JOHNSON POOLE & BLOOMER
LAND CONSULTANTS

PHASE 1 DESK STUDY REPORT

at

BAYFIELDS

CHEPSTOW

RC597-10/TNO

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CHEPSTOW

PHASE 1 DESK STUDY REPORT

This report was carried out in accordance with JPBL Quality Management procedures.

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For the Attention of Mr D J Lloyd

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January 2018

C O N T E N T S

Section

Drawings

Appendices

1 INTRODUCTION

1.1 Further to written instructions received from Mr David J Lloyd of BDW Trading Limited dated 14 November 2017, the Client, we have undertaken a Phase 1 Desk Study of the proposed residential site referred to as Bayfields, Chepstow, as defined on our Drawing No. G/RC597/01.

1.2 The information consulted as part of the desk study searches is outlined in Section 2.0, whilst a detailed walkover of the site was undertaken by Johnson Poole and Bloomer Limited on 22 November 2017. At the time of our Walkover, the weather was overcast with occasional showers.

1.3 The purpose of the Desk Study Report is to allow a technical assessment in the context of potential geotechnical and geo-environmental issues in association with the prospective purchase of the site, in the context of potential residential redevelopment.

1.4 At the time of writing, no development proposals (development layout) was available, and it has been assumed that the development will comprise traditional low-rise dwellings with conventional private gardens.

1.5 The development site plan provided by the Client includes access roads adjacent to the main development site to the north and east. At the request of the Client, these roads have been included in the commissioned Groundsure Reports (Appendices B to D). However, for clarity these roads have not been included in the site description, site history and environmental setting sections contained in this Report; the report focusing on the main development area (fields).

1.6 Separately from this Desk Study Report, trial pitting and soakaway testing has been conducted at the site (excluding the northernmost field) as requested by the Client. The results of this exercise has previously been reported upon in our Letter Report, referenced RC597-23/TNO dated 22 December 2017. However, for completion a summary of the ground conditions encountered in the exercise is outlined in Paragraph 4.2 of this Report.

1.7 Whilst confident in the findings of our report we are unable to give assurance they will be accepted by other authorities without question. We therefore advise that where appropriate our report and associated matters are submitted to approving bodies and approval obtained or sought before detailed design, site works or other irrevocable action is embarked upon.

1.8 The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted and may be subject to amendment in the light of additional information becoming available.

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2 SOURCES OF INFORMATION

2.1 In preparation of this report, the following documentary sources have been consulted and where appropriate examined:

- British Geological Survey Sheet ST 59 SW at 1:10,560 scale.
- British Geological Survey's (BGS) Website for geological data.
- British Geological Survey's (BGS) Website for Borehole Scans.
- Review of Mining Instability in Great Britain, Arup, 1990.
- BRE Report BR 211 (2015).
- "Survey of Contaminated Land in Wales", Sheet No. 162, 1988 at 1:50,000 scale.
- Google Earth and Street View.

2.2 Reference has also been made to the Groundsure Enviro Insight and Geo Insight Reports (referenced GS-4475622 and GS-4475623 dated 16 November 2017, respectively) and Historical Map coverage obtained from Groundsure Insights, included in Appendices B, C and D, respectively.

2.3 No other liaisons with external organisations/regulatory bodies, etc., have been undertaken in preparing this report.

3 THE SITE AND SITE HISTORY

3.1 The Site

3.1.1 The development site is located approximately 1.50 kilometres to the west of the town centre of Chepstow in the suburb of Bayfields; the site being defined by the approximate National Grid Reference 352189, 194042, as shown on our Drawing No. G/RC597/01.

3.1.2 The subject site comprises an irregular, rectangular-shaped parcel of undulating land, currently consisting of undeveloped agricultural fields. The development area consists of three agricultural fields of unequal sizes/areas. The fields are located in the northern area; central and south-western/southern areas and in the south-eastern area of the site (Drawing No. G/RC597/02).

3.1.3 The smallest "northern" field is bounded to the north by the B4235 Road. To the east of the site is a covered (underground) Reservoir, and to the north-east a new housing estate (Edmond Locard Court). Beyond the western boundary of the northern field is an area of undeveloped woodland which also extends half way along the western boundary of the central field.

3.1.4 The northern field consists of grass which slopes down to the north. Vegetation consists of bushes and shrubs close to the site boundaries. Along the northern and eastern boundaries is a small hedge. The southern and western boundaries are separated by small trees. The ground was saturated underfoot at the time of conducting the walkover.

3.1.5 The central/southern field is bounded by residential housing to the east (Wallwern, Wood/Coed Wallwern and Barnets Wood) and south-west (Bayfield Wood Close) and to the west by woodland (central area) and an extension of agricultural fields beyond (southern area); the site boundary being physically undefined in this latter area.

