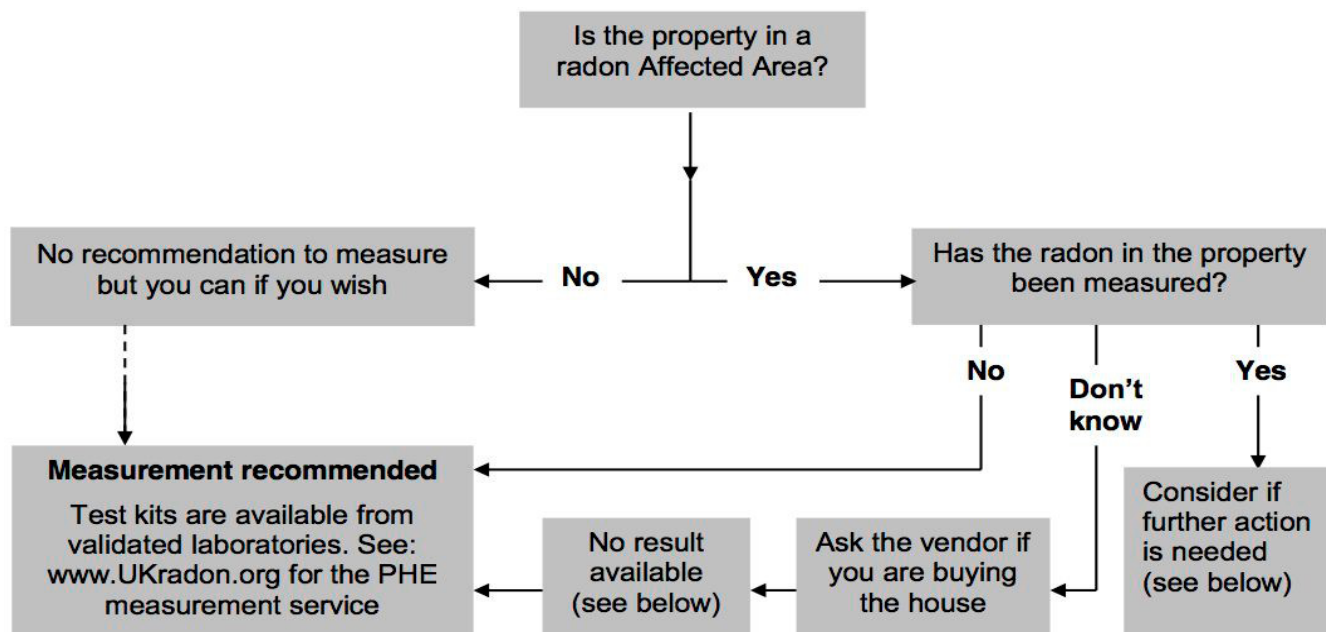
Guidance for new buildings and extensions to existing properties

What is the requirement under Building Regulations for radon protection in new buildings and extensions at the property location? - Basic Protection

If you are buying a new property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

See the Radon and Building Regulations for more details.

PHE guidance for occupiers and prospective purchases



Existing radon test results: There is no public record of individual radon measurements. Results of previous tests can only be obtained from the seller. Radon levels can be significantly affected by changes to the building or its use, particularly by alterations to the heating and ventilation which can also be affected by changes in occupier. If in doubt, test again for reassurance.

Radon Bond: This is simply a retained fund, the terms of which are negotiated between the purchaser and the vendor. It allows the conveyance of the property to proceed without undue delay. The purchaser is protected against the possible cost of radon reduction work and the seller does not lose sale proceeds if the result is low. Make sure the agreement allows enough time to complete the test, get the result and arrange the work if needed.

High Results: Exposure to high levels of radon increases the risk of developing lung cancer. If a test in a home gives a result at or above the Action Level of 200 Becquerels per cubic metre of air (Bq/m³), formal advice will be given to lower the level. Radon reduction will also be recommended if the occupants include smokers or ex-smokers when the radon level is at or above the Target Level of 100 Bq/m³; these groups have a higher risk. Information on health risks and radon reduction work is available from PHE. Guidance about radon reduction work is also available from some Local Authorities, the Building Research Establishment and specialist contractors.