3.1.6 The central/southern field consists of an undulating agricultural field. The highest surface topography is located in the south-east corner at the boundary with the south-eastern field. The lowest surface topography is recorded in the north-west corner adjacent to the boundary with the northern field. Vegetation consists of grass with a hedge and small trees along the southern boundary. On the day of the walkover the ground was particularly wet in the lower north-west corner of the field.

3.1.7 On the southern boundary of the central field on top of the hill is a ruined barn building. Around the building was evidence of fly-tipping with rubber tyres and general waste at surface.

3.1.8 The south-eastern field is bounded by a playground and the Woolpitch Wood Road to the south and the aforementioned residential development at Bayfield Wood Close to the west.

3.1.9 The south-eastern field displays a shallow slope to the north and a steeper slope to the west. The field consists of grass with hedges and bushes along the southern boundary and along the adjacent northern boundary with the central field. There are gaps within the hedgerows to allow access from the "central" field into the south-eastern field.

3.1.10 Two sets of underground water main utility pipes are known to bisect the development site in a north-west to south-east direction, crossing beneath the (northern) central and central southern field, the latter also just encroaching into the south-eastern field.

3.2 Site History

3.2.1 An investigation of the past usage of the site can often provide an indication of the presence of potentially contaminated soils arising from processes associated with former land uses. These researches can help to identify any potential constraints to developments upon which physical investigations can then concentrate.

3.2.2 The historical land uses identified on and adjacent to the site as determined from the Historical Plans provided by Groundsure Insights dating back to 1881, are summarised as follows (the Historical Map coverage of the site being included in Appendix D).

3.2.3 In 1881 the site was recorded lying within upto six agricultural fields of significantly varying sizes. A footpath traversed the northern site area in a north-west to south-east direction, whilst a small structure lay within the north-east corner of the northernmost field. To the south-west of the site was a single farm building referenced "Bayfield". The site was bounded to the north by a road (now B4235). To the west of the site was "Bishops Barnets Wood" in which there was evidence of an antiquity. A "Spring" was located just beyond the site boundary to the east of the northernmost field.

3.2.4 At this time, to the north-east of the site was the village of "Crossway Green" and to the east the village of "St. Kingsmark" with the town of Chepstow located further to the east.

3.2.5 There was little change on-site between 1881 and 1938 other than minor field boundary changes having occurred and a "Footpath" and "Stone" recorded close to the western site boundary. At an unspecified time between 1902 and 1920 "Mount Pleasant Hospital" was constructed within 500 metres of the site well to the south-east. The hospital was extended in a westerly direction over the next thirty-five years with a military hospital being constructed to the west of the original hospital buildings, and extending much closer to the south-west site boundary.

3.2.6 At an unspecified time between 1955 and 1965 a single structure (barn) had been erected at the centre of the site (the structure currently remaining on-site) (paragraph 3.1.7).

3.2.7 To the south-west of the site, the residential property previously referenced "Bayfield" had expanded to become "Bayfield Nurseries" with new buildings being constructed, together with the construction of a "Garage" structure located to the north-west of the site. Evidence of a second "Spring" and a "Pond" was apparent on the land just to the north of the central field.

3.2.8 By 1977 a covered "Reservoir" had been constructed beyond the site to the north of the central field with its access road crossing the northern field onto the B4235 road. The Reservoir had been constructed alongside (to the west of) a "Forensic Laboratory". The laboratory had its car parking area and access route to the north of the building.

3.2.9 At an unspecified time between 1995 and 2002 small-scale plans indicate that "St. Lawrence Hospital" was demolished and new residential development had been constructed to the south-east of the site. Between 2002 and 2010 further houses were constructed in the agricultural field to the east of the site with new access roads being constructed from the A466 "St. Lawrence Road", together with a road access abutting the southern site boundary.

3.2.10 The Laboratory located adjacent to the site was demolished at an unspecified time between 2010 and 2014 and a new housing estate constructed in the general location.

3.2.11 Circa 2015 the eastern "half" of the northernmost field on-site was used as a Contractors Compound associated with the adjacent housing development; the Compound having been removed upon completion of the "build phase".

4 ENVIRONMENTAL SETTING

4.1 General Geology

4.1.1 The published geology plan (Sheet ST 59 SW at 1:10,560 scale) does not record any natural superficial deposits beneath the site. Similarly, the more recent BGS data viewer does not record any natural superficial deposits beneath the site.