PHE designated radon website:

<https://www.ukradon.org>

Building Research Establishment:

<http://www.bre.co.uk/page.jsp?id=3137>

APPENDIX C

Site photographs



Photograph 1

Description: Site entrance

Date: 18/12/2019

Location: North-eastern Site corner – looking to the north



Photograph 2

Description: Site driveway

Date: 18/12/2019

Location: View along eastern Site boundary – looking to the south



Photograph 3

Description: Former stable block and associated hard standing

Date: 18/12/2019

Location: South-western Site corner – looking to the south



Photograph 4

Description: Former stable block and neighbouring orchard

Date: 18/12/2019

Location: Southern half of the Site – looking to the north



Photograph 5

Description: Former horse paddock directly adjacent to the Site

Date: 18/12/2019

Location: Land to east of the Site – looking to the east



Photograph 6

Description: Orchard area

Date: 18/12/2019

Location: Central and northern parts of the Site – looking to the north



Photograph 7

Description: Orchard area

Date: 18/12/2019

Location: Northern half of the Site – looking to the north



Photograph 8

Description: Orchard area

Date: 18/12/2019

Location: Central part of the Site – looking to the south



Photograph 9

Description: Northern part of orchard area

Date: 18/12/2019

Location: Northern edge of the Site – looking to the north



Photograph 10

Description: Topographic change between driveway and orchard area

Date: 18/12/2019

Location: Northern part of the Site – looking to the west



Photograph 11

Description: Compost heap

Date: 18/12/2019

Location: South-western edge of orchard area



Photograph 12

Description: Field equipment used during site investigation works

Date: 18/12/2019



Photograph 13 **Description:** Hand pit HP01
 Date: 18/12/2019
 Location: North-western corner of the Site



Photograph 14 **Description:** Topsoil observed at hand pit HP01
 Date: 18/12/2019
 Location: North-western corner of the Site



Photograph 15

Description: Soil sequence encountered at HP01

Date: 18/12/2019

Location: North-western corner of the Site



Photograph 16

Description: Soil layer encountered at HP01

Date: 18/12/2019

Location: North-western corner of the Site



Photograph 17 **Description:** Reworked Till encountered at HP01
 Date: 18/12/2019
 Location: North-western corner of the Site



Photograph 18 **Description:** Hand pit HP01
 Date: 18/12/2019
 Location: North-western corner of the Site



Photograph 19 **Description:** Hand pit HP02
 Date: 18/12/2019
 Location: Northern part of the Site



Photograph 20 **Description:** Soil sequence encountered at HP02
 Date: 18/12/2019
 Location: Northern part of the Site



Photograph 21

Description: Upper soil layer encountered at HP02

Date: 18/12/2019

Location: Northern part of the Site



Photograph 22

Description: Lower soil layer encountered at HP02

Date: 18/12/2019

Location: Northern part of the Site



Photograph 23

Description: Reworked Till encountered at HP02

Date: 18/12/2019

Location: Northern part of the Site



Photograph 24

Description: Hand pit HP02

Date: 18/12/2019

Location: Northern part of the Site



Photograph 25

Description: Hand pit HP02
Date: 18/12/2019
Location: Northern part of the Site



Photograph 26

Description: Hand pit HP03
Date: 18/12/2019
Location: Northern half of the orchard area



Photograph 27

Description: Soil sequence encountered at HP03

Date: 18/12/2019

Location: Northern half of the orchard area



Photograph 28

Description: Hand pit HP03

Date: 18/12/2019

Location: Northern half of the orchard area



Photograph 29 **Description:** Hand pit HP04
 Date: 18/12/2019
 Location: Northern half of the orchard area



Photograph 30 **Description:** Soil sequence encountered at HP04
 Date: 18/12/2019
 Location: Northern half of the orchard area



Photograph 31 **Description:** Hand pit HP04
 Date: 18/12/2019
 Location: Northern half of the orchard area



Photograph 32 **Description:** Hand pit HP05
 Date: 18/12/2019
 Location: Central part of the orchard area



Photograph 33

Description: Soil sequence encountered at HP05

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 34

Description: Soil layer encountered at HP05

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 35

Description: Hand pit HP05

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 36

Description: Hand pit HP06

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 37 **Description:** Soil sequence encountered at HP06
 Date: 18/12/2019
 Location: Central part of the orchard area



Photograph 38 **Description:** Soil layer encountered at HP06
 Date: 18/12/2019
 Location: Central part of the orchard area



Photograph 39

Description: Reworked Till encountered at HP06

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 40

Description: Hand pit HP07

Date: 18/12/2019

Location: Central part of the orchard area



Photograph 41 **Description:** Soil sequence encountered at HP07
 Date: 18/12/2019
 Location: Central part of the orchard area



Photograph 42 **Description:** Hand pit HP07
 Date: 18/12/2019
 Location: Central part of the orchard area



Photograph 43

Description: Hand pit HP08
Date: 18/12/2019
Location: Southern half of the orchard area



Photograph 44

Description: Soil sequence encountered at HP08
Date: 18/12/2019
Location: Southern half of the orchard area



Photograph 45

Description: Soil layer encountered at HP08

Date: 18/12/2019

Location: Southern half of the orchard area



Photograph 46

Description: Reworked Till encountered at HP08

Date: 18/12/2019

Location: Southern half of the orchard area



Photograph 47

Description: Hand pit HP08

Date: 18/12/2019

Location: Southern half of the orchard area



Photograph 48

Description: Hand pit HP09

Date: 18/12/2019

Location: Southern edge of the orchard area



Photograph 49

Description: Soil sequence encountered at HP09

Date: 18/12/2019

Location: Southern edge of the orchard area



Photograph 50

Description: Hand pit HP09

Date: 18/12/2019

Location: Southern edge of the orchard area



Photograph 51 **Description:** Hand pit HP10
 Date: 18/12/2019
 Location: Southern edge of the orchard area



Photograph 52 **Description:** Soil sequence encountered at HP10
 Date: 18/12/2019
 Location: Southern edge of the orchard area



Photograph 53

Description: Hand pit HP10

Date: 18/12/2019

Location: Southern edge of the orchard area



Photograph 54

Description: Sample containers

Date: 18/12/2019



Photograph 55 **Description:** Example of soil sample PID headspace testing
Date: 18/12/2019



Photograph 56 **Description:** Example of soil sample PID headspace testing
Date: 18/12/2019



Photograph 57 **Description:** Example of soil sample PID headspace testing
Date: 18/12/2019



Photograph 58 **Description:** Example of soil sample PID headspace testing
Date: 18/12/2019

APPENDIX D

Hand pit soil descriptions

Depth: m bgl	Soil description	Comments
HP01		
0.0 – 0.4	Dark brown organic-rich silty sand and gravel with frequent roots and rootlets. Sand is fine. Gravel is fine to medium and sub angular to sub rounded. TOPSOIL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil sample taken at 0.3 m bgl
0.4 – 0.65+	Tan brown gravelly silty clay. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	
HP02		
0.0 – 0.3	Dark brown organic-rich silty sand and gravel with frequent roots and rootlets. Sand is fine. Gravel is fine to medium and sub angular to sub rounded. TOPSOIL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil samples taken at 0.4 m and 0.6 m bgl
0.3 – 0.5	Brown sand and gravel. Sand is fine to medium. Gravel is fine to coarse and sub angular to sub rounded including occasional brick fragments. MADE GROUND	
0.5 – 0.75+	Tan brown gravelly silty clay. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	
HP03		
0.0 – 0.35+	Brown organic silty sand and gravel with frequent roots and rootlets plus some clay inclusions. Sand is fine. Gravel is medium to coarse and typically sub rounded. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel No groundwater encountered No significant odours recorded Soil sample taken at 0.2 m bgl
HP04		
0.0 – 0.35+	Brown to tan organic silty sand and gravel with frequent roots and rootlets plus some clay inclusions. Sand is fine. Gravel is fine to coarse and sub angular to sub rounded. Very occasional brick fragments below 0.3 m bgl. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil sample taken at 0.15 m bgl
HP05		
0.0 – 0.4+	Brown organic silty sand and gravel with frequent roots and rootlets. Sand is fine. Gravel is medium to coarse and typically sub rounded. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel No groundwater encountered No significant odours recorded Soil sample taken at 0.25 m bgl

Depth: m bgl	Soil description	Comments
HP06		
0.0 – 0.3	Brown organic silty sand and gravel with roots and rootlets. Sand is fine. Gravel is medium to coarse and typically sub rounded. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil sample taken at 0.5 m bgl
0.3 – 0.7+	Tan brown slightly gravelly silty clay with grey sand inclusions. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	
HP07		
0.0 – 0.45+	Brown organic silty sand and gravel with frequent roots and rootlets. Sand is fine. Gravel is fine to coarse and sub angular to sub rounded. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel No groundwater encountered No significant odours recorded Soil sample taken at 0.15 m bgl
HP08		
0.0 – 0.55	Brown organic silty sand and gravel with roots and rootlets. Sand is fine. Gravel is medium to coarse and typically sub rounded. One brick fragment at 0.5 m. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil sample taken at 0.3 m bgl
0.4 – 0.62+	Tan brown slightly gravelly silty clay with grey sand inclusions. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	
HP09		
0.0 – 0.4	Brown organic silty sand and gravel with roots and rootlets. Sand is fine. Gravel is medium to coarse and typically sub rounded. One brick fragment at 0.5 m. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel and hand auger No groundwater encountered No significant odours recorded Soil samples taken at 0.35 m and 0.6 m bgl
0.4 – 0.7+	Tan brown slightly gravelly silty clay with grey sand inclusions. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	
HP10		
0.0 – 0.37	Brown organic silty sand and gravel with roots and rootlets. Sand is fine. Gravel is medium to coarse and typically sub rounded. TOPSOIL / REWORKED TILL	Hand pit constructed using pincer shovel No groundwater encountered No significant odours recorded Soil sample taken at 0.1 m bgl
0.37 – 0.4+	Tan brown slightly gravelly silty clay with grey sand inclusions. Gravel is medium to coarse and typically sub rounded. REWORKED TILL	