4.1.2 The above geological plan records the site to be underlain by solid strata comprising of four different geological strata, all of Carboniferous age, their configuration on-site, in part being influenced by structural faults (paragraph 4.1.4). For clarity the various geological strata is outlined in more detail below:-

- Drybrook Limestone (geologically youngest of the four strata) underlies the site along the western site boundary/extending beneath the western site area. It is described as a "Massive cream and white Oolitic Limestone" with a dip of 5 to 12 degrees to the south-west, annotated on the plan to the west of the site.
- Lower Dolomite underlies the south-east area of the site, with the geological unit also trending through the central site area upto the north-west corner. It is described as a "Dolomite with Shelly Bands Spirifer, Zaphrentis, Syringothyris & C". It exhibits a dip angle of 10 and 12 degrees to the south-west and south-east, respectively, in the general site area.
- Lower Drybrook Sandstone occupies a small site area close to the north-west site boundary. The geological plan refers to the strata as a "Grit" with "Sandy Soil" and "Sandstone debris" annotated on the plan to the north-west of the site.
- Lower Limestone Shale (geologically oldest of the four referenced strata) underlies the central eastern and extreme north-eastern site area. It is described as "Thin Dolomite Bands in Clay" and records a dip of 10 degrees to the south annotated on the plan just beyond the north-east site boundary.

4.1.3 The British Geological Survey's Website also records the site to be underlain by solid strata consisting of four different geological units which are similarly located to those on the published geological plan, but are referenced under a new name. For clarity the strata referenced is outlined below:-

- Hunts Bay Oolite sub-group limestone - Ooidial (Drybrook Limestone on the Geological Plan).

- Black Rock Limestone sub-group - Dolostone (Lower Dolomite on the Geological Plan).
- Cromhall Sandstone Formation (Lower Drybrook Sandstone on the Geological Plan).
- Avon Group Mudstone and Limestone Interbedded (Lower Limestone Shale on the Geological Plan).

4.1.4 The conjectured position of a geological fault is recorded on the geological plan trending north-to-south and bisecting the site with the down throw side recorded to the west. The fault separates the Drybrook Limestone (to the west) and the Lower Dolomite strata (to the east). Two other geological faults are also located encroaching upto the aforementioned Fault beneath the western area/boundary of the site, trending in a north-west to south-east direction (beneath the north-west area) and in a north-east to south-west direction (beneath the central site area).

4.1.5 The Groundsure Enviro Insight Report (Appendix B) records reference to a single Borehole data entry within 11 metres of the site boundary to the north of the central field. The BGS viewer indicates that 8 No. boreholes were excavated in 1968 in association with the construction of the future covered "Reservoir" structure. The strata succession in the eight borehole logs have been summarised below:-

- Topsoil recorded in all boreholes attaining thicknesses of between 0.23 metres but more typically 0.30 to 0.46 metres.
- Clay soil described as sandy or stoney to depths of 0.90 to 2.82 metres in all Boreholes, except Borehole 3.
- Shale of varying colours (brown, grey, purple and red streaks) extending to depths of 1.52 to 5.79 metres in all Boreholes, except Borehole 3.
- In the base of Boreholes 1, 2, 4, 5 and 8 a yellow/yellow brown limestone was recorded (described as either fractured or in bands within shale).
- In Borehole 3, fractured yellow limestone was recorded at a shallow depth of 0.23 metres immediately below the topsoil and was proven to a maximum shallow depth of 0.69 metres below ground level.

4.1.6 On the basis of the land use history, significant and widespread accumulations of Made Ground would not be anticipated, although Made Ground and/or local disturbance of the upper natural soils would be expected associated with, the existing foundations of the derelict barn; in proximity to the underground water main pipes crossing beneath the site; in proximity to the access road associated with the current "Reservoir", and more recently associated with the former "Contractors Compound".

4.1.7 In addition, disturbance of the upper natural soils in connection with general farming activities would be expected in the fields.

4.2 Site Specific Ground Conditions

Soil Succession

4.2.1 As an associated exercise undertaken with this Desk Study Report, trial pits have been excavated at the site; the ground conditions being summarised as follows below (paragraph 1.6).

4.2.2 No evidence of any Made Ground was encountered; a dark brown silty clay topsoil being recorded from surface typically attaining 0.20 to 0.25 metres in thickness across the site.

4.2.3 Trial Pit 1 (north-west area of central field) mainly consisted of a firm or firm to stiff, silty clay with variable proportions of gravel and with increasing depths, cobbles of limestone. Possible limestone bedrock strata was recorded at 2.30 metres below ground level.