APPENDIX E

Laboratory results

Appendix E.1: Laboratory test certificates

**Andy Singleton**

Ground first
26 Victoria Street
Castlefields
Shrewsbury
Shropshire
SY1 2HS

e: andy@groundfirst.com

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 19-78788

Project / Site name:	Adwy Grange	Samples received on:	20/12/2019
Your job number:	4127	Samples instructed on:	20/12/2019
Your order number:	4127	Analysis completed by:	03/01/2020
Report Issue Number:	1	Report issued on:	03/01/2020
Samples Analysed:	12 soil samples		

Signed:

Rachel Bradley

Deputy Quality Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Iss No 19-78788-1 Adwy Grange 4127

This certificate should not be reproduced, except in full, without the express permission of the laboratory.

The results included within the report are representative of the samples submitted for analysis.

Page 1 of 9

Analytical Report Number: 19-78788

Project / Site name: Adwy Grange

Your Order No: 4127

Lab Sample Number	1399604	1399605	1399606	1399607	1399608
Sample Reference	HP01	HP02	HP02	HP03	HP04
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.30	0.60	0.40	0.20	0.15
Date Sampled	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	19	16
Total mass of sample received	kg	0.001	NONE	0.43	0.47

Asbestos in Soil	Type	N/A	ISO 17025	-	-	Not-detected	-	-
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	7.2	-	-
Free Cyanide	mg/kg	1	MCERTS	-	-	< 1	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	0.014	-	-
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	-	-	0.027	-	-

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	-	-
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	0.29	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	0.28	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	0.21	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	0.16	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	0.23	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	0.08	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	1.25	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.2	7.2	9.7	9.5	12
Barium (aqua regia extractable)	mg/kg	1	MCERTS	73	84	-	93	81
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.54	0.56	0.69	0.70	0.60
Boron (water soluble)	mg/kg	0.2	MCERTS	1.7	0.5	0.7	0.5	< 0.2
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.6	0.2	0.9	0.5	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-	< 4.0	-	-
Chromium (III)	mg/kg	1	NONE	-	-	17	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	13	14	17	16	20
Copper (aqua regia extractable)	mg/kg	1	MCERTS	20	14	30	21	26
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110	96	130	150	75
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12	11	14	12	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.9	2.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	16	18	20	20	18
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	87	220	140	91

Analytical Report Number: 19-78788

Project / Site name: Adwy Grange

Your Order No: 4127

Lab Sample Number				1399604	1399605	1399606	1399607	1399608
Sample Reference				HP01	HP02	HP02	HP03	HP04
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	0.40	0.20	0.15
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Toluene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
o-xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	< 1.0	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	< 8.0	-	-
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	< 8.4	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	< 10	-	-
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	-	-	< 10	-	-

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	< 10	-	-
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	< 8.4	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	-	-	< 10	-	-

Analytical Report Number: 19-78788

Project / Site name: Adwy Grange

Your Order No: 4127

Lab Sample Number				1399609	1399610	1399611	1399612	1399613
Sample Reference				HP05	HP06	HP07	HP08	HP09
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.50	0.15	0.30	0.35
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	17	16	18	19	17
Total mass of sample received	kg	0.001	NONE	0.44	0.44	0.47	0.46	1.0

Asbestos in Soil	Type	N/A	ISO 17025	-	-	-	-	Not-detected
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	-	-	7.3
Free Cyanide	mg/kg	1	MCERTS	-	-	-	-	< 1
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	-	-	0.0088
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	-	-	-	-	0.021

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	-	-	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	-	-	< 0.80
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.4	8.2	8.2	7.6	6.5
Barium (aqua regia extractable)	mg/kg	1	MCERTS	88	110	88	99	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.65	0.94	0.69	0.71	0.61
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	0.2	0.3	< 0.2	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	< 0.2	0.2	0.4	0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-	-	-	< 4.0
Chromium (III)	mg/kg	1	NONE	-	-	-	-	14
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	17	21	20	20	17
Copper (aqua regia extractable)	mg/kg	1	MCERTS	20	18	20	21	18
Lead (aqua regia extractable)	mg/kg	1	MCERTS	87	40	82	100	71
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	13	17	18	15	14
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	21	21	25	24	20
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	100	47	98	130	100

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Lab Sample Number				1399609	1399610	1399611	1399612	1399613
Sample Reference				HP05	HP06	HP07	HP08	HP09
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.25	0.50	0.15	0.30	0.35
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
o-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	< 8.0
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	-	-	< 8.4
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	< 10
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	-	-	-	-	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	< 10
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	-	-	< 8.4
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	< 10
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	-	-	-	-	< 10

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Lab Sample Number				1399614	1399615			
Sample Reference				HP09	HP10			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.60	0.10			
Date Sampled				18/12/2019	18/12/2019			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	13	18			
Total mass of sample received	kg	0.001	NONE	0.45	0.46			

Asbestos in Soil	Type	N/A	ISO 17025	-	-			
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General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-			
Free Cyanide	mg/kg	1	MCERTS	-	-			
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-			
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	-	-			

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-			
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	-			
Acenaphthylene	mg/kg	0.05	MCERTS	-	-			
Acenaphthene	mg/kg	0.05	MCERTS	-	-			
Fluorene	mg/kg	0.05	MCERTS	-	-			
Phenanthrene	mg/kg	0.05	MCERTS	-	-			
Anthracene	mg/kg	0.05	MCERTS	-	-			
Fluoranthene	mg/kg	0.05	MCERTS	-	-			
Pyrene	mg/kg	0.05	MCERTS	-	-			
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-			
Chrysene	mg/kg	0.05	MCERTS	-	-			
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-			
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-			
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-			
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-			
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-			

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-			
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	14	7.4			
Barium (aqua regia extractable)	mg/kg	1	MCERTS	92	92			
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.86	0.68			
Boron (water soluble)	mg/kg	0.2	MCERTS	< 0.2	0.6			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	0.2			
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-			
Chromium (III)	mg/kg	1	NONE	-	-			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	25			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	19	19			
Lead (aqua regia extractable)	mg/kg	1	MCERTS	50	79			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3			
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	23	16			
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0			
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	21	24			
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	56	97			

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Project / Site name: Adwy Grange

Your Order No: 4127

Lab Sample Number				1399614	1399615			
Sample Reference				HP09	HP10			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.60	0.10			
Date Sampled				18/12/2019	18/12/2019			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		
Monoaromatics & Oxygenates								
Benzene				µg/kg	1	MCERTS	-	-
Toluene				µg/kg	1	MCERTS	-	-
Ethylbenzene				µg/kg	1	MCERTS	-	-
p & m-xylene				µg/kg	1	MCERTS	-	-
o-xylene				µg/kg	1	MCERTS	-	-
MTBE (Methyl Tertiary Butyl Ether)				µg/kg	1	MCERTS	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-			
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-			
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-			
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-			
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	-	-			
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	-	-			
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-			
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-			
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-			
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	-	-			
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-			
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	-	-			



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* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1399604	HP01	None Supplied	0.30	Brown loam and sand with gravel.
1399605	HP02	None Supplied	0.60	Light brown loam and clay with gravel.
1399606	HP02	None Supplied	0.40	Brown loam and clay with gravel and vegetation.
1399607	HP03	None Supplied	0.20	Brown loam and clay with gravel.
1399608	HP04	None Supplied	0.15	Brown clay and sand with gravel.
1399609	HP05	None Supplied	0.25	Brown loam and clay with gravel and vegetation.
1399610	HP06	None Supplied	0.50	Light brown clay and sand with gravel.
1399611	HP07	None Supplied	0.15	Brown loam and clay with gravel and vegetation.
1399612	HP08	None Supplied	0.30	Brown loam and clay with gravel and vegetation.
1399613	HP09	None Supplied	0.35	Brown loam and clay with gravel and vegetation.
1399614	HP09	None Supplied	0.60	Light brown clay and sand with gravel.
1399615	HP10	None Supplied	0.10	Brown loam and clay with gravel and vegetation.

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Project / Site name: Adwy Grange

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
Cr (III) in soil	In-house method by calculation from total Cr and Cr VI.	In-house method by calculation	L080-PL	W	NONE
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L009-PL	D	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In-house method based on BS1377 Part 2, 1990, Classification tests	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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The results included within the report are representative of the samples submitted for analysis.