4.2.4 In Trial Pits 2, 4, 5 and 6 (central, western and eastern site area of central/southern field), the soil succession consisted of a firm to stiff and stiff, locally slightly gravelly, slightly silty clay. This strata was recorded to depths of approximately 3.00 metres in Trial Pits 2, 5 and 6, with cobbles of limestone being recorded in Trial Pits 5 and 6 at depths of 2.90 metres and 2.70 metres below ground level, respectively.

4.2.5 Trial Pit 3 (north-east corner of central field) encountered cobbles and large boulders at shallow depths of 0.60 metres below ground level. The cobbles and boulders consisted of limestone in a firm to stiff, gravelly silty clay matrix.

4.2.6 Trial Pit 7 (south-west area of south-east field) recorded firm, gravelly silty clay (estimated as medium dense by virtue of its increased gravel content). At 1.70 metres below ground level, cobbles of sandstone and limestone were recorded within.

4.2.7 Trial Pits 8 and 9 (south-east field) recorded a firm (also estimated as medium dense) gravelly silty clay with interlocking sub-angular cobbles of limestone.

Groundwater Conditions

4.2.8 No evidence of groundwater was recorded in Trial Pits 1 and 2 and 4 to 9 during their excavation.

4.2.9 In Trial Pit 3 (north-east corner of central field) a groundwater flow was recorded at a depth of 2.10 metres below ground level.

4.3 Ground Stability

4.3.1 The Groundsure Enviro Insight Report (Appendix B) uses data provided by the British Geological Survey (BGS) to obtain information on Ground Stability conditions. It should be noted that these BGS designations are typically for the regional geological conditions rather than specifically for the ground conditions on-site.

4.3.2 The Groundsure Enviro Insight Report (Appendix B) reports a "Negligible" or "Very Low" on-site "hazard" rating in relation to the potential for:-

- Compressible Ground.
- Running Sand.
- Shrink Swell.
- Collapsible Rocks.

4.3.3 The same Report reports a "Low" on-site "hazard" rating in relation to the potential for:-

- Landslides.

4.3.4 The same Report reports a "High" on-site "hazard" rating in relation to the potential for:-

- Soluble Rocks.

4.3.5 The Ground Dissolution of Soluble Rocks plan presented in the Groundsure Geo Insight Report (Appendix C) infers that not all the subject site has a "High" Hazard Rating for Soluble Rocks; the rating being given to a band of strata located trending through the central north-east site area (which possibly correlates with the Lower Dolomite strata previously referred to) (paragraph 4.1.2).

4.3.6 The Groundsure Enviro Insight Report indicates that the maximum risk of natural ground subsidence for the site is "High" (Appendix B).

4.3.7 The Groundsure Geo Insight Report does not record any Non-Coal Mining Cavities or Natural Cavities within 500 metres of the site (Appendix C).

4.4 Mining and Quarrying

4.4.1 On the basis of the "Review of Mining Instability in Great Britain" funded by the Department of the Environment, the site lies within an area with no evidence of underground mining for coal.

4.4.2 The same plan records evidence of metaliferous mining for Lead in Carboniferous Limestone strata in general proximity to the site to the east. It is referenced (33MO4). The dates and output are referenced as 1789 and very small, respectively, whilst access methods are annotated as "No details, possible mine site".

4.4.3 The Groundsure Geo Insight Report records a Vein Mineral commodity on-site. The report assessment of likelihood states that "Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered" (Appendix C).

4.4.4 Whilst the above Report reference infers that such mining may have occurred "on-site", the corresponding plan records the site and surrounding areas to be similarly annotated and thus, not specific to the site.

4.4.5 When taking account of the above, underground mining is not considered to be a criteria for foundation design and selection at the site.

4.4.6 The Groundsure Geo Insight Report records evidence of the closest (now ceased) "Unspecified Quarry" located 146 metres to the north-west of the site (Appendix C). Based on regional geology and the presence of a nearby Limekiln, it is likely that this was a limestone quarry.

4.5 Potentially Contaminative Site Uses

4.5.1 The site is not included on the "Survey of Contaminated Land in Wales", 1988.

4.5.2 The Groundsure Enviro Insight Report does not record any Sites Determined as Contaminated Land under Part 2A EPA 1990 within 500 metres of the site (Appendix B).

4.5.3 The Groundsure Enviro Insight Report records four Historical Potentially Contaminative uses within 100 metres of the main study area (Appendix B). They relate to an Unspecified Laboratory just to the north-east of the site (Forensic Laboratories); Nurseries just to the south-west; a Garage located to the north-east and a Hospital 67 metres to the south. Current potentially contaminative land uses include a Gas Governor Station and Electricity Sub-Station located on the B4235 road just to the north-east of the northern field.

4.5.4 The Groundsure Enviro Insight Report records two Potentially Infilled Land sites within 100 metres of the site (Appendix B). They relate to a "Covered Reservoir" approximately 10 metres to the east of the site (between the northern and central fields) and a "Pond" recorded 87 metres to the east of the site.

4.5.5 The same Report under Potentially Infilled Land also records several Unspecified Quarries lying within 250 metres of the site to the north-west and north-east.

4.5.6 On the basis of the site history forming primarily previously undeveloped land, the site is considered to have a generally low potentially Contaminative past land use and therefore, it is unlikely that any significant widespread contamination will be present on-site (subject to confirmation by undertaking intrusive site investigations).

4.6 Hydrogeology

4.6.1 In the Groundsure Enviro Insight Report (Appendix B) in relation to Groundwater Vulnerability and Soil Leaching Potential, the site lies in an area of both Intermediate Leaching Potential with a Soil Vulnerability Category I1 and High Leaching Potential with a Soil Vulnerability Category H3.

4.6.2 Information obtained from the Groundsure Enviro Insight Report in relation to Aquifer Designation data indicates that beneath the north-western, western and southern areas of the site Bedrock strata is recorded as a Principal Aquifer (i.e. beneath the vast majority of the site). The north-east corner of both the northern and central fields are underlain by a Secondary A Aquifer Designation (Appendix B).

4.6.3 There is no Superficial Deposits Aquifer Designation recorded beneath the site in the database above; the nearest data entry (Secondary Aquifer - Undifferentiated) is recorded encroaching to within 179 metres of the site to the west.

4.6.4 No Groundwater Abstraction Licences are recorded within one kilometre of the site (Appendix B).

4.6.5 No Potable Water Abstraction Licences are recorded within two kilometres of the site (Appendix B).

4.6.6 The Groundsure Enviro Insight Report does not record any Source Protection Zones or Source Protection Zones within a Confined Aquifer within 500 metres of the site (Appendix B).

4.7 Hydrology

4.7.1 The Groundsure Enviro Insight Report indicates that the nearest recorded Surface Water Feature and data entry in the Detailed River Network is a Tertiary River (Drain) which is located just to the north-west of the northern site boundary beyond the B4235 road. The "watercourse" extends in a westerly/south-westerly direction away from the site around Bishop's Barnetts Wood (Appendix B).

4.7.2 Historical researches dating back to 1881 indicate that a "Spring" was located just off the site to the east of the northernmost field. A second "Spring" and "Pond" was also located on the land just to the north of the central field, prior to construction of the "Reservoir".

4.7.3 No Surface Water Abstraction Licenses are recorded within two kilometres of the site (Appendix B).

4.7.4 The site is recorded as lying within 133 metres of an Environment Agency Zone 2 Floodplain encroaching from the west/north-west and within 140 metres of an Environment Agency Zone 3 Floodplain also encroaching from the west/north-west (Appendix B).

4.7.5 The Groundsure Enviro Insight Report records the site to have a "Very Low" Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating (Appendix B).

4.7.6 The same Report indicates that there are groundwater flooding susceptibility areas within 50 metres of the site boundary, although there is no further information available as to their exact geographical location. The data entry relates to Clear water Flooding (i.e. groundwater flooding associated with an unconfined aquifer).

4.8 Pollution Incidents

4.8.1 The Groundsure Enviro Insight Report indicates that there are no National Incidents Recording System (NIRS) (List 1 or List 2) Environment Agency recorded Pollution Incidents within 500 metres of the site boundary (Appendix B).

4.9 Landfills and Waste Transfer Sites

4.9.1 The Groundsure Enviro Insight Report does not record any Environment Agency/ Natural Resources Wales Landfills or Historic Landfills, BGS or DoE non-operational Landfills or Local Authority and Historical Mapping Records Landfill Sites within 500 metres of the site (Appendix B).

4.9.2 The same Report does not record any Waste Treatment, Transfer or Disposal Sites within one kilometre of the site (Appendix B).

4.10 Naturally Occurring Radon

4.10.1 The Groundsure Enviro Insight Report states that "the property is in a Radon Affected Area, as between 5 and 10% of properties are above the Action Level" (Appendix B).

4.10.2 In the 2015 Edition of BRE Report 211, the site lies within an area with light grey shading which indicates a requirement to install a Basic level of Radon Protection (Appendix A in the aforementioned document), unless a site specific BGS Radon Report is obtained which will give definitive guidance on the level of protection required for the site.

4.10.3 The Groundsure Enviro Insight Report which is based upon the BGS Database, states that "Basic radon protective measures are necessary" (Appendix B).

4.11 Sensitive Land Use

4.11.1 The Groundsure Enviro Insight Report records the site to lie within an Area of Outstanding Natural Beauty (AONB) referenced as the Wye Valley (Appendix B). The associated plan indicates this area as abutting the western site boundary and also lying immediately to the north of the site (to the north of the B4235 Road).

4.11.2 The Groundsure Enviro Insight Report records 3 sites of Ancient Woodland within 200 metres of the site. One (unknown reference) is located at the north-west site boundary; one is referenced Cockshoot Wood, located to the north-west of the site and there is also an Ancient Woodland site recorded 85 metres to the north-east of the site with an unknown reference/name (Appendix B).

4.12 Initial Conceptual Site Model

4.12.1 The first step in preparing a risk assessment for the site is to utilise the research information in order to develop a Conceptual Site Model (CSM). The CSM describes how potential contamination sources at the site could contribute to increased levels of risk to potentially sensitive receptors. The CSM identifies the sources of contamination, the likely receptors and the potential pathways present between them. If there appears to be a pathway that links a source to a receptor, then this is considered a potential significant pollutant linkage that will require to be assessed.

4.12.2 The CSM is developed at an early stage and constantly re-assessed in light of investigative findings. The first step in producing such a model is to identify whether there are potential hazards on-site through the desktop research outlined above, together with professional expertise and judgement. The above site-specific environmental data is gathered to assess the environmental resources which could be impacted by potential contamination at the site. Within this context, a hazard is defined as a property that has the potential to cause harm to a receptor group.

4.12.3 On the basis of the desk study researches, the following initial ground model would be anticipated:-

- No mantle of Made Ground anticipated beneath the vast majority of the (farmland) site.
- A thin mantle of Made Ground anticipated in the vicinity of the old Barn and former Contractors Compound, on-site, and possibly close to field margins in proximity to the old "Covered Reservoir".
- No published natural superficial deposits underlying the site.
- Published bedrock strata comprising four main geological units (in part reflecting the presence of Geological Faults) underlying the site at shallow depths (paragraph 4.1.2).
- Site specific investigation works have recorded a shallow natural sequence of essentially "clay" deposits containing variable proportions of gravel (limestone); limestone bedrock strata possibly being encountered at relatively shallow depths beneath the north-west site area (Trial Pit 1).
- A land use history comprising mainly of undeveloped agricultural land with local short term use as a "Contractors Compound" with one barn structure which has since become derelict. Immediately surrounding historical land uses included a former Forensic Laboratory (area now built upon by residential development), Plant Nurseries and a Hospital (well to the south) and a current "Covered Reservoir".
- A Principal Bedrock Aquifer Designation lies beneath the majority of the site, including the southern, central and north-western areas. A Secondary A Bedrock Aquifer Designation encroaches beneath the north-east corner of the northern and central fields.
- There is no Superficial Deposits Aquifer Designation beneath the site.
- No licensed surface, groundwater or potable abstractions within one kilometre of the site.

- Nearest recorded surface water feature to the site is a Tertiary River (Drain) located immediately to the north of the site and extending to the west/south-west away from the site.
- No recorded landfill sites within 500 metres of the site.
- Evidence of former Quarrying activity within 250 metres of the site.
- Solid strata requiring Basic protection against naturally occurring Radon.
- The site is located within/abutting an Area of Outstanding Natural Beauty (AONB) referenced the Wye Valley and a Site of Ancient Woodland also abuts the north-western site boundary.

4.12.4 On the basis of the above ground model, the initial Conceptual Site Model (CSM) enclosed as Appendix A has been prepared using the Source-Pathway-Receptor principle; the risk of a full potential linkage being recorded as Low, Medium or High (L, M or H).

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

5.1.1 It is understood that the site is under consideration for future residential end use, although no detailed development proposals are currently available.

5.1.2 On the basis of the desk study researches and site walkover survey, the following mining, engineering and geo-environmental issues are considered relevant to the site in the context of the future residential development, as proposed by the Client.

5.2 Mining Related Issues

5.2.1 The site lies close to the western fringes of an area which has been subject to local historical underground metaliferous mining,

5.2.2 In addition reference is made in the Groundsure Geo Insight Report to small-scale underground mining for Lead "on-site" (paragraph 4.4.3).

5.2.3 However, the corresponding "mining" plan indicates that the site and surrounding areas to be similarly annotated and thus, it is not deemed to be specific to the study site.

5.2.4 Thus, on the basis of the above and when also taking account of the often localised and haphazard nature of Lead mining, the likelihood of any past underground metaliferous mining occurring at the site is considered to be "low", but cannot be totally discounted.

5.2.5 Close inspection of the sub-soils when undertaking the general site strip and at formation levels will be necessary for any potentially "anomalous" ground conditions which may be mining-related and foundations may need to be upgraded accordingly local to these features, if any were to be identified on-site.

5.3 Engineering/Geotechnical Issues

5.3.1 A significant mantle of Made Ground would not be anticipated to occur beneath the majority of the site due to the lack of any previous significant development.

5.3.2 Furthermore, shallow "disturbed ground" could be expected to occur across the site associated with former/current farming practices.

5.3.3 The natural (limestone and sandstone) bedrock strata recorded in published geology which would theoretically be anticipated to occur at shallow depths beneath the site would be expected to display moderate/high load bearing characteristics compatible with the use of shallow foundations for lightly loaded residential structures (subject to the degree of weathering/jointing proven).

5.3.4 However, localised site specific site investigations have recorded a sequence of essentially natural "cohesive" soils with variable gravel and cobble constituents extending to depths of the order of 2.00 to 3.00 metres below ground level, with possible limestone bedrock strata being proven in one pit located beneath the north-west area of the central field.

5.3.5 In our opinion, the firm, firm to stiff and stiff natural "clay" soils encountered at shallow depths display moderate load bearing characteristics, which would also support the use of lightly loaded residential structures (subject to confirmation by undertaking a more detailed programme of intrusive investigation works across the site).

5.3.6 The Groundsure Enviro Insight Report has (locally) recorded the site to lie at "high risk" from Soluble Rocks, by virtue of the presence of Limestone bedrock present.

5.3.7 In our opinion, in such strata natural solutioning can result in the formation of enlarged/widened fractures, fissures and an irregular sub-surface profile, and "at worst" result in local open cavities (in the form of sink/swallow holes).

5.3.8 The "rock mass" features are often filled with sediment (from soils above) and hence can display locally variable load bearing characteristics.

5.3.9 The associated "solutioning" recorded in the plan contained in the Groundsure Geo Insight Report indicates that the areas at potentially higher risk from natural solutioning are located trending through the central/north-eastern site areas; areas which possibly coincide geologically with the Lower Dolomite strata (and possibly the Drybrook Limestone).

5.3.10 In our opinion, we would expect the Lower Limestone Shale bedrock strata anticipated to lie beneath the north-eastern and eastern site areas to record a lower potential risk of natural solutioning to occur within, whilst the Lower Drybrook Sandstone which encroaches beneath only a relatively small area of the site to the north-west would be expected not to be impacted by natural solutioning.

5.3.11 Close inspection of the sub-soils/bedrock strata will be required at formation levels for the presence of any "anomalous" features which may be attributable to "solutioning".

5.3.12 However, based upon the near surface soil conditions identified in the site specific investigation works, identifying such features "at surface" during construction works may prove difficult.

5.3.13 Therefore, in our opinion, consideration should be given to undertaking a "non intrusive" geophysical survey at the site prior to construction commencing, in order to establish whether any such anomalous features which could be attributable to natural solutioning locally exist. In view of the difficulty trying to differentiate geological strata displaying potentially varying degrees of "solutioning risk" at the site, it is recommended that the survey is extended to cover the entire site.

5.3.14 Such a survey could potentially also identify any local mining related anomalies (should any occur on-site) (paragraph 5.2.5).

5.3.15 In respect to the use of soakaways (SUDS) the limestone bedrock strata (with its likelihood of fissures and joints, etc.) expected to underlie large areas of the site at relatively shallow depth, is anticipated to display "good" infiltration characteristics (mainly as fissure flow).

5.3.16 However, site specific in-situ soakaway testing conducted across the site with response zones undertaken in the natural cohesive soils overlying the limestone bedrock strata, have proven highly variable and locally "poor" soil infiltration characteristics.

5.3.17 Thus, it is recommended that future soakaway tests target specific drainage areas on-site, with possible consideration also being given to undertaking "deeper" soakaway tests in the underlying limestone bedrock strata, where practical to do so.

5.3.18 In view of the potential for natural solutioning to occur in the bedrock strata, future soakaway drainage should be located well in excess of the normal "default" five metres zone away from any proposed structures.

5.3.19 The natural "soils" anticipated on-site would not be expected to exhibit elevated sulphate levels and no significant upgrading of buried concrete would be anticipated (subject to confirmation by laboratory testing).

5.4 Geo-Environmental Issues (Ground Chemistry and Ground Gas)

5.4.1 A significant mantle of Made Ground would not be anticipated to occur beneath the vast majority of the site (current field areas) due to the lack of any previous development. However, a local mantle of Made or Disturbed Ground could occur associated with, the old derelict Barn; in close proximity to the buried water mains crossing the site; close to field boundaries in the north-east site area which abut current/former site development (Covered Reservoir and former Forensic Laboratory) and associated with the recent (former) Contractors Compound.

5.4.2 The past history of the site as agricultural land is not likely to pose a significant potential risk in the context of ground chemistry, although any local spillages of hydrocarbons associated with the use of farm plant or the possible use of pesticides/ herbicides associated with the encouragement of crop growth could potentially occur in the shallow soils, whilst the possible presence of Asbestos (ACM's) cannot be discounted in close proximity to the old barn.

5.4.3 The more recent use of the eastern "half" of the northern field as a "Contractors Compound" associated with the adjacent residential development is however considered to be a higher risk area of potential ground contamination, which will need to be targeted by detailed Phase 2 intrusive investigations.

5.4.4 Potentially contaminative historical land uses in close proximity to the site includes a former Plant Nursery and a former Forensic Laboratory. The Nursery and Laboratory could have had potential for contamination to occur associated with the use of herbicides or pesticides (Nursery) or metals/hydrocarbons (Laboratory), although contamination pathways could have been blocked and/or the individual sites remediated during construction for residential housing.

5.4.5 Abutting the northern field and northern area of the central field is an underground Reservoir. In our opinion, when taking account of its covered status, it is considered unlikely that the Reservoir complex would pose a significant potentially contaminative risk to the site provided that good operating/maintenance procedures are followed in the future by the Operator.

5.4.6 There are no recorded Landfill Sites within 500 metres of the site and thus, "ground gas" generated from such sources would not be considered as a "design criteria" for future residential development.

5.4.7 Several documented quarries are recorded in relative close proximity to the site, the closest lying 146 metres to the west of the site. The status of these quarries should be reviewed in order to establish whether they have been infilled or otherwise in the past, and whether they would pose any ground gas risk to the site.

5.4.8 The site lies in an area where Basic Radon protective measures are necessary in the construction of new dwellings, and when taking account of the proposed use of the site for residential housing, these Radon measures are considered applicable to the proposed end use and it is recommended that this status be confirmed with the Local Environmental Health Officer prior to finalising sub-structure design.

5.4.9 The north-western, western and southern areas of the site lie in a potentially "sensitive" geo-environmental setting, lying above limestone bedrock strata classified as a Principal Aquifer. Thus, good "site management" would need to be adopted during the build phase to ensure no significant contaminating activities occur.

5.4.10 The Groundsure Enviro Insight Report records an Area of Outstanding Natural Beauty (AONB) "on-site" referenced the Wye Valley and also an area of "Ancient Woodland" on-site. The associated plan records these areas encroaching upto the western site boundary (and the AONB also encroaching just beyond the northern site boundary). It is recommended that further searches be carried out to ensure that such areas do not locally impact on the overall developability of the site in these areas.

5.4.11 It is concluded that geo-environmental ground issues present a generally low risk in the context of potential site redevelopment and the wider environmental liabilities of the Landowner, subject to confirmation by physical investigation.

5.5 Future Investigation Works

5.5.1 The following Scope of Works for physical investigation to facilitate assessment of foundation design, and geo-environmental issues at the site is recommended:-

- An "expanded" trial pitting exercise to determine the shallow soil succession and load bearing/settlement properties of the near surface soils.
- If areas of deeper soils or shallow soils displaying "poor" load bearing characteristics are encountered, consideration given to undertaking cable tool boreholes.
- Undertaking additional large-scale In-Situ soakaway tests targeting known future drainage areas and possibly extending into the limestone bedrock strata at depth, if practical.
- Shallow soil samples to be taken for detailed chemical contamination testing of any Made/Disturbed Ground and natural soils for metals, inorganics, organics, asbestos, pesticides and Waste Acceptance Criteria testing.
- A programme of physical laboratory testing to assist with foundation design issues (soil classification, strength and buried concrete design).
- A "Site Wide" Geophysical Survey is recommended to determine the status of the limestone bedrock geology for any ground dissolution features or anomalies/cavities; the same survey also potentially addressing any former underground mining-related features on-site, although the latter are considered to be low risk.

5.5.2 Provided appropriate detailed site investigations are undertaken and appropriate mitigation measures are implemented, we are of the opinion that the site would be suitable for the proposed future use as an area of development for residential uses.

5.5.3 We trust that the Phase 1 Desk Study is satisfactory for your purposes, however if you have any queries, please do not hesitate to contact the undersigned.

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APPENDIX A

Initial Conceptual Site Model

APPENDIX B

Groundsure - Enviro Insight Report

A P P E N D I X C

Groundsure - Geo Insight Report

APPENDIX D

Groundsure Insights - Historical Map Coverage