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Appendix E.2: Summary of laboratory test results

Analytical Report Number: 19-78788

Project / Site name: Adwly Grange

Your Order No: 4127

				TOPSOIL	TILL	MG	SOIL / TILL	SOIL / TILL	SOIL / TILL	TILL	SOIL / TILL	SOIL / TILL	SOIL / TILL	TILL	SOIL / TILL
Lab Sample Number				1399604	1399605	1399606	1399607	1399608	1399609	1399610	1399611	1399612	1399613	1399614	1399615
Sample Reference				HP01	HP02	HP02	HP03	HP04	HP05	HP06	HP07	HP08	HP09	HP09	HP10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	0.40	0.20	0.15	0.25	0.50	0.15	0.30	0.35	0.60	0.10
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)															
Units	Limit of detection	Accreditation Status													
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	19	16	18	18	16	17	16	18	19	17	13	18
Total mass of sample received	kg	0.001	NONE	0.43	0.47	1	0.44	0.48	0.44	0.44	0.47	0.46	1	0.45	0.46
Asbestos in Soil				Type	N/A	ISO 17025	-	-	Not-detected	-	-	-	-	Not-detected	-
General Inorganics															
pH - Automated	pH Units	N/A	MCERTS	-	-	7.2	-	-	-	-	-	-	7.3	-	-
Free Cyanide	mg/kg	1	MCERTS	-	-	< 1	-	-	-	-	-	-	< 1	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	-	-	0.014	-	-	-	-	-	-	0.0088	-	-
Fraction Organic Carbon (FOC)	N/A	0.001	MCERTS	-	-	0.027	-	-	-	-	-	-	0.021	-	-
Total Phenols															
Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
Speciated PAHs															
Naphthalene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	0.29	-	-	-	-	-	-	< 0.05	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	0.28	-	-	-	-	-	-	< 0.05	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	0.21	-	-	-	-	-	-	< 0.05	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	0.16	-	-	-	-	-	-	< 0.05	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	0.23	-	-	-	-	-	-	< 0.05	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	0.08	-	-	-	-	-	-	< 0.05	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	< 0.05	-	-	-	-	-	-	< 0.05	-	-
Total PAH															
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	-	-	1.25	-	-	-	-	-	-	< 0.80	-	-
Heavy Metals / Metalloids															
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	7.2	7.2	9.7	9.5	12	7.4	8.2	8.2	7.6	6.5	14	7.4
Barium (aqua regia extractable)	mg/kg	1	MCERTS	73	84	-	93	81	88	110	88	99	-	92	92
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.54	0.56	0.69	0.7	0.6	0.65	0.94	0.69	0.71	0.61	0.86	0.68
Boron (water soluble)	mg/kg	0.2	MCERTS	1.7	0.5	0.7	0.5	< 0.2	0.9	0.2	0.3	< 0.2	0.5	< 0.2	0.6
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.6	0.2	0.9	0.5	< 0.2	0.3	< 0.2	0.2	0.4	0.2	< 0.2	0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	-	-	< 4.0	-	-	-	-	-	-	< 4.0	-	-
Chromium (III)	mg/kg	1	NONE	-	-	17	-	-	-	-	-	-	14	-	-
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	13	14	17	16	20	17	21	20	20	17	20	25
Copper (aqua regia extractable)	mg/kg	1	MCERTS	14	14	30	21	26	20	21	18	20	21	18	19
Lead (aqua regia extractable)	mg/kg	1	MCERTS	110	96	130	110	130	87	82	100	71	82	50	79
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	12	11	14	12	15	13	17	18	13	15	23	16
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	1.9	2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	16	18	20	20	18	20	21	25	24	20	21	24
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	160	87	220	140	91	100	47	98	130	100	56	97

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				TOPSOIL	TILL	MG	SOIL / TILL	SOIL / TILL	SOIL / TILL	TILL	SOIL / TILL	SOIL / TILL	SOIL / TILL	TILL	SOIL / TILL
Lab Sample Number				1399604	1399605	1399606	1399607	1399608	1399609	1399610	1399611	1399612	1399613	1399614	1399615
Sample Reference				HP01	HP02	HP02	HP03	HP04	HP05	HP06	HP07	HP08	HP09	HP09	HP10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	0.40	0.20	0.15	0.25	0.50	0.15	0.30	0.35	0.60	0.10
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)															
				Units											
				Limit of detection											
				Accreditation Status											

Lab Sample Number				1399604	1399605	1399606	1399607	1399608	1399609	1399610	1399611	1399612	1399613	1399614	1399615
Sample Reference				HP01	HP02	HP02	HP03	HP04	HP05	HP06	HP07	HP08	HP09	HP09	HP10
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.30	0.60	0.40	0.20	0.15	0.25	0.50	0.15	0.30	0.35	0.60	0.10
Date Sampled				18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019	18/12/2019
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
Toluene	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
o-xylene	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC5 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	< 2.0	-	-	-	-	-	-	< 2.0	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	< 8.0	-	-	-	-	-	-	< 8.0	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	< 8.0	-	-	-	-	-	-	< 8.0	-	-
TPH-CWG - Aliphatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	< 8.4	-	-	-	-	-	-	< 8.4	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	< 10	-	-	-	-	-	-	< 10	-	-
TPH-CWG - Aliphatic (EC5 - EC44)	mg/kg	10	NONE	-	-	< 10	-	-	-	-	-	-	< 10	-	-

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	< 0.001	-	-	-	-	-	-	< 0.001	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	< 1.0	-	-	-	-	-	-	< 1.0	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	< 2.0	-	-	-	-	-	-	< 2.0	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	< 10	-	-	-	-	-	-	< 10	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	< 10	-	-	-	-	-	-	< 10	-	-
TPH-CWG - Aromatic > EC35 - EC44	mg/kg	8.4	NONE	-	-	< 8.4	-	-	-	-	-	-	< 8.4	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	< 10	-	-	-	-	-	-	< 10	-	-
TPH-CWG - Aromatic (EC5 - EC44)	mg/kg	10	NONE	-	-	< 10	-	-	-	-	-	-	< 10	-	-

APPENDIX F

Soil screening values

Screening values adopted for the human health risk assessment

Parameter	Units	Screening value/GAC	Comment
Metals			
Arsenic	mg/kg	37	LQM (2015)
Barium	mg/kg	1300	CL:AIRE (2010)
Beryllium	mg/kg	1.7	LQM (2015)
Boron	mg/kg	290	LQM (2015)
Cadmium	mg/kg	11	LQM (2015)
Chromium VI	mg/kg	6	LQM (2015)
Chromium III	mg/kg	910	LQM (2015)
Copper	mg/kg	2400	LQM (2015)
Lead	mg/kg	200	Category 4 Screening Level incorporating vegetable consumption (DEFRA, 2014)
Mercury	mg/kg	11	LQM (2015) - methylmercury
Nickel (residential)	mg/kg	130	LQM (2015)
Selenium	mg/kg	250	LQM (2015)
Vanadium	mg/kg	410	LQM (2015)
Zinc	mg/kg	3700	LQM (2015)
Miscellaneous			
Phenols	mg/kg	200	LQM (2015); 2.5% SOM
Cyanide (free)	mg/kg	16.8	RIVM derived value ¹ for free cyanide
PAHs			
Acenaphthene	mg/kg	510	LQM (2015); 2.5% SOM
Acenaphthylene	mg/kg	420	LQM (2015); 2.5% SOM
Anthracene	mg/kg	5400	LQM (2015); 2.5% SOM
Benzo[a]anthracene	mg/kg	11	LQM (2015); 2.5% SOM
Benzo[a]pyrene	mg/kg	2.7	LQM (2015); 2.5% SOM
Benzo[b]fluoranthene	mg/kg	3.3	LQM (2015); 2.5% SOM
Benzo[g,h,i]perylene	mg/kg	340	LQM (2015); 2.5% SOM
Benzo[k]fluoranthene	mg/kg	93	LQM (2015); 2.5% SOM
Chrysene	mg/kg	22	LQM (2015); 2.5% SOM
Dibenzo[a,h]anthracene	mg/kg	0.28	LQM (2015); 2.5% SOM
Fluoranthene	mg/kg	560	LQM (2015); 2.5% SOM
Fluorene	mg/kg	400	LQM (2015); 2.5% SOM
Indeno[1,2,3-cd]pyrene	mg/kg	36	LQM (2015); 2.5% SOM
Naphthalene	mg/kg	5.6	LQM (2015); 2.5% SOM
Phenanthrene	mg/kg	220	LQM (2015); 2.5% SOM
Pyrene	mg/kg	1200	LQM (2015); 2.5% SOM
BTEX and speciated TPH			
Benzene	mg/kg	0.17	LQM (2015); 2.5% SOM
Toluene	mg/kg	290	LQM (2015); 2.5% SOM
Ethylbenzene	mg/kg	110	LQM (2015); 2.5% SOM
m & p Xylene	mg/kg	130	LQM (2015); 2.5% SOM
o Xylene	mg/kg	140	LQM (2015); 2.5% SOM
Aliphatics C5-C6	mg/kg	78	LQM (2015); 2.5% SOM
Aliphatics >C6-C8	mg/kg	230	LQM (2015); 2.5% SOM
Aliphatics >C8-C10	mg/kg	65	LQM (2015); 2.5% SOM
Aliphatics >C10-C12	mg/kg	330 (118) ^{vap}	LQM (2015). GAC exceeds theoretical soil saturation limit; 2.5% SOM
Aliphatics >C12-C16	mg/kg	2400 (59) ^{sol}	LQM (2015). GAC exceeds theoretical soil saturation limit; 2.5% SOM

Parameter	Units	Screening value/GAC	Comment
Aliphatics >C16-C21	mg/kg	92,000	LQM (2015). Based on GAC for C16-C35 fraction; 2.5% SOM
Aliphatics >C21-C35	mg/kg	92,000	LQM (2015). Based on GAC for C16-C35 fraction; 2.5% SOM
Aromatics C6-C7	mg/kg	140	LQM (2015). Based on GAC for C5-C7 fraction; 2.5% SOM
Aromatics >C7-C8	mg/kg	290	LQM (2015); 2.5% SOM
Aromatics >EC8-EC10	mg/kg	83	LQM (2015); 2.5% SOM
Aromatics >EC10-EC12	mg/kg	180	LQM (2015); 2.5% SOM
Aromatics >EC12-EC16	mg/kg	330	LQM (2015); 2.5% SOM
Aromatics >EC16-EC21	mg/kg	540	LQM (2015); 2.5% SOM
Aromatics >EC21-EC35	mg/kg	1500	LQM (2015); 2.5% SOM
Aromatics >EC35-EC44	mg/kg	1500	LQM (2015); 2.5% SOM

CL:AIRE, 2010. Soil Generic Assessment Criteria for Human Health Risk Assessment.

DEFRA, 2014. SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination. Policy companion document.

LQM, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment.

RIVM, 2001. Technical evaluation of the Intervention Values for Soil/sediment and Groundwater Human and ecotoxicological risk assessment and derivation of risk limits for soil, aquatic sediment and groundwater. RIVM report 711701 023.

APPENDIX G

Risk classification methodology

Risk classification methodology

The method of risk evaluation adopted in this document is consistent with CIRIA C552 (2001). Hence, risk is considered to be a function of both the probability (likelihood) of contamination occurring at the study site and also the potential severity (consequence) of the environmental impacts associated with this contamination.

The classification system used to define contaminant probability, consequence and risk is described in the following tables.

Table A: Classification of probability

Classification	Definition
High Likelihood	There is a contaminant linkage and an event that appears either 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	There is a contaminant linkage and all the elements are present and in the right place, which means that it is probably that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term, and likely over the long term.
Low Likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is contaminant linkage but circumstances are such that it is improbable that an event would occur even in the long term.

Table B: Classification of consequence

Classification	Receptor	Definition	Examples
Severe <i>(acute risks)</i>	Humans	Short-term (acute) risk to human health likely to result in "significant harm" as defined in the CTL Statutory Guidance	High concentrations of cyanide on the surface of an informal recreation area
	Controlled waters	Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource	Major spillage of contaminants from site into controlled water
	Property	Catastrophic damage to buildings/property	Explosion resulting from methane accumulation, causing building collapse (can also equate to an acute human health risk if buildings are occupied)
	Ecology	A short-term risk to a particular ecosystem, or organism forming part of such eco-system	Potentially significant derogation of a designated site or protected species
Medium <i>(long-term)</i>	Humans	Chronic damage to human health ("significant harm" as defined in the Contaminated Land Statutory Guidance)	Concentrations of a contaminant from site exceed the GAC or SSAC
	Controlled waters	Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution)	Leaching of contaminants from a site to a Principal or Secondary Aquifer

Classification	Receptor	Definition	Examples
	Property	Significant damage to sensitive crops, buildings, structures and services	Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability)
	Ecology	A significant change in a particular ecosystem, or organism forming part of such ecosystem	Death of a species within a designated nature reserve
Mild (long-term; less sensitive receptors)	Humans	Contamination present although unlikely to constitute a significant chronic health risk to sensitive receptors	Concentrations of chemical species that exceed the GAC or SSAC for a low sensitive land-use e.g. public open space
	Controlled waters	Pollution of non-sensitive water resources	Pollution of non-classified groundwater
	Property	Damage to sensitive. buildings/structures/services	Aggressive ground conditions leading to potential for long term degradation of buried concrete
	Ecology	Damage to the environment	Localised damage to aquatic habitat causing temporary relocation of certain species
Minor (long-term; less significant receptors)	Humans	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.)	The presence of contaminants at such concentrations that protective equipment is required during site works.
	Controlled waters	Potential minor release of contamination to local water features	Short term or low volume release of potentially polluting material to a secondary surface water course of low existing quality
	Property	Easily reparable effects of damage to buildings, structures and services. Harm which may result in a financial loss, or expenditure to resolve.	The loss of plants in a landscaping scheme. Discolouration of concrete
	Ecology	Short term, localised damage may occur; consequences are spatially and temporally limited	Short term or localised disruption to in situ flora or fauna; no lasting effects

Table C: Risk classification (comparison of consequence and probability)

Probability (likelihood)		Consequence (severity)			
		Severe	Medium	Mild	Minor
	High likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Moderate/low risk	Low risk
	Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk