JH Groundwater Ltd
Hydrogeological Solutions

PUMPING TEST RESULTS AND HIA. GROUNDWATER ABSTRACTION, CWRT PERROTT FARM.

CWRT PERROTT FARM LTD

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1 Introduction

1.1 Background

JH Groundwater Ltd (JHG) was commissioned by Cwrt Perrott Farm Ltd to produce an application for a new groundwater abstraction at Cwrt Perrott Farm, Llandegveth, Newport, NP18 1HX.

1.2 Requirements and Background

The farm already has a groundwater abstraction borehole but it is currently unlicensed. Historically the farm operated a herd of approximately 140 and a small parlour capable of milking 8 cows at a time.

A flow meter installed at the time of borehole completion confirmed that abstraction was below the licensed abstraction rate of 20m^3/d and did not therefore require an abstraction licence. However, data was not routinely collected.

Abstraction has increased over time to support a maximum herd size of 390-400. The operation is therefore now in a position where a licensed abstraction is required.

Following consultation with Natural Resources Wales (NRW), to bring the abstraction into regulation it is understood that a full abstraction licence application needs to be submitted.

To support this application submission of a WRC form, a water features survey (WFS) was required. Following receipt of the consent, a pumping test and hydrogeological impact assessment report has now been completed. This report reports on the testing and provides a hydrogeological impact report to assess impacts to identified water features.

1.3 Abstraction requirement

Detailed records of abstraction have not previously been kept and the volumes of groundwater abstraction required are therefore estimated based on livestock watering figures, parlour washing requirements and audited livestock numbers during proceeding years. There is some variability in year on year figures but the maximum daily average abstraction volume in one year during the period 2011-2017 has been estimated to be 46.1m^3/d.

There is also some natural variability in the stock rate year on year as a result of birth rates and an annual total water requirement of 18263m^3 (assuming a rounded average annual daily volume of 50m^3/d) is requested in the application. Day to day flows also vary and to take account of this a maximum daily flow of 65m^3/d is outlined.

2 Site Characterisation

Based on the available data, a focused conceptual site model has been developed to inform the hydrogeological impact assessment. This is outlined below.

2.1 Site Summary

Site Address	Cwrt Perrott Farm, Llandegveth, Newport, NP18 1HX
National Grid Reference	Approximate location of Abstraction Borehole: NGR ST 33840 95820 to an accuracy of 10m.
Site Location	The site location is shown in Figure 1.
Surrounding Land Uses	The surrounding land use is predominantly rural.
Borehole Details	Details of the existing borehole and proposed abstraction are outlined in the WRC form (Appendix 1).
Water usage	The water is used on this dairy farm for livestock watering, wash down and general agricultural purposes. Water use is minimised where possible and a proportion of abstracted water is returned to the catchment through land spreading and natural means.
Proposed abstraction regime	It is proposed that the abstraction takes place at all times of the year. The volume of abstraction will vary seasonally.

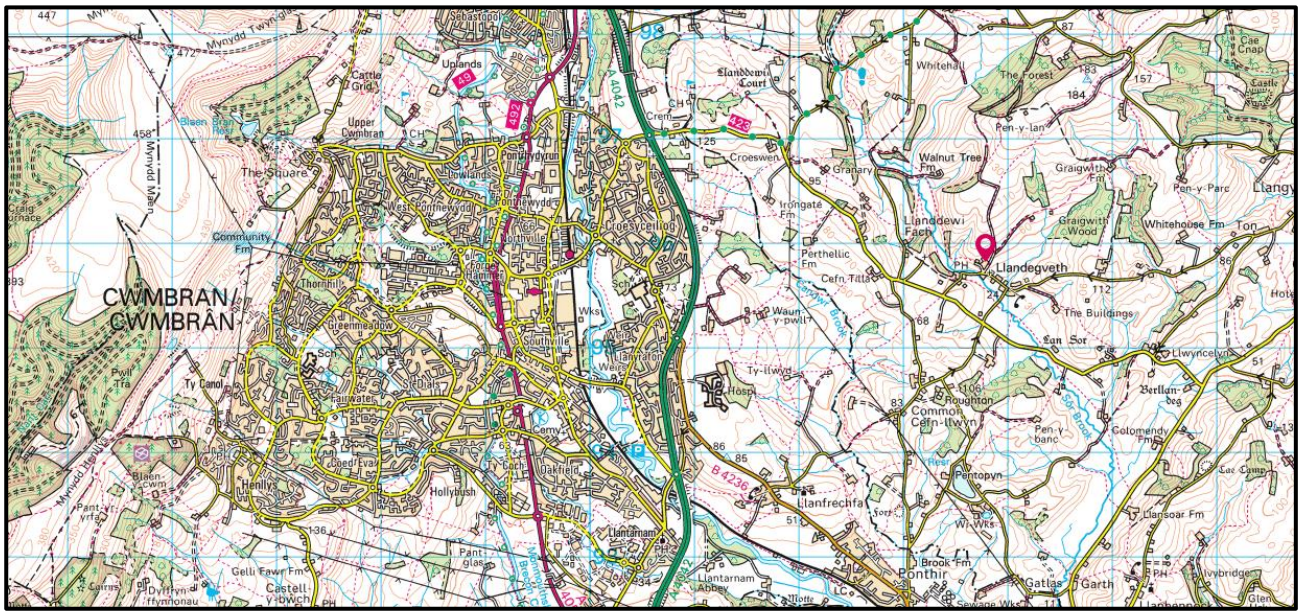


Figure 2.1 Location Map. (© Crown copyright [2019] Ordnance Survey [licence number 100054967])

2.2 Terrain and topography

The groundwater abstraction borehole is estimated to be located at approximately 48mAOD as determined from Google Earth imagery. Ground adjacent to the groundwater abstraction borehole falls broadly to the southeast.

2.3 Surface water

Mapping showing surface water features is reproduced in Appendix 2.

The Sor Brook, runs roughly northwest - southeast and forming a tributary of the River Usk SAC, is the closest water course to the west of the abstraction borehole. The closest part of the Sor Brook is approximately 160m southwest becoming a main river approximately 1km downstream. The River Usk SAC designation begins a further 4.4km downstream.

No published data for flow on the Sor Brook has been obtained. The nearest surface water gauging station is upstream on the Usk at Chainbridge on Usk (NGR – SO 345 056, Station ID 56001). This is approximately 10km north of the abstraction borehole. At Chainbridge on Usk the river flow 95% exceedance (Q95) for the period 1957-2018 is stated to be 4.62 m^3/s.

The catchment geology is analogous to that in which the abstraction borehole is located and a relatively low baseflow index (BFI) of 0.5 is specified by Marsh, T. J. and Hannaford, J. (2008)[1] with a very similar BFI of 0.52 in the National River Flow Archive[2]. However, this may be lower as the Usk CAMS document suggests only moderate baseflow.

No closer gauging stations are available in the hydrometric register and there is no publicly available gauging station downgradient of the abstraction borehole in either the River Usk or its tributaries.

A further unnamed tributary lies in excess of 250m to the east of the abstraction borehole. This runs broadly northeast - southwest and joins the Sor Brook at a point adjacent to Nantsor Road.

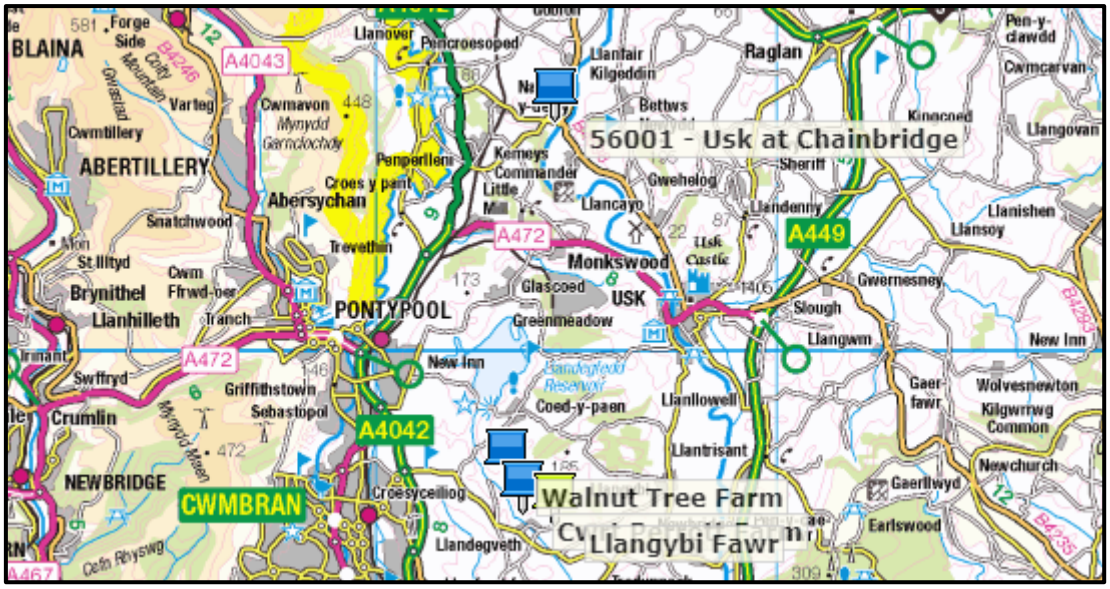


Figure 2.2 River Usk gauging station, Licensed (yellow) and Private (Blue) Water Supply Abstractions. (© Crown copyright [2019] Ordnance Survey [licence number 100054967])

[1] Marsh, T. J. and Hannaford, J. (Eds). 2008. UK Hydrometric Register. Hydrological data UK series. Centre for Ecology & Hydrology. 210 pp

[2] https://nrfa.ceh.ac.uk/data/station/meanflow/56001 accessed 30/7/19.

2.4 Soils

Soil mapping shows that the predominant soil type 541a MILFORD - Well drained fine loamy reddish soils over rock and 541j DENBIGH 1 - Well drained fine loamy and fine silty soils over rock.

They are also HOST Class 17. These are stated to be relatively free draining soils with a large storage capacity over hard impermeable rocks with no storage capacity.

In terms of aquifer protection, the soils are classified as I1 Soils of intermediate leaching potential which have a moderate ability to attenuate a wide range of diffuse source pollutants but in which it is possible that some non-adsorbed diffuse source pollutants and liquid discharges could penetrate the soil layer.

2.5 Geology

The geology beneath and adjacent to the groundwater abstraction borehole is outlined in Table 2.1 and maps are reproduced in Appendix 3.

There are no mapped superficial deposits over the area of the groundwater abstraction borehole. However, Alluvium lies to the southwest, associated with the Sor Brook.

The groundwater abstraction borehole is constructed in Silurian Strata to a depth of approximately 53mbgl.

Table 2.1: Geological strata

Period and Unit		Strata	Geological Description
Quaternary	Holocene	Alluvium	Alluvium is a general term for clay, silt, sand and gravel. Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel. A stronger, desiccated surface zone may be present.
Silurian	Pridoli	Downton Castle Sandstone Formation	Mainly yellow, fine-grained, micaceous, well-sorted cross-bedded sandstone (Sandstone Member), with siltstone and olive-green mudstone.
	Ludfordian	Upper Llanbadoc Beds and Llangibby Beds	The Upper Llanbadoc Beds and Lower, Middle and Upper Llangibby Beds collectively form the larger part of the former Upper Ludlow Shales. The Llanbadoc, and Lower and Middle Llangibby Beds are generally flaggy calcareous siltstones. The Upper Llangibby Beds are essentially light olive-grey calcareous siltstones and silty flags, with rare thin seams of shelly limestone.

2.6 Hydrogeology

2.6.1 Hydrogeology – General

A summary of hydrogeology for the formations of interest is outlined in Table 2.2.

According to Jones et *al* (2000)[3], primary porosity in most horizons is very low (commonly less than 2%), flow is almost entirely via fractures. Groundwater flow and storage occurs in joints and fracture systems developed to varying degrees according to the formation's deformation history and proximity to local structural features such as faults and fold axes. Primary porosity contributes an insignificant proportion of the total permeability and storage.

Table 2.2: Hydrogeological conditions

Period and Unit		Strata	Hydrogeological Conditions
Quaternary	Holocene	Alluvium	Classified by NRW as a Secondary A Aquifer although previously classified as a Non-Aquifer. Assumed to be predominantly intergranular flow. Due to the geological nature of the material it is likely that there will hydraulic connection with surface water but may be a limited hydraulic connection with the underlying bedrock. This is supported by the relatively low BFI.
Silurian	Pridoli	Downton Castle Sandstone Formation	Classified by NRW as a Secondary A Aquifer. Local aquifers yield small supplies. A generally low productivity local aquifer with moderate permeability. Almost exclusively fracture flow. Considered to be in hydraulic continuity with the Upper Llanbadoc Beds and Llangibby Beds.
	Ludfordian	Upper Llanbadoc Beds and Llangibby Beds	Classified by NRW as a Secondary A Aquifer. Local aquifers yield small supplies. A generally low productivity local aquifer with moderate permeability. Interbedded calcareous siltstones and mudstones and thin limestones which may result in separate aquifer units within the sequence. Almost exclusively fracture flow. Considered to be in hydraulic continuity with the Downton Castle Sandstone Formation.

2.6.2 Groundwater Flows and Levels

The depth to groundwater was approximately 22.67mbd (datum being top of casing) based on dips in the abstraction borehole on 12th August 2019. This equates to 23.17mbgl or an estimate of approximately 25mAOD. Further dips on 19th and 25th September recorded a groundwater level of 22.83mbd.

[3] Jones, H. K., Morris, B. L., Cheney, C. S., Brewerton, L.J., Merrin, P. D., Lewis, M. A., MacDonald, A. M., Coleby, L. M., Talbot, J. C., McKenzie, A. A., Bird, M. J., Cunningham, J., and Robinson, V. K., 2000. The physical properties of minor aquifers in England and Wales. British Geological Survey Technical Report, WD/00/4. 234pp. Environment Agency R&D Publication 68.

The local hydraulic gradient is unknown but it is assumed that locally the groundwater flow direction will be coincident with topography, flowing towards the southeast. Coincidence of groundwater flow with topography is anticipated throughout the catchment. It is assumed that this flow direction will be independent of lithology.

Groundwater levels in the aquifers are likely to be seasonally variable but the magnitude of change is unknown.

2.6.3 Aquifer properties

Aquifer properties are poorly defined and only general observations are made here.

2.6.3.1 Alluvium

Aquifer properties for Alluvium can be variable over short distances depending on the materials present. However, clays and silts tend to predominate, together with some sandy layers and it is likely that the overall permeability will be low. This is supported by observations of BFI in similar geological conditions higher in the catchment and the previous classification of the Alluvium as a Non-Aquifer in EA (date unknown)[4].

2.6.3.2 Silurian Strata

Jones *et al* (2000) report a small range of transmissivity values but these are for strata out with the area of interest and are therefore not reported further here. The occurrence of open, water-bearing fractures is greatest at shallower depths. Permeability declines rapidly with depth as fractures become tighter and less common. This marked reduction in permeability with depth effectively imposes a base to the aquifer which for practical purposes is commonly around 30 to 40mbgl.

2.7 Groundwater Quality

According to Robins and Davies (2015)[5] the chemical composition of groundwater in the Silurian strata is variable, reflecting the range of residence times as well as pH and redox. Most groundwaters are young, varying in age from weeks/months to a few decades and are dominated by poorly reactive minerals such that groundwaters tend to be weakly mineralised. However, the largest variations are likely to occur with depth and boreholes that abstract waters from a variety of fractures at different depths produce waters of contrasting chemistry.

2.8 Water Features Survey

A Water Features Survey (WFS) has been completed for a radius of 250m from the location of the abstraction borehole based on NRW requirements. The outcome of a desk based WFS is summarised below and details of individual features from a physical WFS undertaken on 12th August are provided in Appendix 4.

[4] EA, date unknown. Policy and Practice for the Protection of Groundwater. Environment Agency Wales Regional Appendix.

[5] Robins N. S., Davies, J. 2015. Hydrogeology of Wales. British Geological Survey.

2.8.1 Licensed Groundwater Abstractions

The site is not within a Source Protection Zone (SPZ).

Table 2.3 and Figure 2.3 show the presence of a single historical groundwater licensed abstractions within 1km of the groundwater abstraction borehole. However, this is at a distance of approximately 750m eastsoutheast from the abstraction borehole and significantly outside the 250m search radius of the WFS.

Table 2.3 Licensed abstractions within 1km of the groundwater abstraction borehole.

Distance (m)	Direction	NGR	Details	
734	SE	334510 195520	Status: Historical Licence No: 20/56/13/0003 Details: General Farming & Domestic Direct Source: EAW Groundwater Point: WELL IN LLANGYBI FAWR Data Type: Point Name: Greenland	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 15/11/1965 Expiry Date: - Issue No: 100 Version Start Date: 07/03/1994 Version End Date:

2.8.2 Private Water Supply Abstractions

The presence of registered private water supplies was requested from Monmouthshire Council and two have been identified within 1km of the groundwater abstraction borehole (Table 2.4). The location of the abstractions is shown in Figure 2.3.

Of these the Cwrt Perrott Farm abstraction is the subject of this application. The Walnut Tree Farm abstraction is at a distance of approximately 930m northwest from the abstraction borehole and significantly outside the 250m search radius of the WFS.

Table 2.4 Private Water Supply Abstractions within 1km of the groundwater abstraction borehole.

Address	NGR	Type of Supply
Cwrt Perrott Farm, NP6 1HX	ST 33722 95807	Borehole supply to single premise
Walnut Tree Farm, NP44 2DE	ST 33294 96630	Spring supply to single premise

2.8.3 Boreholes and Wells

There are no boreholes or well records recorded in the British Geological survey (BGS) database within 1km of the abstraction borehole.

A single well is shown on Ordnance Survey mapping but lies outside of the 250m search radius at Beech Cottage to the westsouthwest of the abstraction borehole.

2.8.4 Springs and issues

There are no mapped springs or issues within the 250m radius of the WFS. The nearest spring (Spring 1 on Figure 2.4) is approximately 365m to the southwest of the abstraction borehole and a second spring (Spring

2) is located at a distance of approximately 590m to the north east. Both are outside the search radius for the WFS.

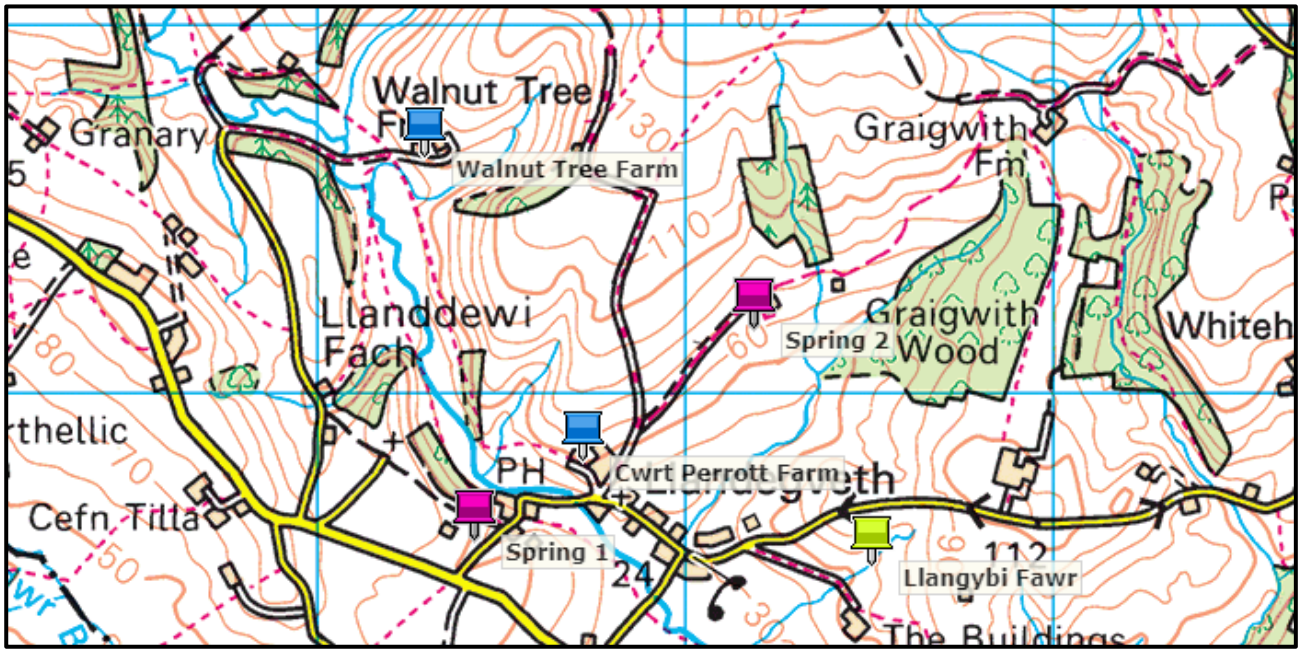


Figure 2.3 Licensed (yellow) and Private (Blue) Water Supply Abstractions. Springs shown in pink. (© Crown copyright [2019] Ordnance Survey [licence number 100054967])

2.9 Conservation interests

There are no mapped SSSIs, SACs or Local Nature Reserves within 1km of the abstraction borehole according to the NRW mapping tool[6]. There are several areas of ancient woodland within 1km of the site but none within the 250m search radius.

[6] http://lle.gov.wales/map#m=-2.96739,51.65917,14&l=38;291;292;1356;284;290;15;772;46;12;289;&b=osraster accessed 29/7/19.

3 Pumping Test Analysis

3.1 Introduction

3.1.1 Time and location of pumping test

The pumping test took place within the abstraction borehole at Cwrt Perrott Farm on 25th and 26th September 2019.

3.1.2 Duration of test

Abstraction took place for a period of 24 hours followed by a period of recovery of 3 hours to achieve recovery to within 95% of the initial drawdown.

3.1.3 Details of pumping test

Water level drawdown and flow rates was recorded for the pumped borehole. No other boreholes were available for recording of drawdown during the test. Manual and logged data was collected.

Unfortunately, there was an issue with the data logger and so there is a gap in the reported data. However, given the stability of the data after a period of approximately 3 hours and the stability of the data at the end of the 24 hour period the data is considered to fit with the expected conceptual model and the absence of the intervening data is not considered to be a significant issue for the purpose of interpretation.

3.1.4 Flow rates

The flow rates recorded during the tests are presented in Appendix 5 and a graph of the data shown in Figure 3.1 against drawdown data. An average flow rate of 68m^3/d was recorded during the test.

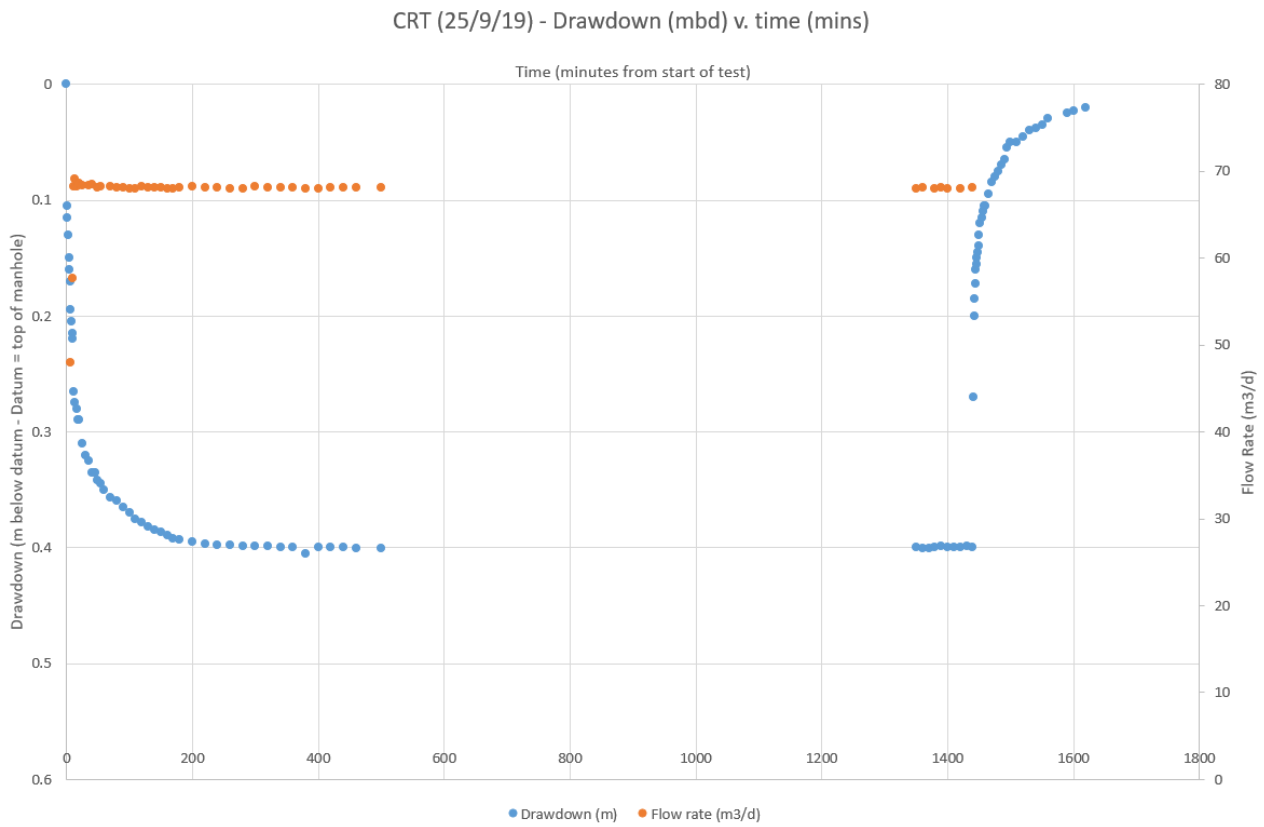


Figure 3.1 Drawdown and Flow rate data

3.1.5 Drawdown data

Drawdown and recovery during the pumping test are presented in Appendix 5 and a graph of the data shown in Figure 3.1. A stable drawdown of approximately 0.4m was recorded during the test. Recovery was recorded to 95% but subsequently reached full recovery.

3.2 Factual Data

The results of the pumping test are outlined below.

The following observations were made regarding the test:

- The early data has been ignored due to initial low flows and changes made to the pumping rate to approximate the flow stated in the permit. After this initial revision to flows, the flow rate was stable throughout the rest of the test.
- Stability of drawdown was achieved relatively quickly with minor fluctuations during the test.
- The graph shows that there is a reduced drawdown compared to the Theis function as the test progresses. This apparent recharge effect is interpreted to be due to either drainage from the multi-layered aquifer or extension of the drawdown to intercept other fractures not connected directly to

the borehole, both mechanisms suggested by Headworth (1998)[7]. Calculations of the abstraction radius of influence and drawdown, discussed further in Section 4, are such that this recharge is not considered to be surface water leakage. The sequence can therefore act as a semi-confined multi-layered aquifer.

- Recovery was relatively quick and reached 95% in 3 hours. The recovery test was terminated at this point but full recovery was subsequently reached.
- The well performance is good with a drawdown in the order of 0.4m for an average flow rate of 68m^3/d.

3.3 Calculations

3.3.1 Assumptions

The following assumptions are made in analysis of the test data. These are the assumptions of the Theis equation. Whilst some deviation of these is expected they are considered to be reasonable:

- The aquifer is homogeneous, isotropic, of uniform thickness and infinite areal extent.
- The aquifer is unconfined. Although primarily for use in confined aquifers, Theis can be a good approximation for unconfined aquifers if the drawdown is small compared with the saturated thickness of the aquifer which is considered to be the case here.
- The piezometric surface is horizontal before pumping.
- Flow in the aquifer is entirely horizontal.
- Storage in the well can be neglected.
- Water removed from storage is discharged instantaneously with decline of head. Aquifer properties and observations

3.3.2 Transmissivity

The transmissivity of the aquifer has been calculated from the drawdown data using Aquifer^{win32} software. This is estimated to be approximately 110m^2/d. This is in the expected range for these strata, albeit at the higher end.

[7] Headworth D., 1998. Introduction to the Geology and Hydrogeology of Herefordshire. Unpublished internal EA report.

4 Hydrogeological Impact Assessment

4.1 Introduction

A hydrogeological impact assessment for the abstraction has been completed and the results outlined below. The assessment considers impacts to both levels and flows of groundwater and surface water.

4.2 Regional Water Resource Status

The site lies within the USK CAMS and the sub catchment of the Sor Brook[8]. As there are only limited groundwater abstraction in the catchment the policy states that groundwater resource availability is to be considered on a case by case basis. In these instances, application of abstraction constraints will be assessed and resource reliability discussed on submission of an application.

It is understood that indicative figures of resource reliability for surface water do not apply to non-consumptive abstraction (surface water and groundwater) or a consumptive groundwater abstraction if this is assessed not to have a negative impact on designated and local species and / or habitats or other existing water users. The CAMS document states that there is only a moderate groundwater baseflow component to surface watercourses in the Sor Brook catchments.

4.3 Controlled Waters Conceptual Model

Based on available data the following conceptual model has been developed.

- No superficial deposits are present at the location of the groundwater abstraction borehole. However, Alluvium is present to the west of the borehole along the alignment of the Sor Brook.
- The permeability of the Alluvium is generally considered to be low, having previously been designated as a Non-Aquifer and consisting predominantly of silts and clays with some sand layers.
- The borehole abstracts groundwater from the Downton Castle Sandstone Formation and the Upper Llanbadoc Beds and Llangibby Beds. These bedrock sequences are considered to be in hydraulic continuity. There may be some hydraulic connection with the Alluvium although baseflow is only moderate according to the CAMs document.
- Flow in the aquifer is generally limited by the presence of secondary porosity fractures. Flow may occur preferentially within the permeable thin limestone and calcareous sandstone bands within the

[8] Natural Resources Wales, 2017. River Usk Abstraction Licensing Strategy. A licensing strategy to manage water resources sustainably.

Upper Llanbadoc Beds and Llangibby Beds rather than the intervening low permeability siltstones and mudstones.

- The depth to groundwater is approximately 28mbgl based on the most recent dips in the abstraction borehole.
- Local groundwater flow is generally to the southwest following topography and anticipated to be perpendicular to the Sor Brook and the unnamed watercourse. Groundwater flow in the catchment is considered to be coincident with topography.
- It is assumed that baseflow occurs throughout the catchment to all surface water courses. Groundwater provides an element of baseflow but this may be limited by a poor hydraulic connection between surface water and groundwater due to the presence of silt and clay dominated Alluvium.

4.4 Flow Impact Apportionment

Any impact to the Sor Brook would occur due to either reduction in flow from the catchment or due to drawdown of groundwater at the brook resulting in direct derogation during abstraction. The relative elevation of groundwater and surface water is unknown.

To conservatively assess the loss of groundwater baseflow within the catchment a simple analysis has been completed comparing the size of catchment to sustain the borehole abstraction relative to the area of catchment which can contribute baseflow to the Sor Brook and its tributaries. Based on the results of that calculation, further consideration is then given to impact to the River Usk SAC.

4.4.1 Consumptive use and water returned to catchment

The water is used for both livestock watering and washdown. As such there is a reasonable proportion of water which will be returned to the catchment.

Approximately 15% of the total abstracted is used for washdown. Washdown arising are subsequently land spread, returning the majority of washdown water to the catchment.

A proportion of groundwater used for livestock watering is also returned to the catchment by natural means.

4.4.2 Relative area of catchment baseflow contribution

Contribution of baseflow to surface water occurs through slow release of groundwater over time. This naturally mitigates the “flashiness” of surface water flow. This baseflow is buffered by groundwater discharging to surface water over a large area of catchment, significantly greater than that required to sustain an abstraction.

The surface water catchment to the Sor Brook which includes the borehole location covers an area of 16.17km^2 (Figure 4.1). Baseflow to surface water would also occur throughout this area and, assuming local flow coincident with topography, it is concluded that the whole catchment has the potential to contribute to baseflow of the Sor Brook. The area of catchment required to support the average groundwater abstraction of 50m^3/d has been calculated as 58852m^2. Calculations are reproduced in Appendix 5.

By comparing the area of catchment which will provide potential baseflow to the Sor Brook, with that required to sustain abstraction, this represents approximately 0.3% of the total area.

To put this into context, based on calculations of a flow estimate on 25th September 2019, where discharge in the brook was calculated to be of the order of 300 litre/second, this would equate to a fraction of just 0.9l/s or an imperceptible height reduction of approximately 0.5mm for a river stage of 200mm. Clearly this represents an insignificant flow impact on the Sor Brook and there is not considered to be a risk posed by the abstraction.

Flows were again estimated at the start and end of the testing (25th and 26th September) and flows were seen to have increased slightly during the test, most likely due to rainfall. Notwithstanding this there was no evidence of significant impact to flow during testing in line with the anticipated effects.

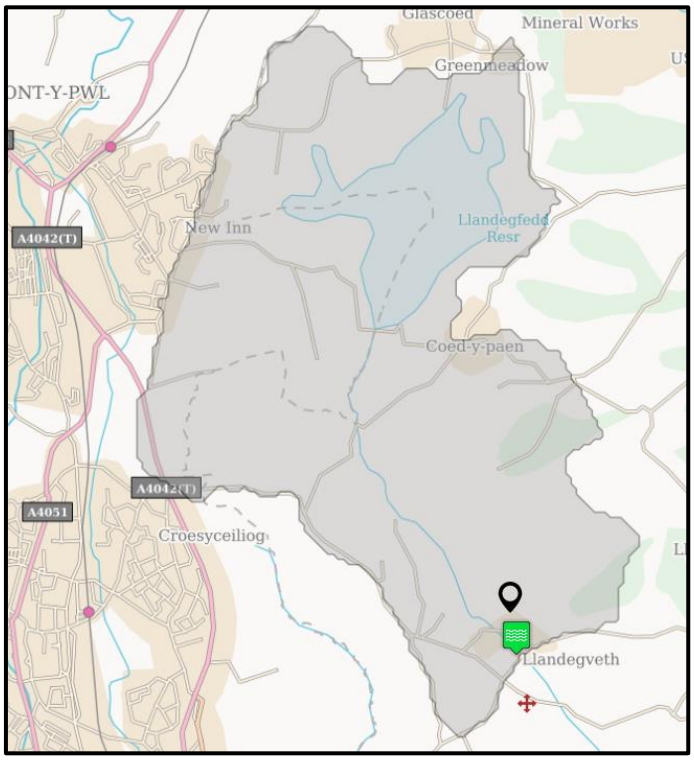


Figure 4.1 Sor Brook catchment which includes the Cwrt Perrott borehole (shown in black). (© Crown copyright [2019] Ordnance Survey [licence number 100054967])

4.4.3 Impact to the River Usk

Whilst there are no available data for flows on the Sor Brook at Chainbridge on Usk, some 10km north of the Cwrt Perrott abstraction, the river low flow 95% exceedance (Q95) for the period 1957-2018 is stated to be 4.61 m^3/s. Assuming an abstraction volume of 50m^3/d at Cwrt Perrott and assuming that this equates to 0.013% of the flow at low flow in the River Usk or 0.0065% of the flow assuming a BFI of approximately 0.52. At Q50 this decreases to a fraction of 0.0034% and 0.0018% respectively.

Clearly the flow will be significantly higher at the point of entry into the River Usk SAC and as such the impact from the abstraction is considered to be insignificant to the River Usk SAC.

4.5 Mitigation of Flow Impacts

None required.

4.6 Significance of Net Flow Impacts

Not significant for the Sor Brook or the River Usk SAC based on the calculations presented.

4.7 Features Susceptible to Drawdown Impacts

With the exception of the Sor Brook, no other abstraction or surface water (e.g. spring) features are identified as being susceptible to drawdown impacts.

To evaluate the risk of direct drawdown and potential derogation of the Sor Brook, the abstraction zone of influence has been estimated using a Theis well function calculation and the catchment zone for the abstraction is estimated using a capture zone calculation to show the down gradient "stagnation" point. These features are shown in Figure 4.2 (EA, 2007)[9].

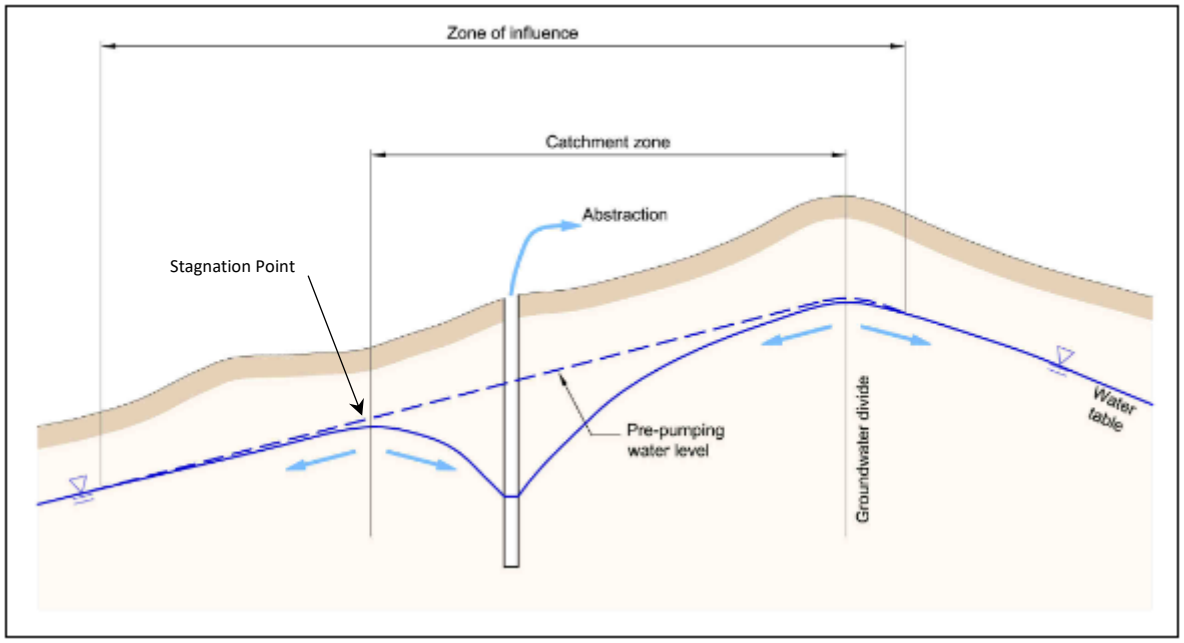


Figure 4.2 Zone of Influence, catchment zone and stagnation point.

The calculations use a maximum daily pumping period of 17 hours, this being equivalent to the maximum daily abstraction volume of 60m^3/d with the current pump set up. As such there is a minimum of 7 hours recovery period per day and full daily recovery is expected as observed during the pumping test.

A firm hydraulic gradient has not been established but this is conservatively estimated to be 0.005 based on experience of similar catchments. The assessment also assumes a hydraulic conductivity of approximately

[9] EA, 2007. Hydrogeological impact appraisal for groundwater abstractions. Science Report – SC040020/SR2

7m/d based on a transmissivity of 110m^2/d and an effective aquifer thickness of 15m. The thickness assumes that half of the saturated thickness of the borehole is productive. A porosity of 0.05 is also assumed this is considered to be reasonable based on the transmissivity observed.

The calculations predict that at a distance of 160m (this being the closest point of the Sor Brook to the borehole) drawdown is predicted to be significantly less than 0.001m. Furthermore, the stagnation point, this being the point at which downgradient flow is back towards the borehole, is predicted to be approximately 15m. Calculations are reproduced in Appendix 5.

As such there is predicted to be no direct impact of the abstraction on the Sor Brook as a result of drawdown and drainage.

4.8 Mitigation of Drawdown Impacts

None required.

4.9 Significance of the Drawdown Impacts

Not significant.

4.10 Maximum Drawdown Impacts

The maximum drawdown at the borehole is predicted to be of the order of 0.4m. At the nearest water feature identified, based on the abstraction regime and the proposed daily abstraction volumes, the maximum drawdown is predicted to be significantly less than 0.001m.

As such there is predicted to be no adverse impact due to the proposed abstraction.

4.11 Water Quality Impacts

No water quality impacts predicted.

4.12 Conclusions

The pumping test and calculations presented in this report are such that no adverse impact to the Sor Brook, River Wye or any other water features is predicted.

It is concluded that licensing of the abstraction at a maximum daily rate of 65m^3/d with an average annual abstraction of 18263 m^3 based on 50m^3/d would not result in any adverse environmental impacts.

Appendices

Appendix 1 – WRA and WRD Forms

FORM WRA: Applicant details and proposal outline

Water Resources Act 1991 (as amended by the Water Act 2003), Environment Act 1995, The Water Resources (Abstraction and Impounding) Regulations 2006, The Natural Resources Body for Wales (Functions) Order 2012

Cyfoeth Naturiol Cymru
Natural Resources Wales

1. Application type and fee

For the application types listed, complete this form and/or the relevant additional forms named below. Please tick which forms have been included with your application. Forms should be completed with reference to Guidance Note WRX.

* Pre-application enquiry (non-hydropower)	☐ Only complete this form
* Pre-application enquiry (hydropower)	☐ Also complete form WRB
* Application for a Groundwater Investigation Consent	☐ Only complete form WRC
New full abstraction licence	☒ Also complete form WRD
New temporary abstraction licence	☐ Also complete form WRD
New licence to transfer water	☐ Also complete form WRD
New impoundment licence	☐ Also complete form WRE
Renewal of a time-limited licence	☐ Also complete form WRD
Removal of an existing impoundment	☐ Also complete form WRE
Technical variation of an abstraction licence	☐ Also complete form WRD
Technical variation of an impoundment licence	☐ Also complete form WRE
* Administrative variations to existing licences	☐ Only complete form WRF
* No fee required	

Please indicate how you wish to pay your application fee and provide a reference number where relevant.

Cheque ☐ BACS ☒ Credit or debit card ☒ Your reference number: 1166_CPF

2. Applicant details

This is who the licence would be issued to and must be a legal entity such as an individual, registered company, charity or public body. If you are an agent acting on behalf of an applicant, provide their details here and yours in Section 3. See Guidance Note WRX for clarification of the details required and signatories permissible for organisations.

Applicant type:

Individual	☐	Limited company	☒	Charity	☐	Corporate body	☐
Partnership	☐	Sole trader	☐	Club	☐	Other	☐

If other, please specify:

Title: Mr

Full Name: Charles Dowds

Company, Charity or Trading Name: Cwrt Perrott Farm Ltd

Company or Charity Registration Number: 08907005

Registered Address:
Cwrt Perrott Farm Ltd
Cwrt Perrott Farm
Llandegveth
Newport
Postcode: NP18 1HX

Telephone Number:
Office: 07970 800 002
Mobile: 07970 800 002

Email Address	cwrtperrott@outlook.com

We will contact you by email unless you tick here ☐

Please specify who we should contact with regard to your site operation.

Site operations contact	Applicant ☒	Agent ☐

For applications for abstraction licences, please also specify who we should contact for invoices and abstraction records (returns).

Invoice address*	Applicant ☒	Agent ☐
Abstraction records contact*	Applicant ☒	Agent ☐

* Not required for temporary or transfer licences.

Enter the agent's details in Section 3, or provide details of alternative or additional contacts on a separate sheet and tick here to show that you have done so. ☒

3. Details of agent or individual authorised to act as application contact

This is who we will correspond with unless otherwise informed. If an agent has signed on behalf of an applicant, please include a letter of authorisation from the applicant allowing the agent to act as signatory.

Title	Mr	Full Name	Julian Hatherall
Company, Charity or Trading Name	JH Groundwater		
Position in Company	Director / Principal Hydrogeologist		
Registered Address	23 Westbury Park Redland Bristol Postcode: BS6 6LT		N.B. Correspondence Address: 41 Rownham Mead Bristol BS8 4YB
Telephone Number	Office: 07765 255 197 Mobile: 07765 255 197		
Email Address	julian@jhgroundwater.co.uk		

4. Entitlement to apply (only required for abstraction licence applications)

Does the applicant have a legal right of access to the point of abstraction?

Has a right of access	☐	Has an expected right of access	☐
Owner/occupier of land	☒	Date these access rights are expected	

For formal abstraction licence applications where you are the landowner/occupier, provide a map with the land boundary and all abstraction and discharge point(s) marked. Please tick here to show that you have done this. ☒

For expected rights of access, please also provide the additional evidence as outlined in Guidance Note WRX. Please tick here to show that you have done this. ☐

5. Application reference number

Have you undertaken a pre-application enquiry or had any previous discussions with us?

No ☐ Yes ☒ Provide reference number or staff member's name

Application number PAN-005699, PPN-00351. Alex Cowell

6. Remediation work

Is this proposal as a result of a Restoring Sustainable Abstraction programme or other work requested by us?

No ☒ Yes ☐ If yes, provide your licence number

7. Source of supply

7.1 State where you intend to abstract from

Surface Water ☐ Groundwater ☒

Give Groundwater Investigation Consent number if applicable

PPN-00351

7.2 Provide a 12 digit National Grid Reference for the proposed or existing abstraction or impoundment point (e.g. ST 19057 76826)

ST | 33836 | 95823

7.3 Source of supply or location of proposed impoundment

Groundwater – abstraction borehole

7.4 Site name / reference

Cwrt Perrott Farm

8. Proposal summary

Please provide an outline of your proposal as described in Guidance Note WRX, including any sketches. If you are submitting a pre-application enquiry, this must include the quantities of water you propose to abstract. If necessary continue on a separate sheet and tick here to show that you have done this. ☐

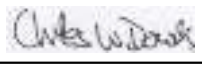
The proposal is for an agricultural abstraction for livestock watering and process water for a dairy unit.

Water is distributed to a series of 3 reservoirs across the landholding (approx. 136m^3 total capacity) from where water is fed by a combination of pumps and gravity to feeding troughs, yard and the milking parlour.

9. Declaration

Please see Guidance Note WRX for details of who can sign this section and note the information in that document relating to the Data Protection Act 1998.

By signing below, you are declaring that as far as you know and believe the information given in this form, on any map and in any supporting or additional information, is true.

Signed	
Print name	Charles Dowds
Position	Director
Date	30/9/19

Application Checklist

Please tick the following checklist items to indicate that you have included the required information. If any sections of the form are left blank and no supporting information submitted, where we have insufficient information to make a decision on your application, we will return your application to you.

Essential:

Letter of authorisation from the applicant, allowing the agent to act as signatory ☐
Map showing the land ownership boundary with all abstraction and discharge point(s) clearly marked ☒

Where relevant:

Evidence of negotiations of expected access rights, if applicable ☐
For groundwater abstractions, results of pump test (if not previously submitted) ☒

For Natural Resources Wales' use only:

Date received _____

Reference Number _____

Payment received Yes ☐ Amount received _____
No ☐ Not required ☐

FORM WRD: Application for a new abstraction licence or a technical variation to an abstraction licence

Water Resources Act 1991, Environment Act 1995, The Water Resources (Abstraction and Impoundment) Regulations 2006, The Natural Resources Body for Wales (Functions) Order 2012

Cyfoeth Naturiol Cymru Natural Resources Wales

1. Application type

New full abstraction licence	☒	Give existing licence serial number and/ pre-application reference number
New temporary abstraction licence	☐	
New licence to transfer water	☐	Application number PAN-005699. Alex Cowell
Renewal of a time-limited abstraction licence	☐	
Technical variation to an abstraction licence	☐	

For hydropower abstractions, specify the capacity (in kilowatts) of your scheme.
25kW or less ☐ >25 to 50kW ☐ >50 to 100kW ☐ >100kW ☐

2. Linked licences

2.1 Does your proposal involve water rights trading?
No ☒ Yes ☐ If yes, provide licence serial number(s)

2.2 Is the licence (to be) aggregated with any other licences?
No ☒ Yes ☐ If yes, provide licence serial number(s)

3. Abstraction details

Provide details of all points of abstraction**.** Details of abstraction location(s) should correspond with any maps submitted.
If necessary, continue on a separate sheet and tick here to show that you have done this ☒

Abstraction location name / reference	Type (single point / reach)	National Grid Reference (12 digit)	If a reach, downstream National Grid Reference (12 digit)
Cwrt Perrott BH	Single Point	ST33836 95823	

4. Means of abstraction

Detail the structure and equipment involved in the abstraction process. If this information is detailed in a supporting document, provide the document reference. For groundwater abstractions, include borehole depth and diameter and provide details of screening and lining.
If necessary, continue on a separate sheet and tick here to show that you have done this. ☐

Borehole depth 53mbgl based on borehole plumbed depth. Casing details 100mm (screen and casing) 150mm (shallow casing). Shallow casing to at least 5mbgl. Screened section estimated approx. >6mbgl to 53mbgl. Grundfos SP 3A-25 Pump.

5. Abstraction quantities

Provide details of the abstraction quantities and periods proposed, including any deregulated abstractions (< 20 cubic metres per day) you currently have. Details of abstraction locations should correspond with any maps submitted.

Abstraction location name / reference	Purpose which water will be used for	Abstraction period (state 'all year' or give months)	Maximum annual abstraction volume (cubic metres)	Maximum daily abstraction volume (cubic metres)	Maximum hourly abstraction volume (cubic metres)	Number of hours of abstraction per day	Peak abstraction rate (litres per second)
Cwrt Perrott Farm	Livestock Watering, General Agriculture	All Year	18263	65	3.6	Up to 18.5	1
		Total	18263	65	3.6		

6. Calculations and supporting information

Please provide further details of your intended use of water, including calculations in support of the quantities you have requested, your operational regime and any management agreements. See Guidance Note WRX for details of what is required. If your proposal involves the provision of a residual flow via a notch or orifice, provide information on how this has been calculated.
If necessary, continue on a separate sheet and tick here to show that you have done this. ☒

See attached summary.

7. Industry-specific requirements

Complete the relevant table in line with the purpose of your proposal to demonstrate a justification of need for the quantities proposed. For uses not covered here or to provide further details, please use a separate sheet and tick here to show that you have done this ☒

7.1 For agricultural use:

Crop type	Soil type (for multiple soil types, indicate approximate split)	Maximum area of crop to be irrigated annually (hectares)	Maximum annual depth of irrigation to be applied (millimetres)

Livestock type	Number of animals	Maximum daily quantity of water used (cubic metres)	Comments
See attached for details	*See attached for details*	*See attached for details*	*See attached for details*
Provide details of any additional requirements (washing / cleaning)		*See attached for details*	*See attached for details*

7.2 For golf course irrigation:

Feature	Maximum area to be irrigated daily (hectares)	Maximum depth of water to be applied daily (millimetres)
e.g. Greens	*0.9*	*220*
Tees		
Greens		
Fairways		
Others		

7.3 For industrial use:

Industry sector or process type	Water use per unit produced (state units)	Maximum units produced per year
e.g. Ice cream	*1.9 cubic metres per tonne of ice cream*	*10,000 tonnes*

7.4 For hydropower:

If you have submitted this information as part of your pre-application enquiry and no changes have been made to your proposal in the meantime, you are not required to provide these details again.

% abstraction and zone applied for (see HGN2)	Average gradient of depleted reach (%)	Catchment size above abstraction point (kilometres square d)	Net head between abstraction and discharge points (metres)

Turbine efficiency (%)	System efficiency (%)	Maximum power output (kilowatts)	Annual capacity (kilowatt hours)

State the length of depleted reach (in metres)

Provide the flow data (in cubic metres per second) & ratios specified below:	
Q95	
Q10	
Qmean	
What is the ratio of Q95:Qmean?	
What is the ratio of Q10:Qmean?	

Please send us a copy of the full flow duration curve for the site and confirm the method used to derive this. If you have used modelling software such as LowFlows, please provide us with a copy of the output (graph, data and catchment map) including the Long Term Average rainfall.

What low flow protection* do you propose to maintain in the depleted reach when the hydropower scheme is operating (in m^3/s)?

* Low flow protection is the flow rate above which abstraction can begin and is separate to the abstraction % take, see HGN2 for details.

8. Means of measurement

State how you intend to measure abstracted quantities at each abstraction point.

Meter ☒ Power Generated ☐ Other ☐

If other, please specify

9. Water efficiency

Describe all steps you have taken or intend to introduce to ensure efficient use of water, such as water storage, re-use or conservation provision. If necessary, continue on a separate sheet and tick here to show that you have done this. ☐

Water is stored in a series of reservoirs which are only refilled on demand through the use of float switches. Water used for washing is spread back to the catchment through land spreading in line with good agricultural practice. A proportion of groundwater consumed by livestock watering is also returned to the catchment through natural means.

10. Fish and eel considerations (surface water abstractions only)

10.1 Confirm the fish species present at your site. If you are submitting a survey or report with your application, please tick here to show that you have done this. ☐

10.2 Does your proposal include measures to safeguard fish and eels? Only provide details of outfall screening if abstracted water is to be discharged back into a watercourse.

	Intake	Outfall
Type of fish screen		
Screen aperture size (mm)		

11. Discharge details

11.1 If you intend to return any of the abstracted water to the environment, provide details below. Details of discharge location(s) should correspond with any maps submitted.

Discharge location name / reference	National Grid Reference of discharge point (12 digit)	Total volume to be discharged (cubic metres)	Environmental Permit for Water Discharge Activity number (if applicable)

11.2 Provide a description of the structure and equipment involved in discharge.

12. Other abstractors / water users

Provide details of nearby abstractors or users of water who could be affected by your proposal. This should include deregulated users (exempt activities or abstractions < 20 cubic metres per day), anglers and canoeists.

This has been addressed in the accompanying HIA and reference should be made to this.

13. Planning application

Have you sought advice on your planning application?

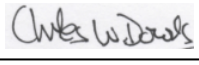
No ☒ Yes ☐

If yes, submit a copy of the Planning Authority's response.

14. Declaration

Please see Guidance Note WRX for details of who can sign this section and note the information in that document relating to the Data Protection Act 1998.

By signing below, you are declaring that as far as you know and believe the information given in this form, on any map and in any supporting or additional information, is true.

Signed	
Print name	Charles Dowds
Position	Director
Date	30/9/19

Application Checklist

Please tick the following checklist items to indicate that you have included the required information. If any sections of the form are left blank and no supporting information submitted, where we have insufficient information to make a decision on your application, we will return your application to you.

Essential:

Form WRA completed ☒

Map showing applicant's land boundary with all abstraction and discharge point(s) clearly marked ☒

Evidence of negotiations of expected access rights, if applicable ☐

State number of continuation sheets (enter 0 if none included) [ ]

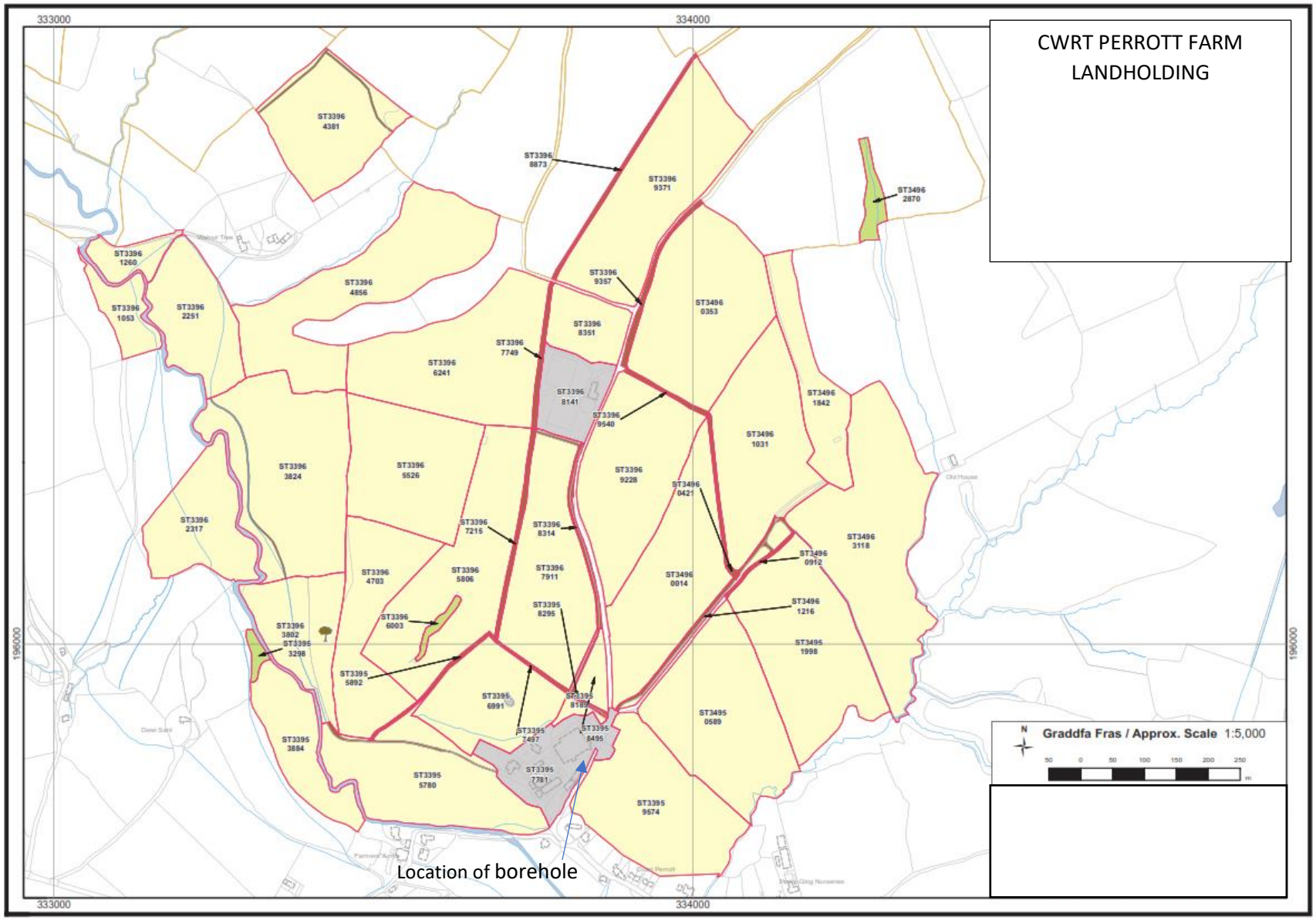
Where relevant:

Letter of authorisation from the applicant, allowing the agent to act as signatory ☐

Form WRE completed, if your proposal also requires an impoundment licence ☐

Further information requested in our pre-application response letter to you ☐
For hydropower applications, full flow duration curve for the site, confirmation of the method used to derive this and a copy of the output (graph, data and catchment map) including the Long Term Average rainfall, where available ☐
Planning Authority response, where available ☐
Additional supporting information - please list below:

- Pumping test and HIA report
- Livestock usage figures


CWRT PERROTT FARM
LANDHOLDING
333000
334000
196000
ST3396 4381
ST3396 8873
ST3396 9371
ST3496 2870
ST3396 1260
ST3396 1053
ST3396 2251
ST3396 4856
ST3396 9357
ST3496 0353
ST3396 8351
ST3396 7749
ST3396 6241
ST3396 8141
ST3396 9540
ST3496 1842
ST3496 1031
ST3396 3824
ST3396 5526
ST3396 9228
ST3496 0421
ST3396 2317
ST3396 7215
ST3396 8314
ST3496 3118
ST3496 0912
ST3396 4703
ST3396 5806
ST3396 7911
ST3496 0014
ST3396 8295
ST3496 1216
ST3396 6003
ST3396 3802
ST3395 3298
ST3495 1998
ST3395 5892
ST3395 6991
ST3395 8189
ST3495 0589
ST3395 7497
ST3395 8495
ST3395 3884
ST3395 7781
ST3395 5780
ST3395 9574
Graddfa Fras / Approx. Scale 1:5,000
50 0 50 100 150 200 250 m
Location of borehole

Figures have been included for livestock drinking and parlour washing operations estimated for livestock numbers for 2011 to 217. The figures have been rounded up to 50m^3/d to allow for birth rate variation. A maximum of 65m^3/d is also stated to allow for daily variation.

The figures presented below are based on a livestock needs basis and are estimated based on average intake volumes for given livestock age in line with industry guidance. The volume of parlour washing is also based on industry standards.

Year	Abstraction location name or reference (as labelled on map)	Purpose(s) water used for	Period of abstraction		
			All year, or months, or days (provide specific dates)	Year (cubic metres)	Day (cubic metres)
01 January 2011 to 31 December 2011	Borehole	Livestock drinking water	All year	8501	32.6
	Borehole	Parlour washings	All year	1108.8	3.08
01 January 2012 to 31 December 2012	Borehole	Livestock drinking water	All year	13071	36
	Borehole	Parlour washings	All year	2102.4	5.8
01 January 2013 to 31 December 2013	Borehole	Livestock drinking water	All year	13791	38
	Borehole	Parlour washings	All year	2066	5.7
01 January 2014 to 31 December 2014	Borehole	Livestock drinking water	All year	14384	40
	Borehole	Parlour washings	All year	2138.4	6
01 January 2015 to 31 December 2015	Borehole	Livestcok drinking water	All year	14042	39
	Borehole	Parlour washing	All year	2016	5.6
01 January 2016 to 31 December 2016	Borehole	Livestcok drinking water	All year	14421	40
	Borehole	Parlour washings	All year	2203	6.1
01 January 2017 to 31 December 2017	Borehole	Livestcok drinking water	All year	14263	39.6
	Borehole	Parlour washings	All year	2196	6.1

Appendix 2 – Enviro Insight Report

Enviro Insight

Address:	**CWRT PERROTT FARM, PENYGLOG ROAD, LLANDEGVETH, NP18 1HX**
Date:	**29 Jul 2019**
Reference:	**GS-6205221**
Client:	**JH Groundwater**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	25-May-2017
Grid Reference:	333831,195809
Site Size:	0.0124ha

Report Reference: GS-6205221
Client Reference: 1166

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Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Historical Industrial Sites	On-site	0-50	51-250	251-500
1.1 Potentially Contaminative Uses identified from 1:10,000 scale mapping	0	0	8	0
1.2 Additional Information – Historical Tank Database	0	0	0	0
1.3 Additional Information – Historical Energy Features Database	0	0	0	0
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	0
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	0	0	0	0
1.6 Historical military sites	0	0	0	0
1.7 Potentially Infilled Land	0	0	6	0

Section 2: Environmental Permits, Incidents and Registers	On-site	0-50m	51-250	251-500
2.1 Industrial Sites Holding Environmental Permits and/or Authorisations				
2.1.1 Records of historic IPC Authorisations	0	0	0	0
2.1.2 Records of Part A(1) and IPPC Authorised Activities	0	0	0	0
2.1.3 Records of Red List Discharge Consents	0	0	0	0
2.1.4 Records of List 1 Dangerous Substances Inventory sites	0	0	0	0
2.1.5 Records of List 2 Dangerous Substances Inventory sites	0	0	0	0
2.1.6 Records of Part A(2) and Part B Activities and Enforcements	0	0	0	0
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0
2.1.8 Records of Licensed Discharge Consents	0	0	5	2
2.1.9 Records of Water Industry Referrals	0	0	0	0
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site	0	0	0	0
2.2 Records of COMAH and NIHHS sites	0	0	0	0
2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	0	1	0
2.3.2 National Incidents Recording System, List 1	0	0	0	0
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990	0	0	0	0

Section 3: Landfill and Other Waste Sites	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency/Natural Resources Wales Registered Landfill Sites	0	0	0	0	0	Not searched
3.1.2 Environment Agency/Natural Resources Wales Historic Landfill Sites	0	0	0	0	1	0
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	0	0
3.1.4 Records of Landfills in Local Authority and Historical Mapping Records	0	0	0	0	0	0
3.2 Landfill and Other Waste Sites Findings						
3.2.1 Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	Not searched	Not searched
3.2.2 Environment Agency/Natural Resources Wales Licensed Waste Sites	0	0	0	0	0	0

Section 4: Current Land Use	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	0	0	0	Not searched
4.2 Records of Petrol and Fuel Sites	0	0	0	0
4.3 National Grid Underground Electricity Cables	0	0	0	0
4.4 National Grid Gas Transmission Pipelines	0	0	0	0

Section 5: Geology	
5.1 Records of Artificial Ground and Made Ground present beneath the study site	None identified
5.2 Records of Superficial Ground and Drift Geology present beneath the study site	None identified
5.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 6: Hydrogeology and Hydrology	0-500m
6.1 Records of Strata Classification in the Superficial Geology within 500m of the study site	Identified
6.2 Records of Strata Classification in the Bedrock Geology within 500m of the study site	Identified

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
6.3 Groundwater Abstraction Licences (within 2000m of the study site)	0	0	0	0	1	0
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
6.6 Source Protection Zones (within 500m of the study site)	0	0	0	0	Not searched	Not searched
6.7 Source Protection Zones within Confined Aquifer	0	0	0	0	Not searched	Not searched
6.8 Groundwater Vulnerability and Soil Leaching Potential (within 500m of the study site)	0	0	1	0	Not searched	Not searched

Section 6: Hydrogeology and Hydrology

	0-500m					
	On-site	0-50m	51-250	251-500	501-1000	1000-1500
6.9 Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site	No	No	No	No	No	No
6.10 Ordnance Survey MasterMap Water Network entries within 500m of the site	0	0	8	42	Not searched	Not searched
6.11 Surface water features within 250m of the study site	No	No	Yes	Not searched	Not searched	Not searched

Section 7: Flooding

7.1 Enviroment Agency Zone 2 floodplains within 250m of the study site	Identified
7.2 Environment Agency/Natural Resources Wales Zone 3 floodplains within 250m of the study site	Identified
7.3 Risk of flooding from Rivers and the Sea (RoFRaS) rating for the study site	Very Low
7.4 Flood Defences within 250m of the study site	None identified
7.5 Areas benefiting from Flood Defences within 250m of the study site	None identified
7.6 Areas used for Flood Storage within 250m of the study site	None identified
7.7 Maximum BGS Groundwater Flooding susceptibility within 50m of the study site	Not Prone
7.8 BGS confidence rating for the Groundwater Flooding susceptibility areas	Not Applicable

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	1
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	0	3	13	65
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	0	0
8.8 Records of World Heritage Sites	0	0	0	0	0	0
8.9 Records of Environmentally Sensitive Areas	0	0	0	0	0	0

Section 8: Designated Environmentally Sensitive Sites	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
8.11 Records of National Parks	0	0	0	0	0	0
8.12 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
8.13 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0
8.14 Records of Green Belt land	0	0	0	0	0	0

Section 9: Natural Hazards

9.1 Maximum risk of natural ground subsidence	Very Low
9.1.1 Maximum Shrink-Swell hazard rating identified on the study site	Negligible
9.1.2 Maximum Landslides hazard rating identified on the study site	Very Low
9.1.3 Maximum Soluble Rocks hazard rating identified on the study site	Negligible
9.1.4 Maximum Compressible Ground hazard rating identified on the study site	Negligible
9.1.5 Maximum Collapsible Rocks hazard rating identified on the study site	Very Low
9.1.6 Maximum Running Sand hazard rating identified on the study site	Negligible
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The site is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level.
9.2.2 Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary.

Section 10: Mining

10.1 Coal mining areas within 75m of the study site	None identified
10.2 Non-Coal Mining areas within 50m of the study site boundary	Identified
10.3 Brine affected areas within 75m of the study site	None identified

Using this report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between Groundsure and the Client. The document contains the following sections:

1. Historical Industrial Sites

Provides information on past land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. Potentially Infilled Land features are also included. This search is conducted using radii of up to 500m.

2. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

3. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

4. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure gas pipelines and underground electricity transmission lines.

5. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

6. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licences, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

7. Flooding

Provides information on river and coastal flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

8. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites and Scheduled Ancient Woodland. These searches are conducted using radii of up to 2000m.

9. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence and radon..

10. Mining

Provides information on areas of coal and non-coal mining and brine affected areas.

11. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, Groundsure provide a free Technical Helpline (08444 159000) for further information and guidance.

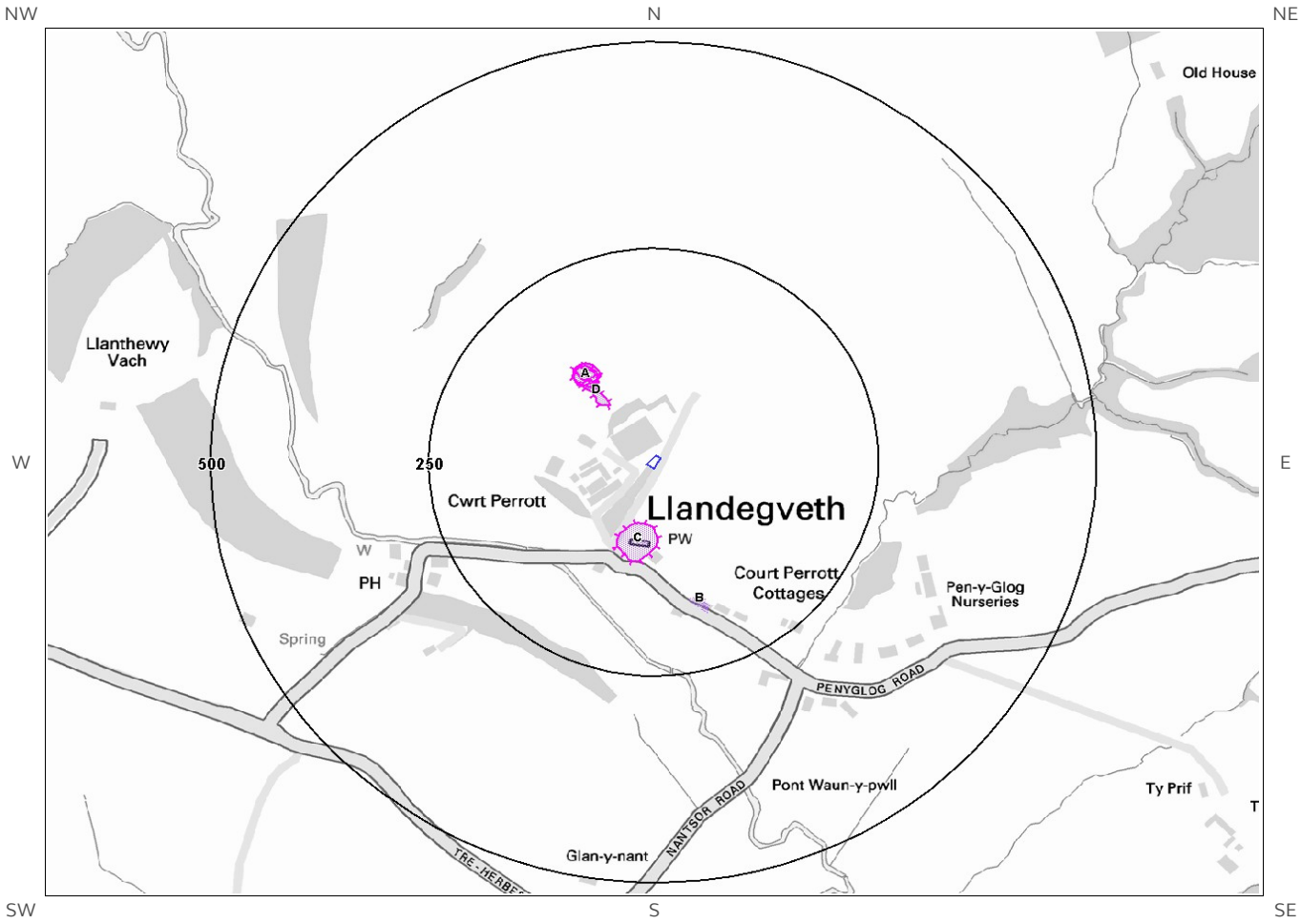
Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier “A” on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as “Not Shown”.

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Historical Land Use



Site Outline

250
500
Search Buffers (m)

Historical 1:10,000 and 1:10,560 scale mapping

Industrial Land Use

Potentially Infilled Land

Historical 1:2,500, 1:1,250 and 1:500 scale mapping

Energy Features

Petrol Stations

Historical military sites

Tanks

Garages

1. Historical Industrial Sites

1.1 Potentially Contaminative Uses identified from 1:10,000 scale Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information:

Records of sites with a potentially contaminative past land use within 500m of the search boundary: 8

ID	Distance [m]	Direction	Use	Date
1C	67	S	Grave Yard	1881
2D	79	NW	Unspecified Quarry	1881
3A	111	NW	Unspecified Old Quarry	1902
4A	111	NW	Unspecified Pit	1922
5A	112	NW	Unspecified Pit	1881
6A	114	NW	Unspecified Pit	1964
7B	159	S	Smithy	1881
8B	163	S	Smithy	1902

1.2 Additional Information – Historical Tank Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical tanks within 500m of the search boundary: 0

Database searched and no data found.

1.3 Additional Information – Historical Energy Features Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical energy features within 500m of the search boundary: 0

Database searched and no data found.

1.4 Additional Information – Historical Petrol and Fuel Site Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical petrol stations and fuel sites within 500m of the search boundary: 0

Database searched and no data found.

1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical garage and motor vehicle repair sites within 500m of the search boundary: 0

Database searched and no data found.

1.6 Historical military sites

Certain military installations were not noted on historic mapping for security reasons. Whilst not all military land is necessarily of concern, Groundsure has researched and digitised a number of Ordnance Factories and other military industrial features (e.g. Ordnance Depots, Munitions Testing Grounds) which may be of contaminative concern. This research was drawn from a number of different sources, and should not be regarded as a definitive or exhaustive database of potentially contaminative military installations. The boundaries of sites within this database have been estimated from the best evidence available to Groundsure at the time of compilation.

Records of historical military sites within 500m of the search boundary: 0

Database searched and no data found.

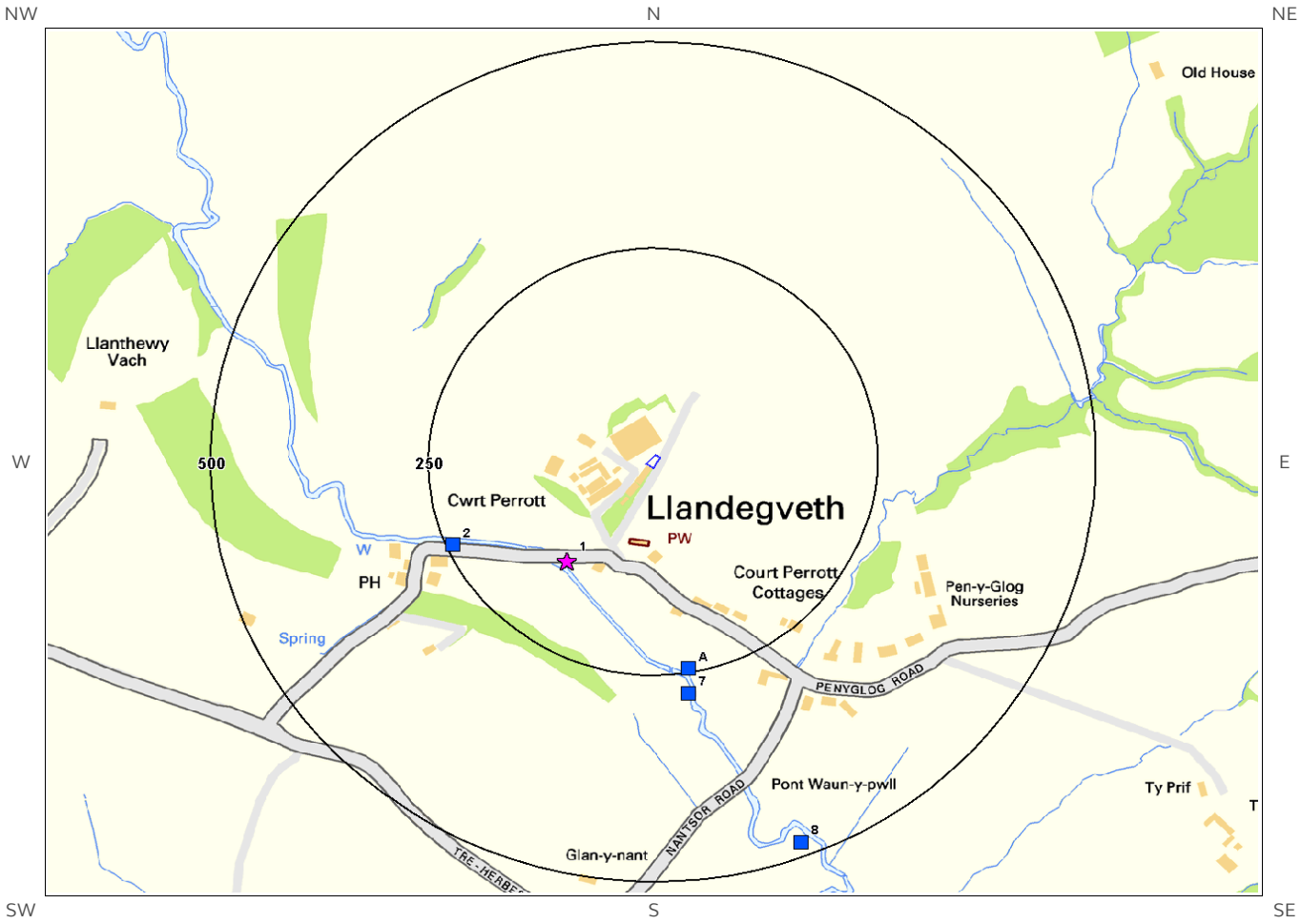
1.7 Potentially Infilled Land

Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 6

The following Historical Potentially Infilled Features derived from the Historical Mapping information is provided by Groundsure:

ID	Distance(m)	Direction	Use	Date
9C	67	S	Grave Yard	1881
10D	79	NW	Unspecified Quarry	1881
11A	111	NW	Unspecified Pit	1922
12A	111	NW	Unspecified Old Quarry	1902
13A	112	NW	Unspecified Pit	1881
14A	114	NW	Unspecified Pit	1964

2. Environmental Permits, Incidents and Registers Map



- Site Outline
- Search Buffers (m) 250 500
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

2. Environmental Permits, Incidents and Registers

2.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency/Natural Resources Wales and Local Authorities reveal the following information:

2.1.1 Records of historic IPC Authorisations within 500m of the study site:

0

Database searched and no data found.

2.1.2 Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:

0

Database searched and no data found.

2.1.3 Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site:

0

Database searched and no data found.

2.1.4 Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site:

0

Database searched and no data found.

2.1.5 Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site:

0

Database searched and no data found.

2.1.6 Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site:

0

Database searched and no data found.

2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

2.1.8 Records of Licensed Discharge Consents within 500m of the study site:

7

The following Licensed Discharge Consents records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
2	243	SW	333600 195710	Address: THE FARMERS ARMS LLANDEGVETH, THE FARMERS ARMS, LLANDEGVETH, NEWPORT, , NP6 1HX Effluent Type: SEWAGE & TRADE COMBINED - UNSPECIFIED Permit Number: AN0285901 Permit Version: 1	Receiving Water: SOR BROOK Status: Effective Issue date: 08/05/2001 Effective Date: 08-May-2001 Revocation Date: -
3A	245	S	333870 195560	Address: CWRT PERROTT SEWAGE TREATMENT WORKS, CHURCH ROAD, LLANDEGFEDD, NEWPORT, GWENT, NP18 1JA Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0011501 Permit Version: 4	Receiving Water: TO LAND Status: Effective Issue date: 11/12/2012 Effective Date: 11-Dec-2012 Revocation Date: -
4A	245	S	333870 195560	Address: CWRT PERROTT SEWAGE TREATMENT WORKS, CHURCH ROAD, LLANDEGFEDD, NEWPORT, GWENT, NP18 1JA Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0011501 Permit Version: 4	Receiving Water: TO LAND Status: VARIED UNDER EPR 2010 Issue date: 11/12/2012 Effective Date: 11-Dec-2012 Revocation Date: -
5A	245	S	333870 195560	Address: CWRT PERROTT SEWAGE TREATMENT WORKS, CHURCH ROAD, LLANDEGFEDD, NEWPORT, GWENT, NP18 1JA Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0011501 Permit Version: 3	Receiving Water: TO LAND Status: NEW CONSENT, BY APPLICATION (WRA 91, SECTION 88) Issue date: 29/04/1994 Effective Date: 29-Apr-1994 Revocation Date: 10/12/2012
6A	245	S	333870 195560	Address: CWRT PERROTT SEWAGE TREATMENT WORKS, CHURCH ROAD, LLANDEGFEDD, NEWPORT, GWENT, NP18	Receiving Water: TO LAND Status: NEW CONSENT, BY APPLICATION (WRA 91, SECTION 88)

ID	Distance (m)	Direction	NGR	Details	
				1JA Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0011501 Permit Version: 3	Issue date: 29/04/1994 Effective Date: 29-Apr-1994 Revocation Date: 10/12/2012
7	275	S	333870 195530	Address: CWRT PERROTT SEWAGE TREATMENT WORKS, CHURCH ROAD, LLANDEGFEDD, NEWPORT, GWENT, NP18 1JA Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0011501 Permit Version: 1	Receiving Water: TO LAND Status: REVOKED - UNSPECIFIED Issue date: 04/06/1971 Effective Date: 04-Jun-1971 Revocation Date: 02/03/1993
8	483	S	334000 195350	Address: LLANDEGFEDD (WAUNYPWLL) STW , , LLANDEGFEDD (WAUNYPWLL) STW , , , Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: AD0002601 Permit Version: 2	Receiving Water: SOR BROOK Status: Effective Issue date: 17/08/1993 Effective Date: 17-Aug-1993 Revocation Date: -

2.1.9 Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site:

0

Database searched and no data found.

2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site:

0

Database searched and no data found.

2.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: 0

Database searched and no data found.

2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

2.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:

1

The following NIRS List 2 records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
1	150	SW	333730.0 195690.0	Incident Date: 04-Sep-2003 Incident Identification: 187331.0 Pollutant: Agricultural Materials and Wastes Pollutant Description: Slurry and Dilute Slurry	Water Impact: Category 1 (Major) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)

2.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:

0

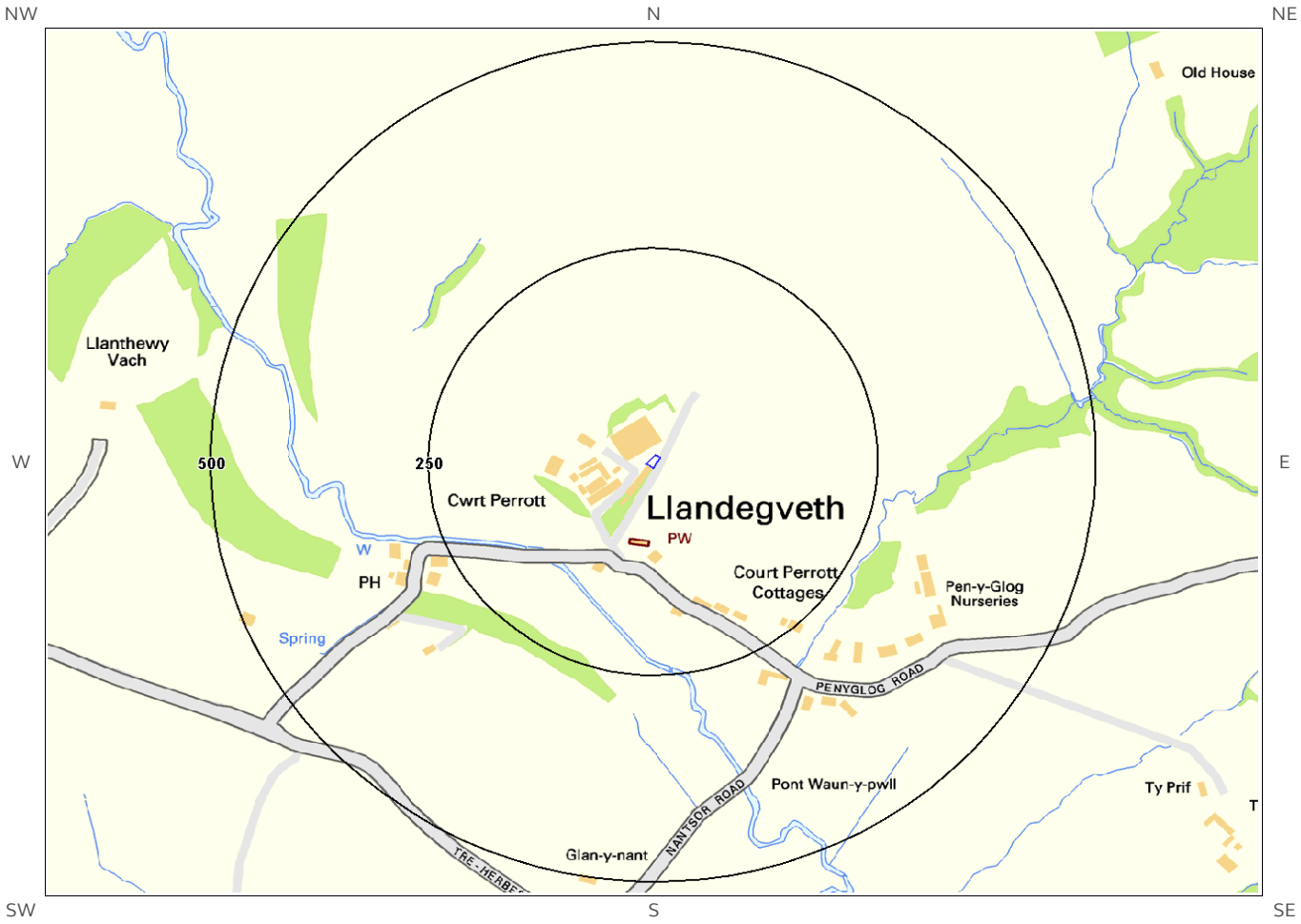
Database searched and no data found.

2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

Records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site 0

Database searched and no data found.

3. Landfill and Other Waste Sites Map



Site Outline

250
500
Search Buffers (m)

EA/NRW Active Landfill

EA/NRW Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

EA/NRW Licensed Waste Site

Local Authority/Historical Mapping Landfill Records

3. Landfill and Other Waste Sites

3.1 Landfill Sites

3.1.1 Records from Environment Agency/Natural Resources Wales landfill data within 1000m of the study site:

0

Database searched and no data found.

3.1.2 Records of Environment Agency/Natural Resources Wales historic landfill sites within 1500m of the study site:

1

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
Not shown	939	E		Site Address: Penyglog Waste Licence: - Site Reference: - Waste Type: Industrial, Household Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: - First Recorded: - Last Recorded: -

3.1.3 Records of BGS/DoE non-operational landfill sites within 1500m of the study site:

0

Database searched and no data found.

3.1.4 Records of Landfills from Local Authority and Historical Mapping Records within 1500m of the study site:

0

Database searched and no data found.

3.2 Other Waste Sites

3.2.1 Records of waste treatment, transfer or disposal sites within 500m of the study site:

0

Database searched and no data found.

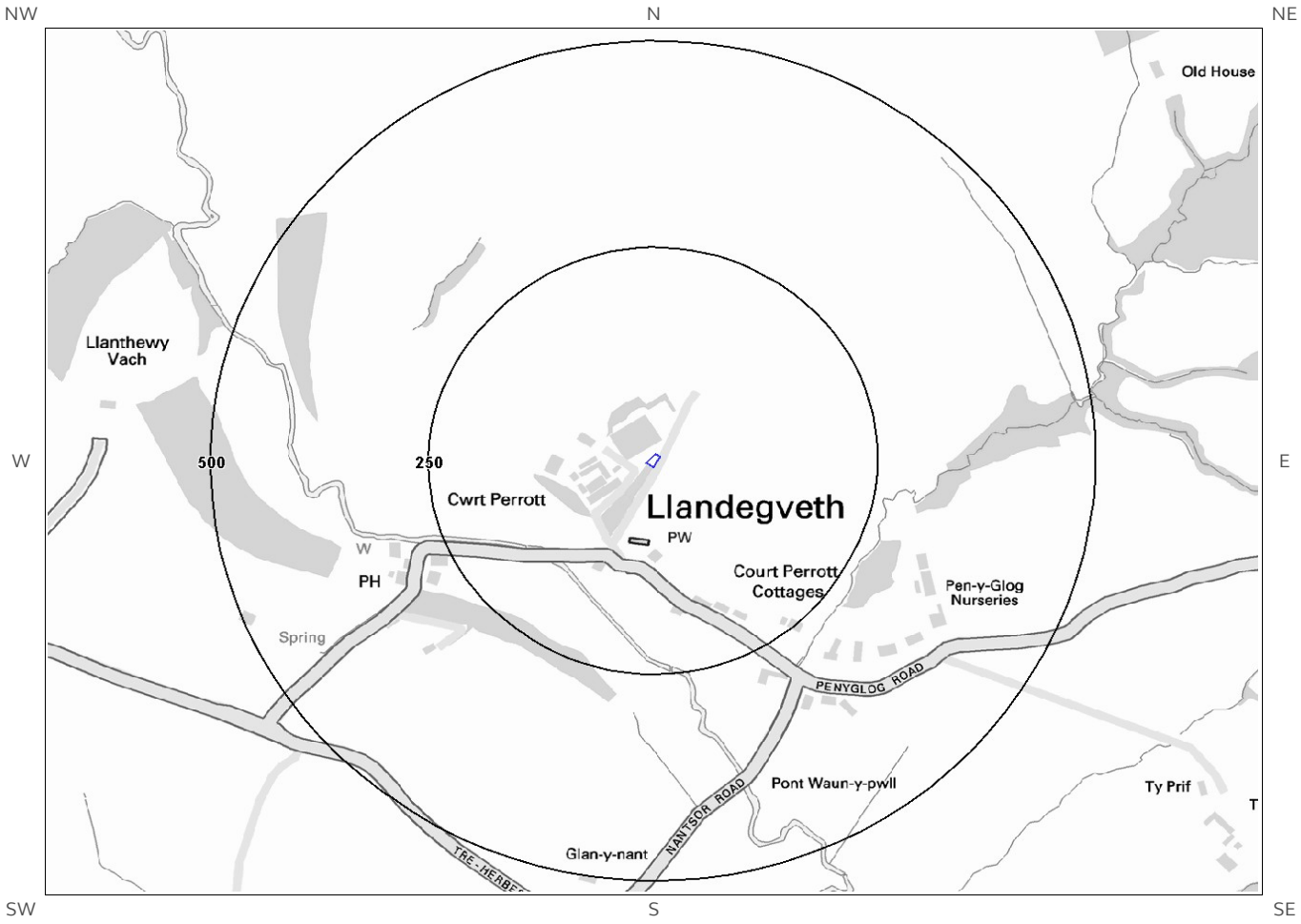
3.2.2 Records of Environment Agency/Natural Resources Wales licensed waste sites within 1500m of the study site:

0

Database searched and no data found.

---

4. Current Land Use Map



Site Outline

Search Buffers (m)
250
500

Current Industrial Sites

Petrol & Fuel Sites

Electricity Transmission Cables

Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 0

Database searched and no data found.

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 0

Database searched and no data found.

4.3 National Grid High Voltage Underground Electricity Transmission Cables

This dataset identifies the high voltage electricity transmission lines running between generating power plants and electricity substations. The dataset does not include the electricity distribution network (smaller, lower voltage cables distributing power from substations to the local user network). This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high voltage underground electricity transmission cables within 500m of the study site: 0

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

This dataset identifies high-pressure, large diameter pipelines which carry gas between gas terminals, power stations, compressors and storage facilities. The dataset does not include the Local Transmission System (LTS) which supplies gas directly into homes and businesses. This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high pressure gas transmission pipelines within 500m of the study site: 0

Database searched and no data found.

---

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

5.2 Superficial Ground and Drift Geology

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

5.3 Bedrock and Solid Geology

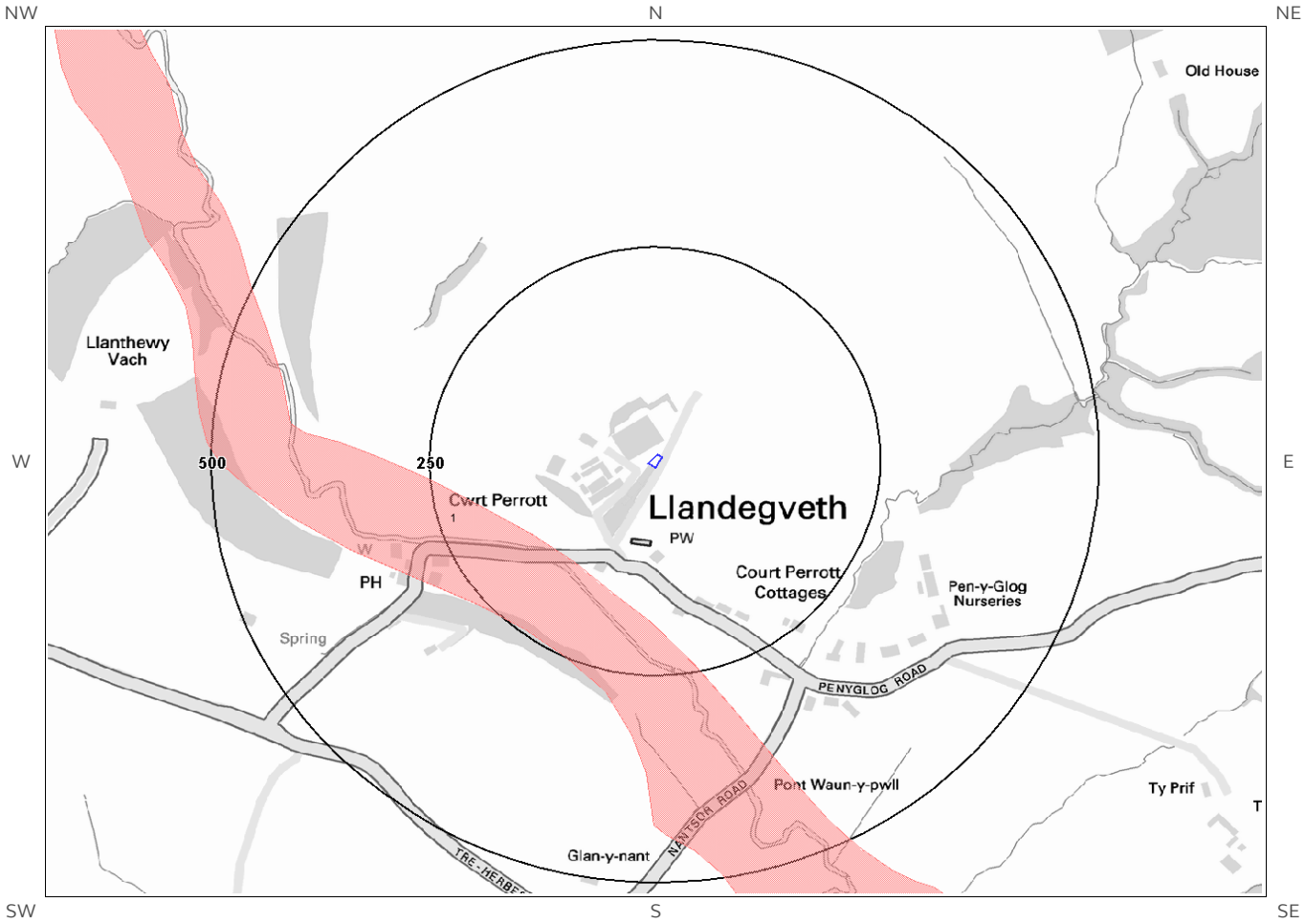
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
DCS-SDST	DOWNTON CASTLE SANDSTONE FORMATION	SANDSTONE

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

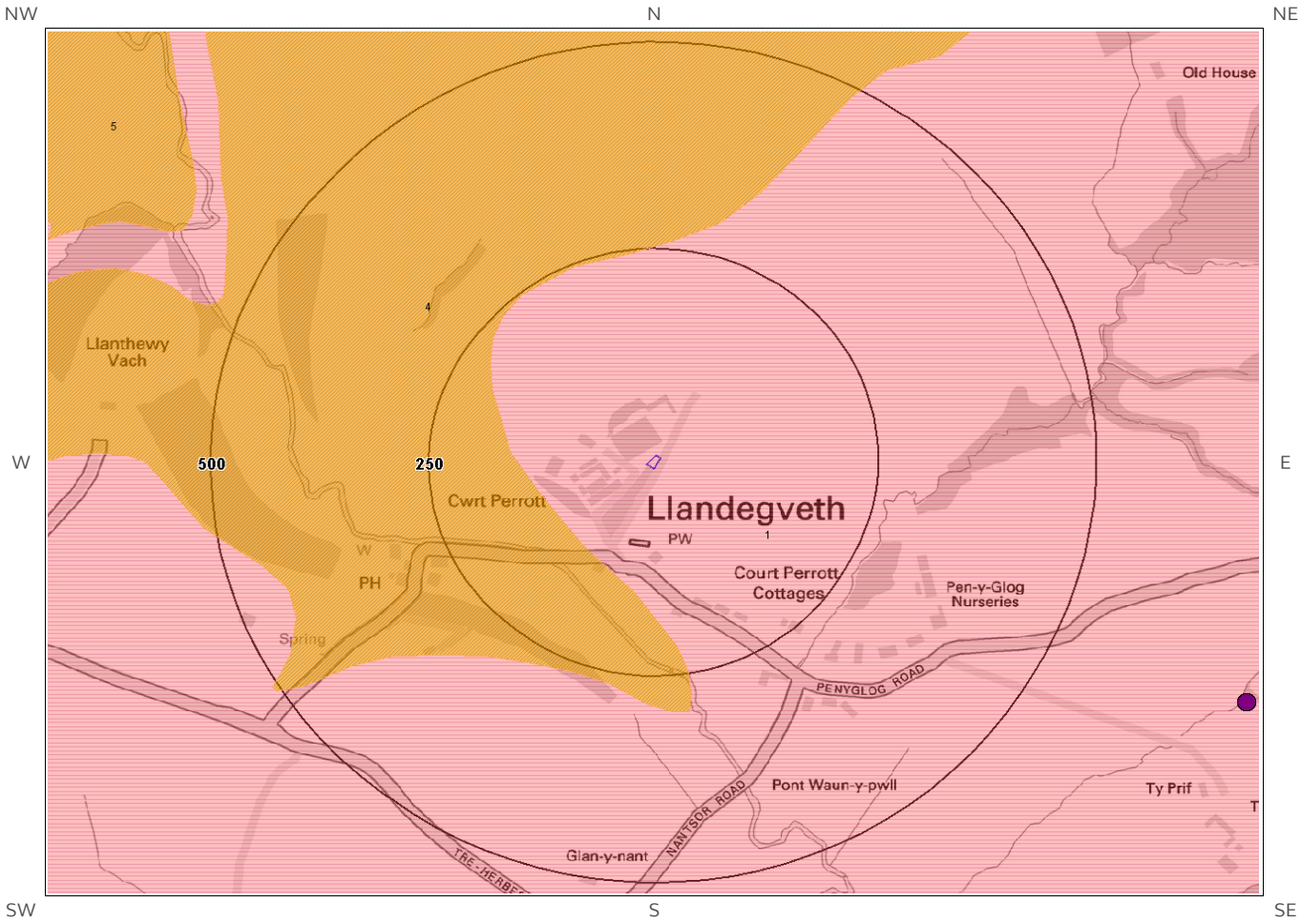
Secondary (B) Aquifer - Lower Permeability Layers

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licences



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

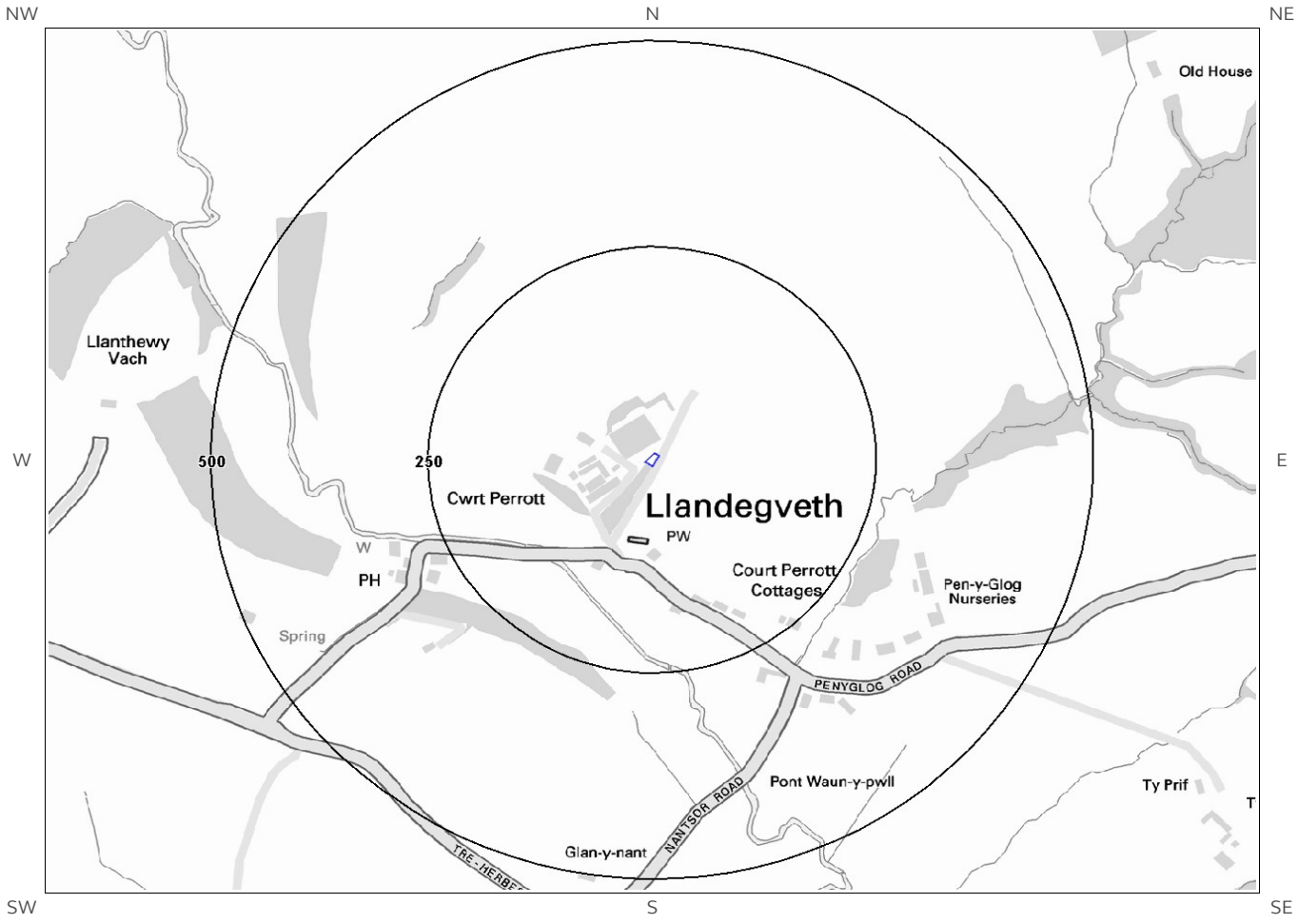
Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

Surface Water Abstraction Licence

6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licences



Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

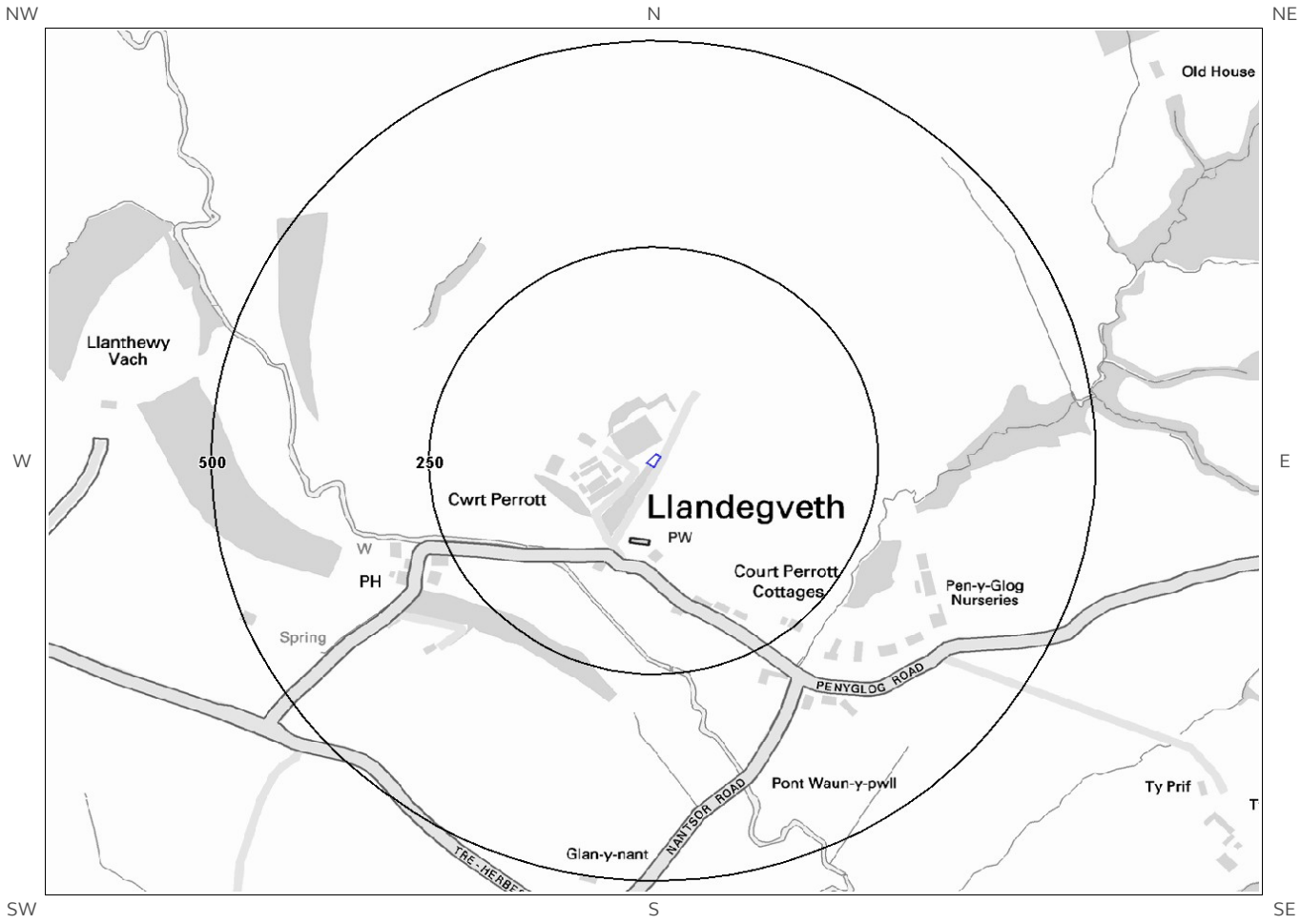
Source Protection Zone 2 - Outer Catchment

Source Protection Zone 3 - Total Catchment

Source Protection Zone 4 - Zone of Special Interest

Potable Water Abstraction Licence

6d. Hydrogeology – Source Protection Zones within confined aquifer



Site Outline

250
500
Search Buffers (m)

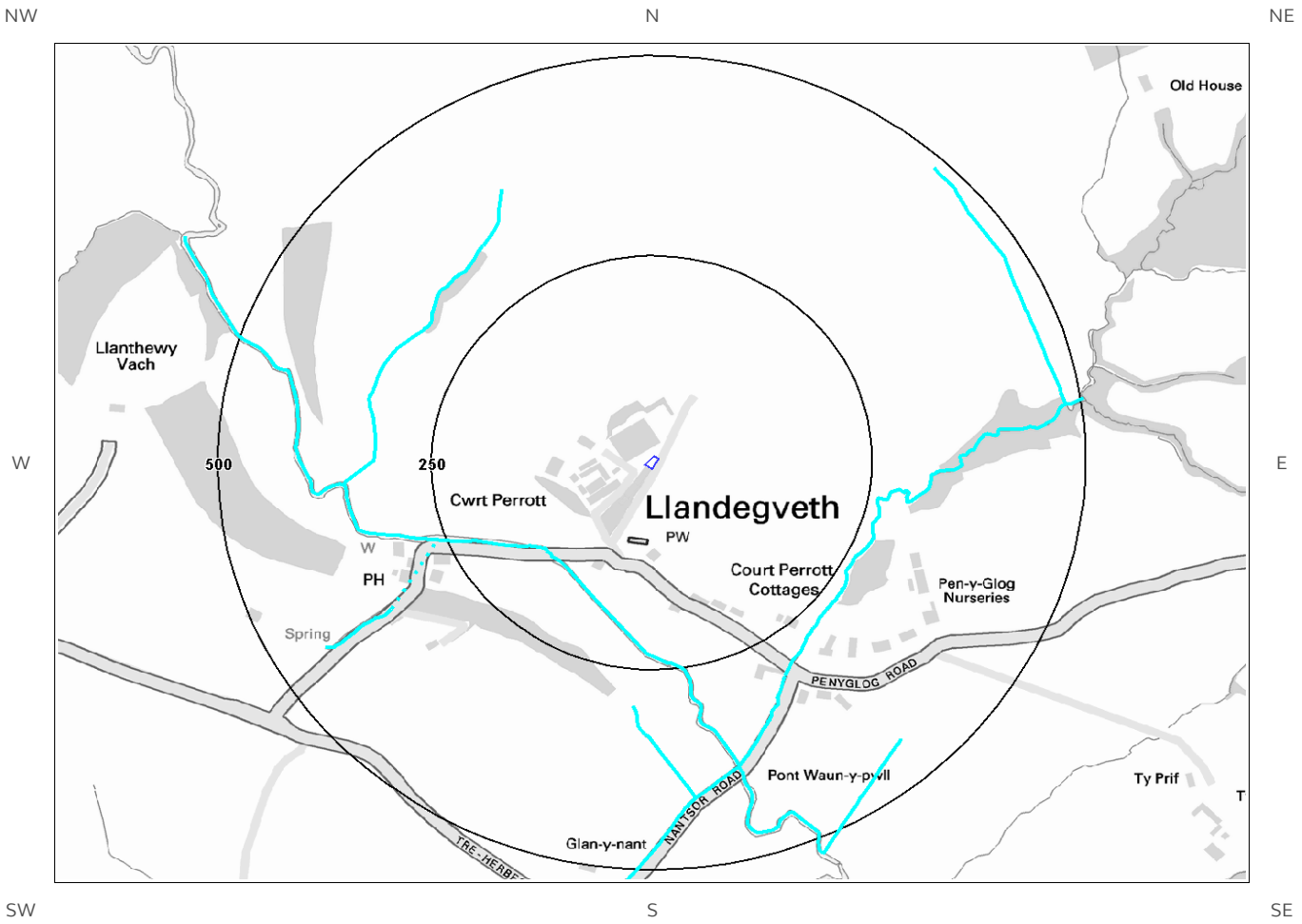
Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2C - Outer Catchment within Confined Aquifer

Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

6e. Hydrology – Watercourse Network and River Quality



Site Outline

250
500
Search Buffers (m)

Watercourse type

- Tidal River
- Inland River
- Canal
- Lock or Flight of Locks
- Lake, Reservoir, or Marsh
- Foreshore
- Drain or Transfer

Watercourse level

- On ground surface
- Underground or Elevated
- Level unknown

- General Quality Assessment: Biology
- General Quality Assessment: Chemistry

6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

Records of strata classification within the superficial geology at or in proximity to the property Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (6a):

ID	Distance (m)	Direction	Designation	Description
1	147	SW	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.2 Aquifer within Bedrock Deposits

Records of strata classification within the bedrock geology at or in proximity to the property Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
4	118	SW	Secondary B	Predominantly lower permeability layers which may store/yield limited amounts of groundwater due to localised features such as fissures, thin permeablehorizons and weathering. These are generally the water-bearing parts of the former non-aquifers

6.3 Groundwater Abstraction Licences

Groundwater Abstraction Licences within 2000m of the study site — Identified

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	NGR	Details	
6	734	SE	334510 195520	Status: Historical Licence No: 20/56/13/0003 Details: General Farming & Domestic Direct Source: EAW Groundwater Point: WELL IN LLANGYBI FAWR Data Type: Point Name: Greenland	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 15/11/1965 Expiry Date: - Issue No: 100 Version Start Date: 07/03/1994 Version End Date:

6.4 Surface Water Abstraction Licences

Surface Water Abstraction Licences within 2000m of the study site — None identified

Database searched and no data found.

6.5 Potable Water Abstraction Licences

Potable Water Abstraction Licences within 2000m of the study site — None identified

Database searched and no data found.

6.6 Source Protection Zones

Source Protection Zones within 500m of the study site — None identified

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

Source Protection Zones within the Confined Aquifer within 500m of the study site None identified

Historically, Source Protection Zone maps have been focused on regulation of activities which occur at or near the ground surface, such as prevention of point source pollution and bacterial contamination of water supplies. Sources in confined aquifers were often considered to be protected from these surface pressures due to the presence of a low permeability confining layer (e.g. glacial till, clay). The increased interest in subsurface activities such as onshore oil and gas exploration, ground source heating and cooling requires protection zones for confined sources to be marked on SPZ maps where this has not already been done.

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

Environment Agency/Natural Resources Wales information on groundwater vulnerability and soil leaching potential within 500m of the study site Identified

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
161	SW	Minor Aquifer/Intermediate Leaching Potential	I1	Soils which can possibly transmit a wide range of pollutants.

6.9 River Quality

Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site None identified

6.9.1 Biological Quality:

Database searched and no data found.

6.9.2 Chemical Quality:

Database searched and no data found.

6.10 Ordnance Survey MasterMap Water Network

Ordnance Survey MasterMap Water Network entries within 500m of the study site

This watercourse information is provided by Ordnance Survey MasterMap Water Network. The data provides a detailed centre line following the curve of the waterway precisely, so all distances provided in the report should be understood as measurements to the centreline rather than a measurement to the nearest point of the watercourse. Underground watercourses are inferred from entry and exit points so caution is advised in using these to indicate precise locations of underground watercourses when planning site investigation and development.

The following Ordnance Survey MasterMap Water Network records are represented on the Hydrology Map (6e):

ID	Distance/ Direction	Name	Type of Watercourse	Additional Details
1	156 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.2
2	156 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
7	156 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.2
8	156 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
3	157 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 4.3
4	157 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
9	157 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 4.3
10	157 SW	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
5	260 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided

ID	Distance/ Direction	Name	Type of Watercourse	Additional Details
11	260 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
6	262 W	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: Not provided Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
7	262 W	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
12	262 W	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: Not provided Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
13	262 W	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
8	287 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 2.3
14	287 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 2.3
9	291 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: Underground Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
15	291 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: Underground Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
10	296 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	296 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
11	301 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	301	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface

ID	Distance/ Direction	Name	Type of Watercourse	Additional Details
	SE			Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
12	307 NW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
18	307 NW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
13	330 NW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	330 NW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
14	331 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	331 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
15	347 SW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
21	347 SW	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
16	353 W	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
Not shown	353 W	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.5
17	384 S	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 4.4
Not shown	384 S	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions)

ID	Distance/ Direction	Name	Type of Watercourse	Additional Details
				Average Width in Watercourse Section (m): 4.4
18	385 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
19	385 S	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.2
Not shown	385 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	385 S	Sôr Brook	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 5.2
20	413 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	413 S	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
21	445 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	445 SE	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
22	469 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
Not shown	469 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): Not Provided
23	478 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 1.3
Not shown	478 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 1.3

ID	Distance/ Direction	Name	Type of Watercourse	Additional Details
24	481 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 0.3
25	481 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 3.2
Not shown	481 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 0.3
Not shown	481 E	-	Inland river not influenced by normal tidal action.	Catchment Area: Usk and Llwyd Relationship to Ground Level: On ground surface Permanence: Watercourse contains water year round (in normal conditions) Average Width in Watercourse Section (m): 3.2

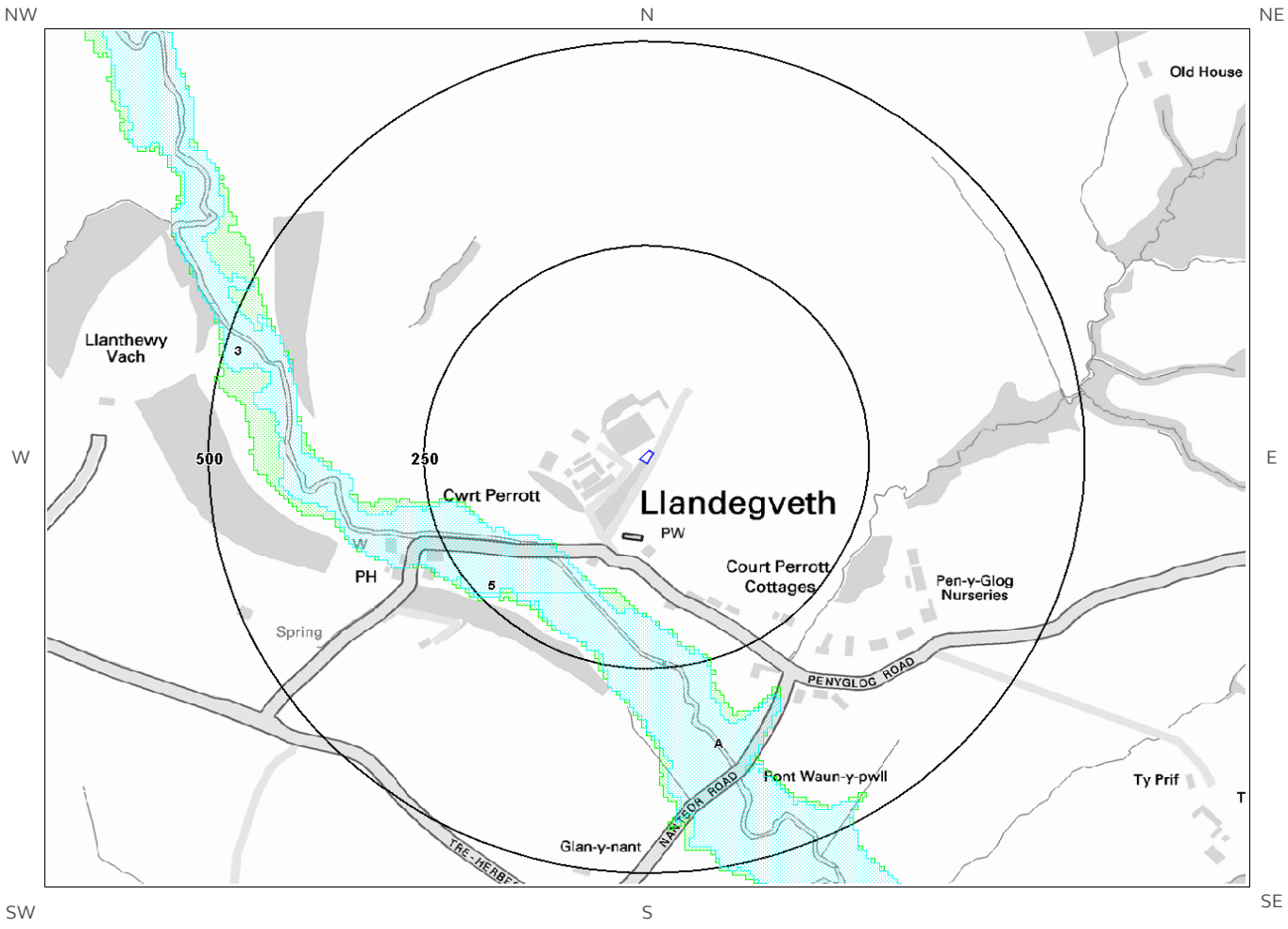
6.11 Surface Water Features

Surface water features within 250m of the study site Identified

The following surface water records are not represented on mapping:

Distance (m)	Direction
151	SW
152	SW

7a. Environment Agency/Natural Resources Wales Flood Map for Planning (from rivers and the sea)



Site Outline

100
250
Search Buffers (m)

Zone 2 Floodplain

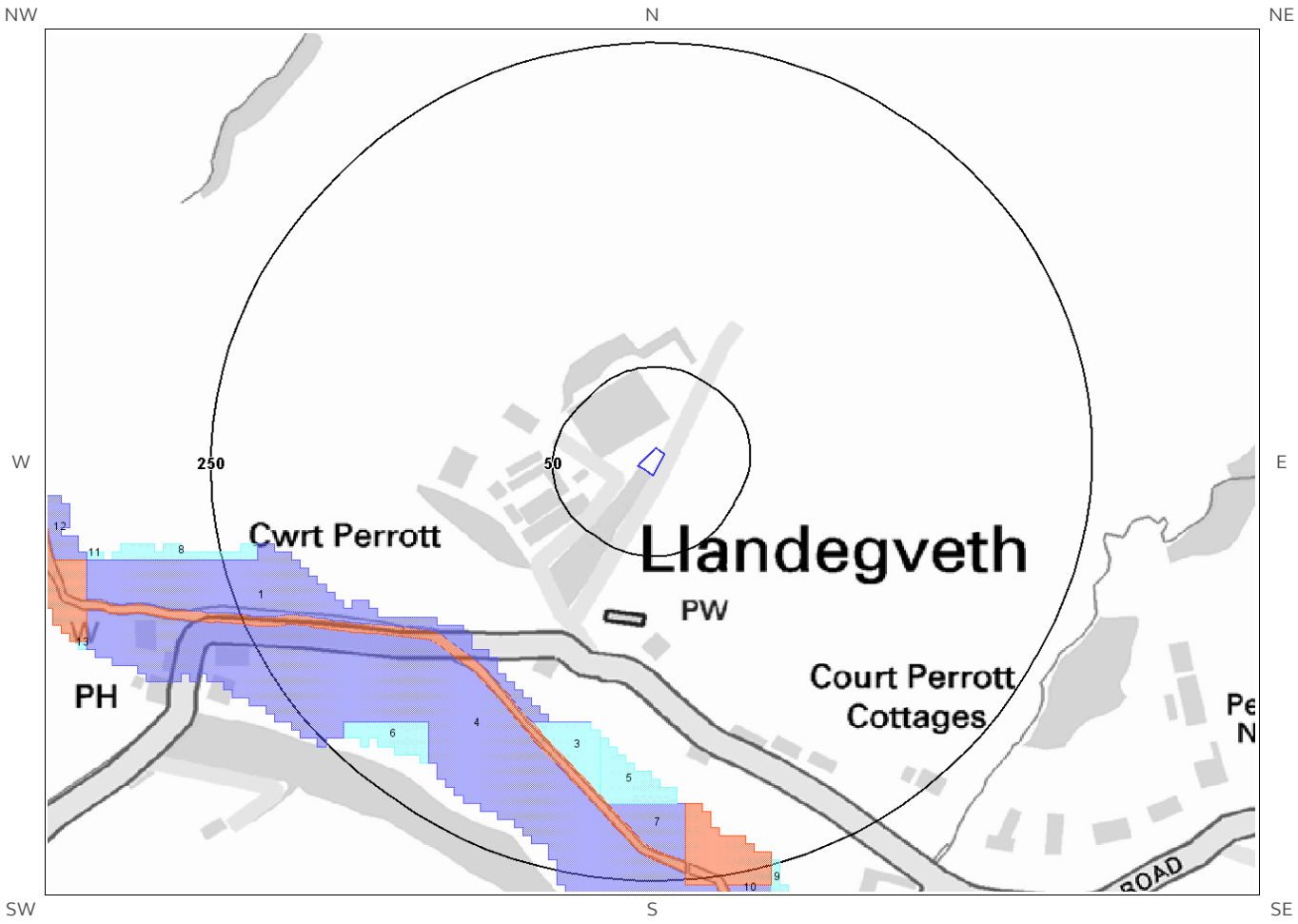
Zone 3 Floodplain

Flood Defences

Area used for Flood Storage

Area Benefiting from Flood Defences

7b. Environment Agency/Natural Resources Wales Risk of Flooding from Rivers and the Sea (RoFRaS) Map



Site Outline

100
250
Search Buffers (m)

RoFRaS Rating

- Very Low
- Low
- Medium
- High

7 Flooding

7.1 River and Coastal Zone 2 Flooding

Environment Agency/Natural Resources Wales Zone 2 floodplain within 250m — Identified

Environment Agency/Natural Resources Wales Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 7a – Flood Map for Planning:

ID	Distance (m)	Direction	Update	Type
1	142	SW	20-Jun-2019	Zone 2 - (Fluvial /Tidal Models)
2A	160	S	20-Jun-2019	Zone 2 - (Fluvial /Tidal Models)

7.2 River and Coastal Zone 3 Flooding

Environment Agency/Natural Resources Wales Zone 3 floodplain within 250m — Identified

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 7a – Flood Map for Planning.

ID	Distance (m)	Direction	Update	Type
1	142	SW	20-Jun-2019	Zone 3 - (Fluvial Models)
2A	167	S	20-Jun-2019	Zone 3 - (Fluvial Models)
	230	SW	20-Jun-2019	Zone 3 - (Fluvial Models)

7.3 Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating

Highest risk of flooding onsite — Very Low

The Environment Agency/Natural Resources Wales RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the probability that the flood defences will overtop or breach by considering their location, type, condition and standard of protection.

RoFRaS data for the study site indicates the property is in an area with a Very Low (less than 1 in 1000) chance of flooding in any given year.

7.4 Flood Defences

Flood Defences within 250m of the study site — None identified

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

Areas benefiting from Flood Defences within 250m of the study site — None identified

7.6 Areas benefiting from Flood Storage

Areas used for Flood Storage within 250m of the study site — None identified

7.7 Groundwater Flooding Susceptibility Areas

7.7.1 British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site — None identified

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

7.7.2 Highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions

Not Prone

The area is not considered to be prone to groundwater flooding based on rock type.

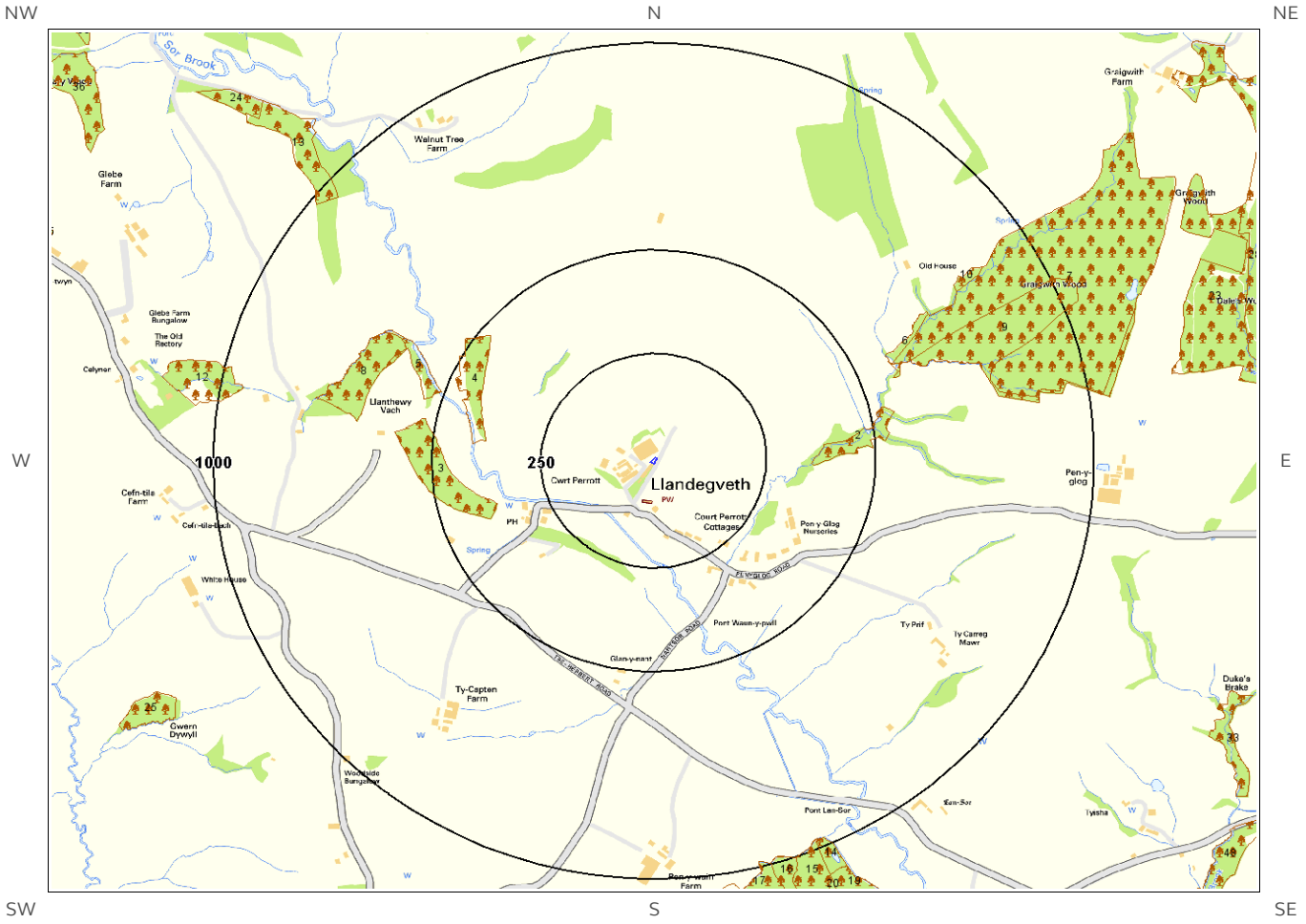
7.8 Groundwater Flooding Confidence Areas

British Geological Survey confidence rating in this result — Not Applicable

Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

8. Designated Environmentally Sensitive Sites Map



Site Outline

100
250
Search Buffers (m)

AONB

National Park

SSSI

Special Protection Areas

Nitrate Vulnerable Zones

Green Belt

Environmentally Sensitive Areas

Special Areas of Conservation

World Heritage Sites

Nitrate Sensitive Areas

Ancient Woodland

National Nature Reserve

Local Nature Reserves

Ramsar Sites

8. Designated Environmentally Sensitive Sites

Designated Environmentally Sensitive Sites within 2000m of the study site | Identified

8.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:

1

The following Site of Special Scientific Interest (SSSI) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	SSSI Name	Data Source
Not shown	1509	E	BROOK COTTAGE, LLANGYBI	Natural Resources Wales

8.2 Records of National Nature Reserves (NNR) within 2000m of the study site:

0

Database searched and no data found.

8.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site:

0

Database searched and no data found.

8.4 Records of Special Protection Areas (SPA) within 2000m of the study site:

0

Database searched and no data found.

8.5 Records of Ramsar sites within 2000m of the study site:

0

Database searched and no data found.

8.6 Records of Ancient Woodland within 2000m of the study site:

81

The following records of Designated Ancient Woodland provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
2	354	E	UNKNOWN	Restored Ancient Woodland Site
3	365	W	UNKNOWN	Ancient and Semi-Natural Woodland
4	381	W	UNKNOWN	Ancient and Semi-Natural Woodland
5	508	W	UNKNOWN	Ancient and Semi-Natural Woodland
6	575	E	UNKNOWN	Restored Ancient Woodland Site
7	582	NE	UNKNOWN	Restored Ancient Woodland Site
8	622	NW	UNKNOWN	Ancient and Semi-Natural Woodland
9	625	E	UNKNOWN	Restored Ancient Woodland Site
10	794	NE	UNKNOWN	Restored Ancient Woodland Site
11	892	E	UNKNOWN	Restored Ancient Woodland Site
12	949	W	UNKNOWN	Ancient and Semi-Natural Woodland
13	958	NW	UNKNOWN	Ancient and Semi-Natural Woodland
14	976	SE	UNKNOWN	Ancient Replanted Woodland
15	976	S	UNKNOWN	Ancient Replanted Woodland
16	986	S	UNKNOWN	Ancient and Semi-Natural Woodland
17	987	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1054	S	UNKNOWN	Ancient and Semi-Natural Woodland
19	1060	SE	UNKNOWN	Ancient and Semi-Natural Woodland
20	1068	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1168	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1194	SE	UNKNOWN	Ancient and Semi-Natural Woodland
23	1196	E	UNKNOWN	Ancient and Semi-Natural Woodland
24	1220	NW	UNKNOWN	Ancient and Semi-Natural Woodland
25	1225	SW	UNKNOWN	Restored Ancient Woodland Site
Not shown	1327	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1361	N	UNKNOWN	Ancient Replanted Woodland
28	1377	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not	1379	N	UNKNOWN	Ancient Replanted Woodland

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
shown				
Not shown	1379	E	UNKNOWN	Other Ancient Woodland
Not shown	1380	N	UNKNOWN	Restored Ancient Woodland Site
Not shown	1408	E	UNKNOWN	Ancient and Semi-Natural Woodland
33	1414	SE	UNKNOWN	Restored Ancient Woodland Site
Not shown	1474	E	UNKNOWN	Ancient and Semi-Natural Woodland
35	1476	W	UNKNOWN	Ancient and Semi-Natural Woodland
36	1482	NW	UNKNOWN	Ancient and Semi-Natural Woodland
37	1492	NE	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1494	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1497	E	UNKNOWN	Restored Ancient Woodland Site
Not shown	1512	E	UNKNOWN	Ancient Replanted Woodland
Not shown	1519	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1528	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1535	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1535	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1537	E	UNKNOWN	Other Ancient Woodland
Not shown	1538	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1539	E	UNKNOWN	Other Ancient Woodland
48	1579	SE	UNKNOWN	Restored Ancient Woodland Site
Not shown	1615	SW	UNKNOWN	Ancient and Semi-Natural Woodland
50	1634	NW	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1651	W	UNKNOWN	Ancient Replanted Woodland
Not shown	1663	S	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1667	SE	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1679	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1684	NE	UNKNOWN	Ancient and Semi-Natural Woodland

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
Not shown	1704	SW	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1711	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1721	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1735	NE	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1736	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1738	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1758	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1777	SE	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1798	NW	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1806	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1817	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1824	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1859	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1859	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1873	W	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1885	E	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1888	N	UNKNOWN	Restored Ancient Woodland Site
Not shown	1891	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1892	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1893	N	UNKNOWN	Restored Ancient Woodland Site
Not shown	1926	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1961	NW	UNKNOWN	Ancient Replanted Woodland
Not shown	1975	W	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1976	E	UNKNOWN	Restored Ancient Woodland Site
Not shown	1989	N	UNKNOWN	Ancient and Semi-Natural Woodland
Not shown	1992	N	UNKNOWN	Ancient Replanted Woodland
Not shown	1996	SE	UNKNOWN	Ancient and Semi-Natural Woodland

8.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

0

Database searched and no data found.

8.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

8.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

8.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

8.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

0

Database searched and no data found.

8.14 Records of Green Belt land within 2000m of the study site:

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a Groundsure Geo Insight, available from our website. The following information has been found:

9.1.1 Shrink Swell

Maximum Shrink-Swell*[*] hazard rating identified on the study site — Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

9.1.2 Landslides

Maximum Landslide* hazard rating identified on the study site — Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

9.1.3 Soluble Rocks

Maximum Soluble Rocks* hazard rating identified on the study site — Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This indicates an automatically generated 50m buffer and site.

9.1.4 Compressible Ground

Maximum Compressible Ground* hazard rating identified on the study site — Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

9.1.5 Collapsible Rocks

Maximum Collapsible Rocks* hazard rating identified on the study site — Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

9.1.6 Running Sand

Maximum Running Sand*[*] hazard rating identified on the study site — Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

* This indicates an automatically generated 50m buffer and site.

9.2 Radon

9.2.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The site is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level.

The radon data in this report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland. The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supercede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square. As such, the radon atlas is considered indicative, whereas the data given in this report is considered definitive.

9.2.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing
ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

10. Mining

10.1 Coal Mining

Coal mining areas within 75m of the study site — None identified

Database searched and no data found.

10.2 Non-Coal Mining

Non-Coal Mining areas within 50m of the study site boundary — Identified

The following non-coal mining information is provided by the BGS:

Distance (m)	Direction	Name	Commodity	Assessment of likelihood
0.0	On Site	Usk	Vein Mineral	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

Past underground mine workings may occur. The rock types present in these areas are such that small mineral veins may be present on which it is possible that small scale mining has been undertaken and/or it is possible that limited underground extraction of other materials may have occurred. All such occurrences are likely to be of minor localised extent and infrequent. It should be noted, however, that there is always the possibility of the existence of other sub-surface excavations, such as wells, cess pits, follies, air raid shelters/bunkers and other military structures etc. that could affect surface ground stability but which are outside the scope of this dataset. However, if in a coalfield area you should still consider a Coal Authority mining search for the area of interest.

10.3 Brine Affected Areas

Brine affected areas within 75m of the study site — None identified
Guidance: No Guidance Required.

Contact Details

Groundsure Helpline
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info@groundsure.com

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143.
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Email:
Web:**www.bgs.ac.uk**
BGS Geological Hazards Reports and general geological enquiries:
enquiries@bgs.ac.uk

Natural Resources Wales
Ty Cambria
29 Newport Road
Cardiff
CF24 0TP
Tel: 0300 065 3000
Email: enquiries@naturalresourceswales.gov.uk

Public Health England
Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
www.gov.uk/phe
Email:**enquiries@phe.gov.uk**
Main switchboard**: 020 7654 8000**

The Coal Authority
200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Ordnance Survey
Adanac Drive, Southampton
SO16 0AS
Tel: 08456 050505

Local Authority
Authority: Sir Fynwy - Monmouthshire County Council
Phone: 01633 644 644
Web: http://www.monmouthshire.gov.uk
Address: County Hall, The Rhadyr, Usk, Monmouthshire, NP15 1GA

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Virginia Villas, High Street, Hartley Witney,
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Acknowledgements: Site of Special Scientific Interest, National Nature Reserve, Ramsar Site, Special Protection Area, Special Area of Conservation data is provided by, and used with the permission of, Natural England/Natural Resources Wales who retain the Copyright and Intellectual Property Rights for the data.

Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:

https://www.groundsure.com/terms-and-conditions-feb11-2019

Appendix 3 – Geo Insight Report

Geo Insight

Address:	**CWRT PERROTT FARM, PENYGLOG ROAD, LLANDEGVETH, NP18 1HX**
Date:	**29 Jul 2019**
Reference:	**GS-6205222**
Client:	**JH Groundwater**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	25-May-2017
Grid Reference:	333831,195809
Site Size:	0.0124ha

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Overview of Findings

The Groundsure Geo Insight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 and 1:10,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Non-coal mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and Groundsure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Geology 1:10,000 Scale		
1.1 Artificial Ground	1.1 Is there any Artificial Ground/ Made Ground present beneath the study site at 1:10,000 scale?	No
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site at 1:10,000 scale?*	No
	1.2.2 Are there any records of landslip within 500m of the study site boundary at 1:10,000 scale?	No
1.3 Bedrock, Solid Geology and linear features	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records of linear features within 500m of the study site boundary at 1:10,000 scale?	No

Section 2: Geology 1:50,000 Scale		
2.1 Artificial Ground	2.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	2.1.2 Are there any records relating to permeability of artificial ground within the study site*boundary?	No
2.2 Superficial Geology and Landslips	2.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	No
	2.2.2 Are there any records of permeability of superficial ground within 500m of the study site?	No
	2.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	2.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No

Section 2: Geology 1:50,000 Scale

2.3 Bedrock, Solid Geology and linear features	2.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	2.3.2 Are there any records relating to permeability of bedrock ground within the study site boundary?	Yes
	2.3.3 Are there any records of linear features within 500m of the study site boundary?	No

Section 3: Radon

3. Radon	3.1Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level.
	3.2Radon Protection	No radon protective measures are necessary.

Section 4: Ground Workings	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	0	0	6	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	0
4.3 Current Ground Workings	0	0	1	0	1

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.1 Historical Mining	0	0	0	0	0
5.2 Coal Mining	0	0	0	0	0
5.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
5.4 Non-Coal Mining*	1	0	0	0	1
5.5 Non–Coal Mining Cavities	0	0	0	0	0
5.5 Natural Cavities	0	0	0	0	0

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.6 Brine Extraction	0	0	0	0	0
5.7 Gypsum Extraction	0	0	0	0	0
5.8 Cornwall and Devon Metalliferous Mining	0	0	0	0	0
5.9 Clay Mining	0	0	0	0	0

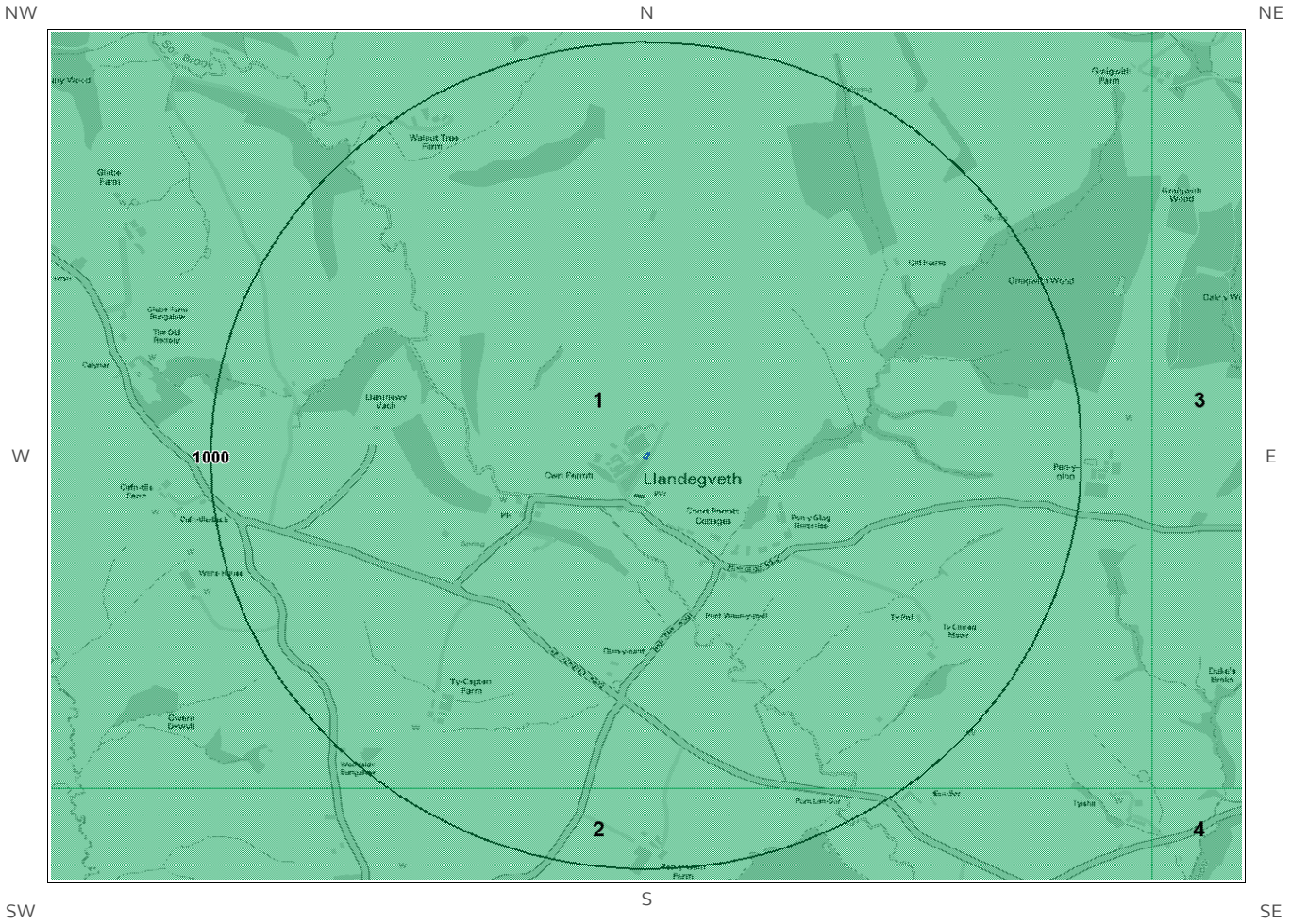
Section 6: Natural Ground Subsidence	On-site
6.1 Shrink-Swell Clay	Negligible
6.2 Landslides	Very Low
6.3 Ground Dissolution of Soluble Rocks	Negligible
6.4 Compressible Deposits	Negligible
6.5 Collapsible Deposits	Very Low
6.5 Running Sand	Negligible

Section 7: Borehole Records	On-site	0-50m	51-250
7 BGS Recorded Boreholes	0	0	0

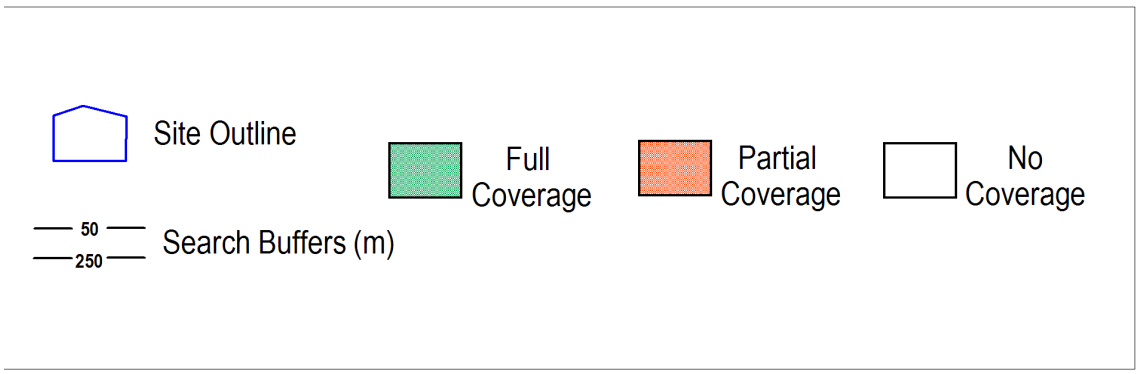
Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250
8 Records of Background Soil Chemistry	1	0	0

Section 9: Railways and Tunnels	On-site	0-50m	51-250	250-500
9.1 Tunnels	0	0	0	Not Searched
9.2 Historical Railway and Tunnel Features	0	0	0	Not Searched
9.3 Historical Railways	0	0	0	Not Searched
9.4 Active Railways	0	0	0	Not Searched
9.5 Railway Projects	0	0	0	0

1:10,000 Scale Availability



1_10,000 Availability Legend



Availability of 1:10,000 Scale Geology Mapping

The following information represents the availability of the key components of the 1:10,000 scale geological data.

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	No deposits are mapped	Full	Full	Some deposits are mapped
2	802.0	No deposits are mapped	Full	Full	No coverage
3	1162.0	No deposits are mapped	Full	Full	Some deposits are mapped
4	1418.0	No deposits are mapped	Full	Full	No coverage

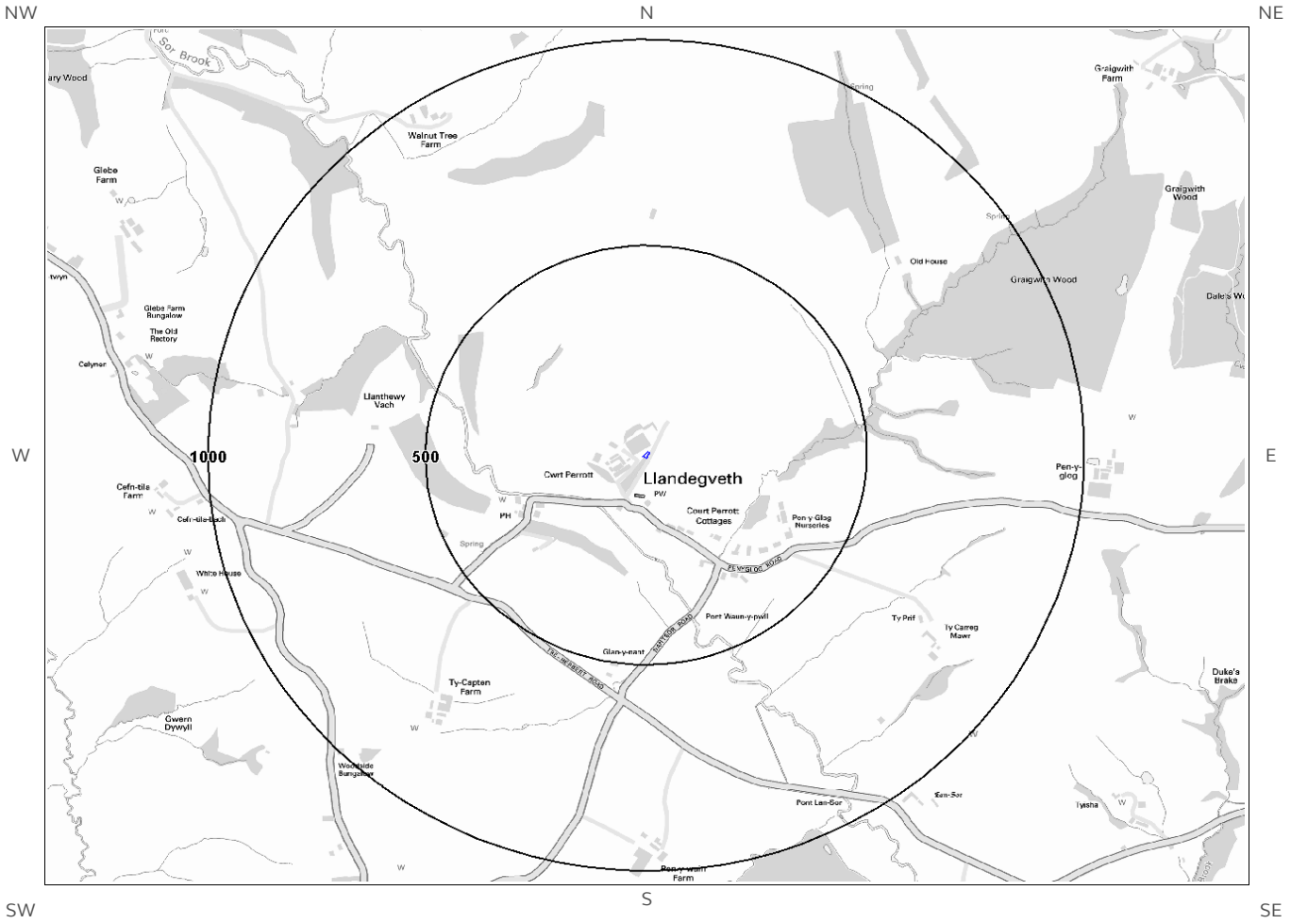
Guidance: The 1:10,000 scale geological interpretation is the most detailed generally available from BGS and is the scale at which most geological surveying is carried out in the field. The database is presented as four types of geology (artificial, mass movement, superficial and bedrock), although not all themes are mapped or available on every map sheet. Therefore a coverage layer showing the availability of the four themes is presented above.

The definitions of coverage are as follows:

Geology	Full Coverage	Partial Coverage	No Coverage
Bedrock	The whole tile has been mapped	Some but not all the tile has been mapped	No coverage
Superficial	The whole tile has been mapped	Some but not all of the tile has been mapped	No coverage
Artificial	Some deposits are mapped on this tile	-	No deposits are mapped
Mass Movement	Some deposits are mapped on this tile	-	No coverage

1 Geology (1:10,000 scale).

1.1 Artificial Ground map (1:10,000 scale)



Artificial Ground Legend

Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

1. Geology 1:10,000 scale

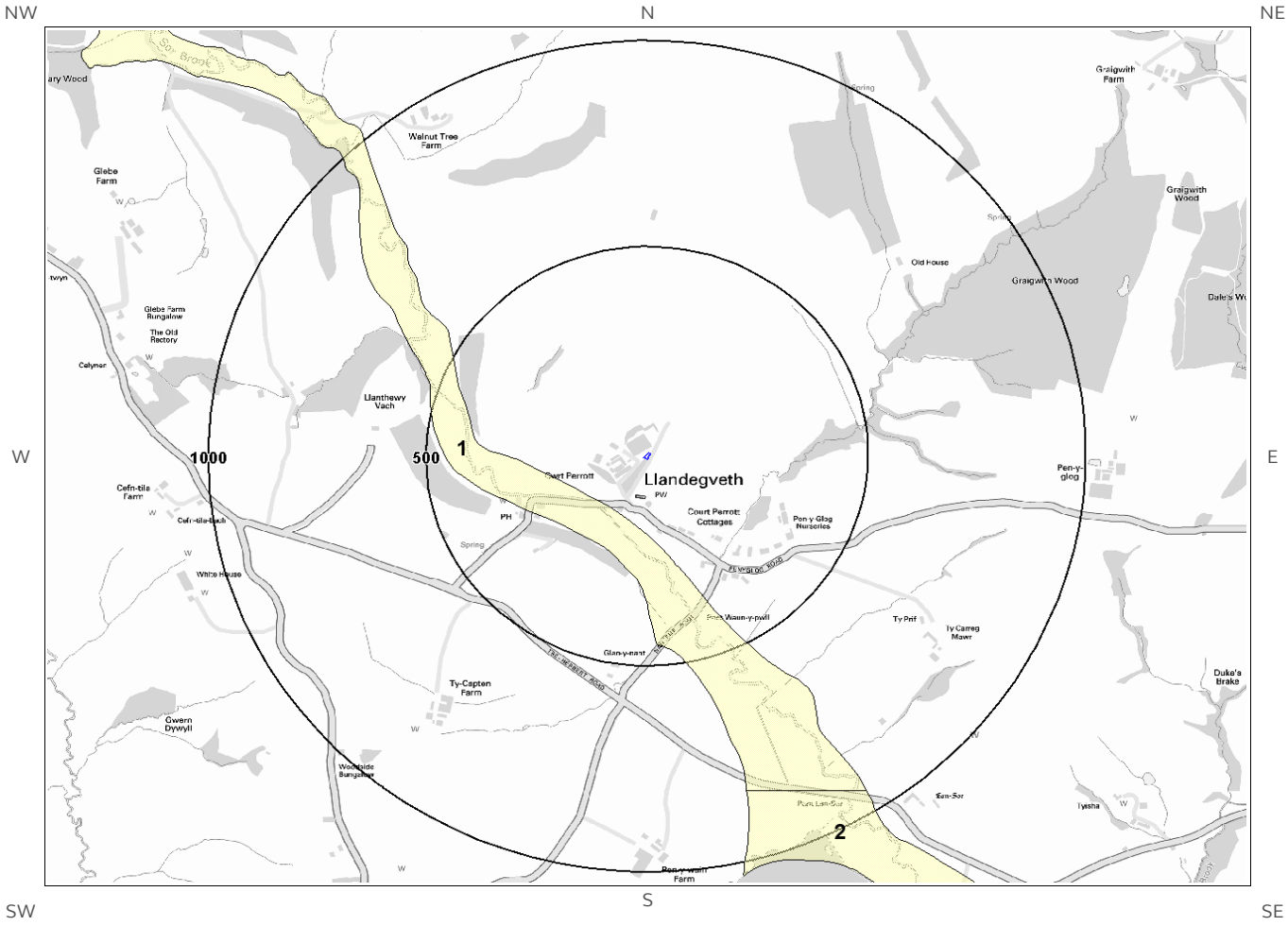
1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

Are there any records of Artificial/ Made Ground within 500m of the study site boundary at 1:10,000 scale? No

Database searched and no data found.

1.2 Superficial Deposits and Landslips map (1:10,000 scale)



Artificial Ground Legend

Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	144.0	SW	ALV-XCZSV	Alluvium - Clay, Silt, Sand And Gravel	Clay, Silt, Sand And Gravel

1.2.2 Landslip

Are there any records of Landslip within 500m of the study site boundary at 1:10,000 scale?

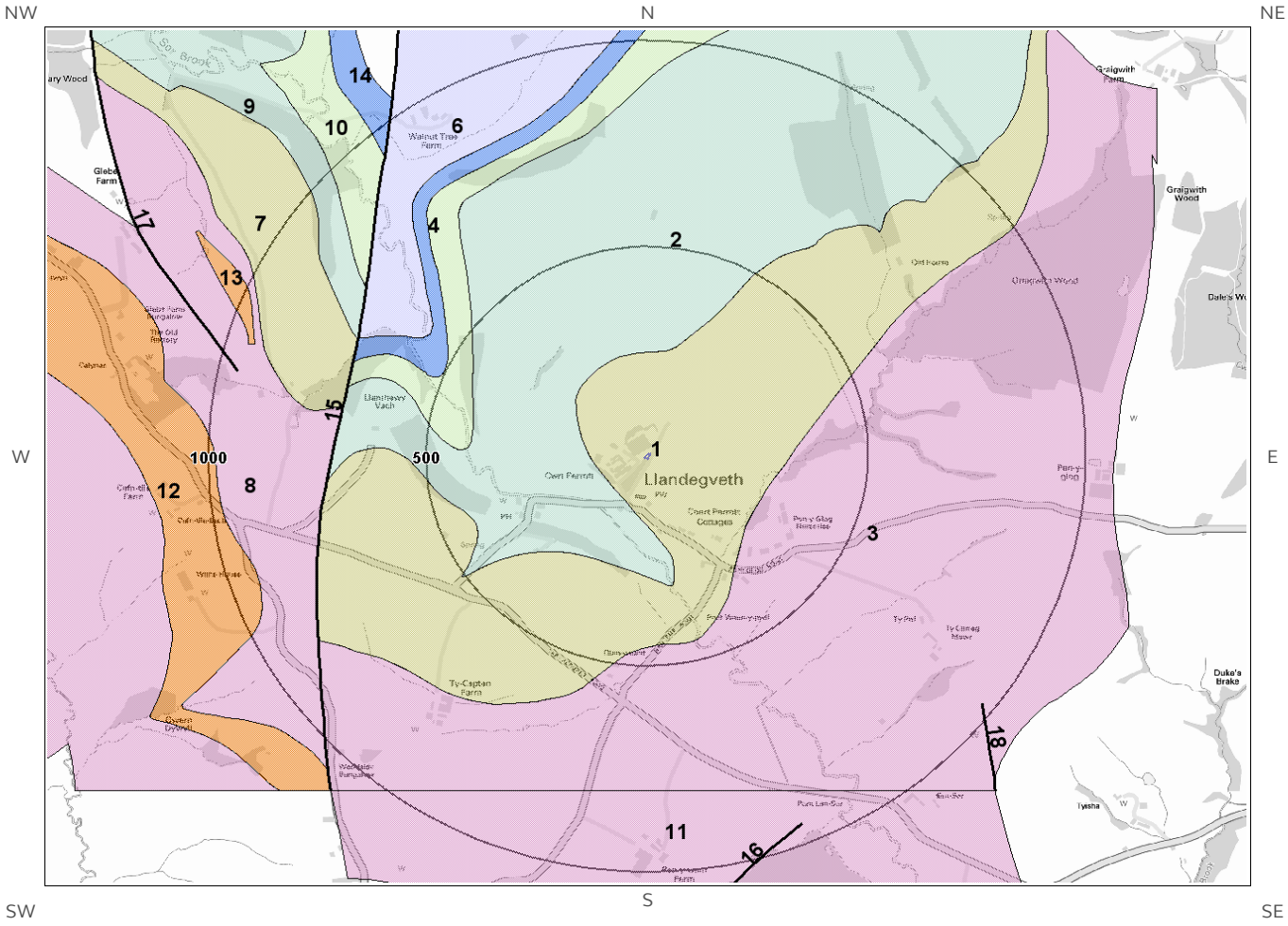
No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:10,000 scale

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.3 Bedrock and linear features map (1:10,000 scale)



Bedrock and linear features Legend

Site Outline

500
1000
Search Buffers (m)

1.3 Bedrock and linear features

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary at 1:10,000 scale.

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	DCS-SDST	Downton Castle Sandstone Formation - Sandstone	Pridoli Epoch
2	100.0	SW	MLUL-LSMD	Middle Llangibby Beds And Upper Llangibby Beds (undifferentiated) - Interbedded Limestone And Mudsto	Ludfordian Age
3	273.0	SE	RG-MDSA	Raglan Mudstone Formation - Interbedded Mudstone And Sandstone	Pridoli Epoch
4	398.0	W	ULLLY-SLMDST	Upper Llanbadoc Beds And Lower Llangibby Beds (undifferentiated) - Silty Mudstone	Ludfordian Age

1.3.2 Linear features

Are there any records of linear features within 500m of the study site boundary at 1:10,000 scale? No

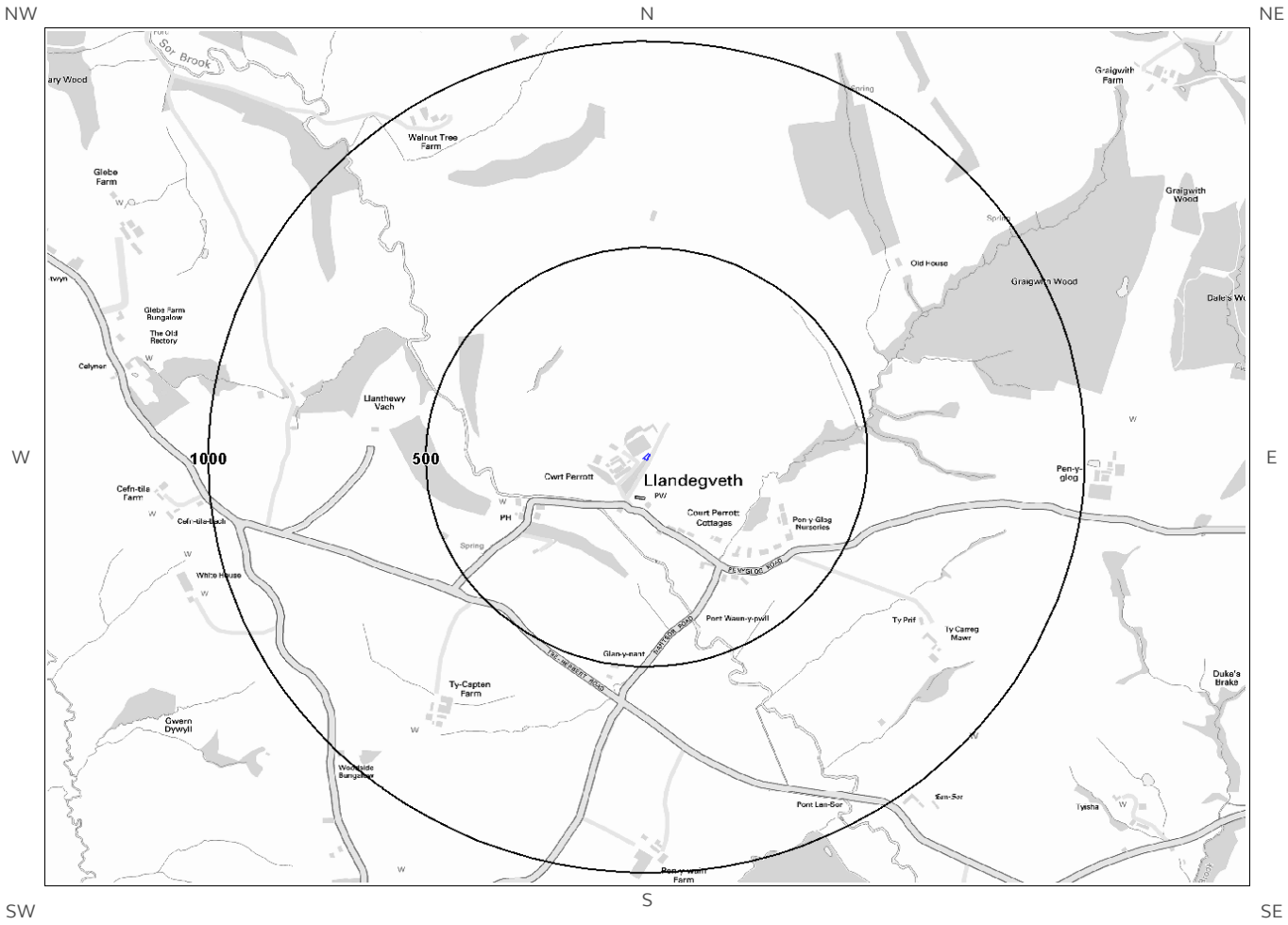
Database searched and no data found at this scale.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of great Britain at 1:10,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2 Geology 1:50,000 Scale

2.1 Artificial Ground map



Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 249

2.1.1 Artificial/ Made Ground

Are there any records of Artificial/ Made Ground within 500m of the study site boundary? No

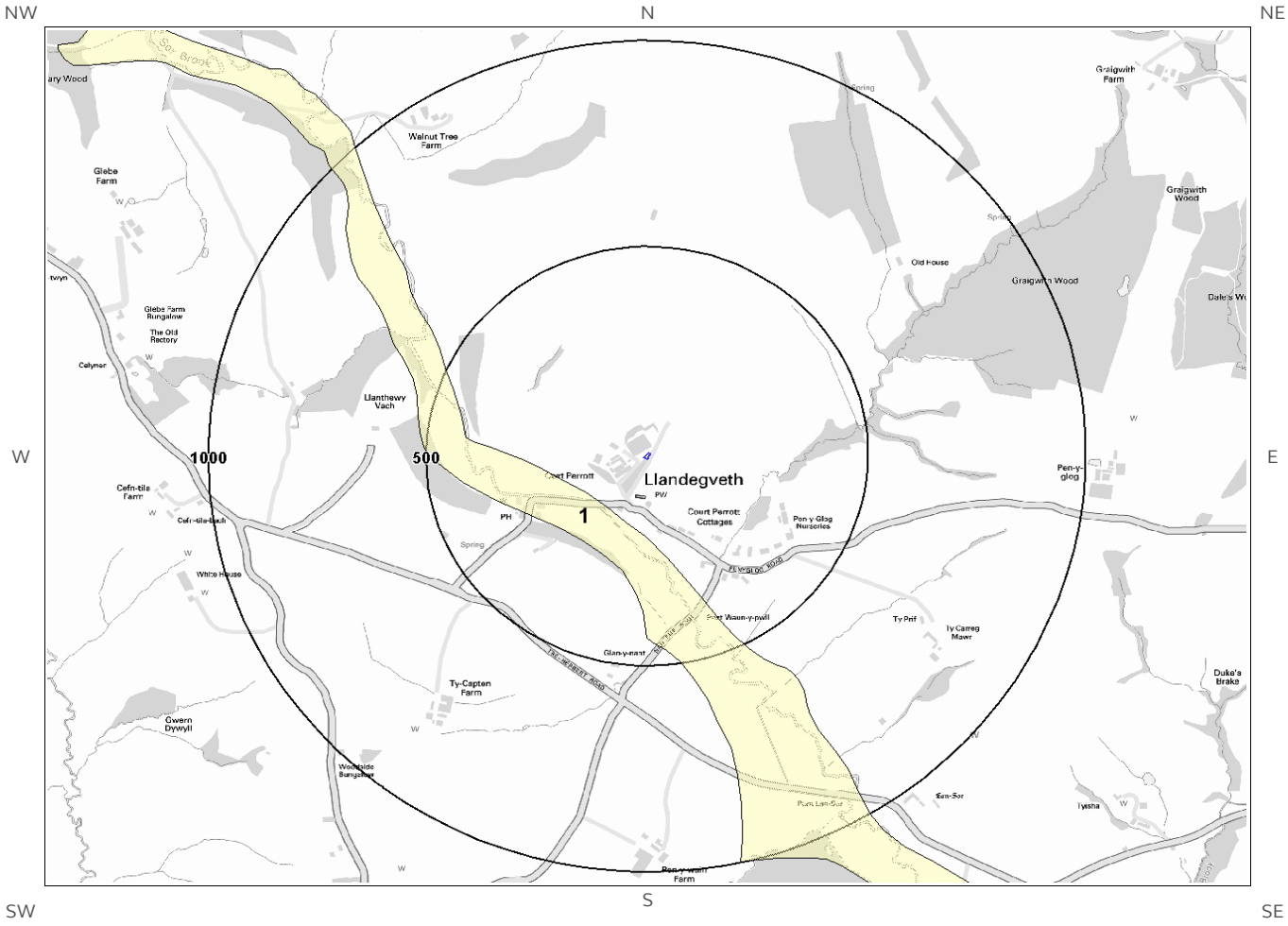
Database searched and no data found.

2.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? No

Database searched and no data found.

2.2 Superficial Deposits and Landslips map (1:50,000 scale)



Site Outline

500
1000
Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	147.0	SW	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL

2.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site boundary? No

Database searched and no data found.

2.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

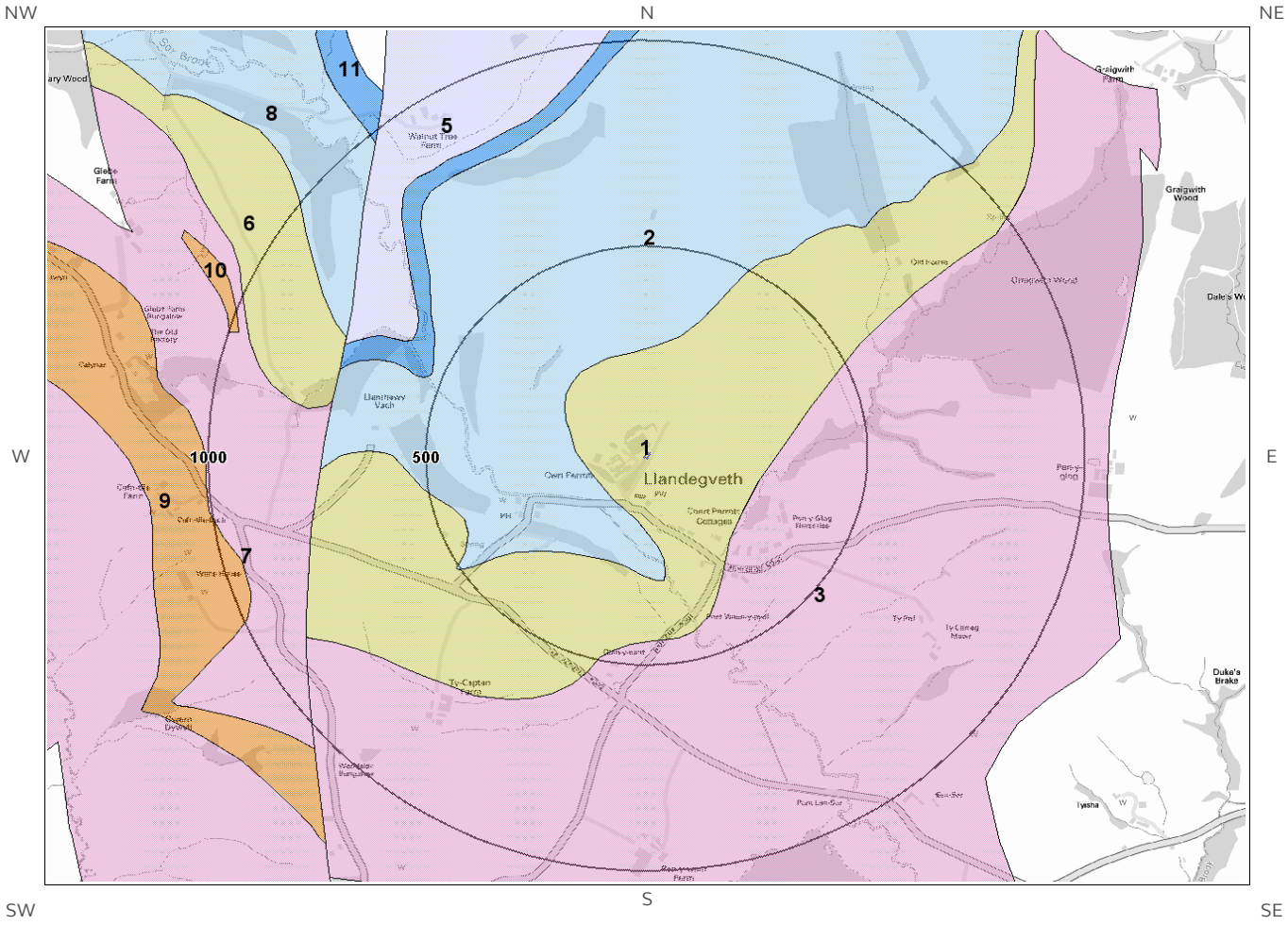
This Geology shows the main components as discrete layers, there are: Artificial/ Made Ground, Superficial/ Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2.2.4 Landslip Permeability

Are there any records relating to permeability of landslips within the study site boundary? No

Database searched and no data found.

2.3 Bedrock and linear features map (1:50,000 scale)



Site Outline

500
1000
Search Buffers (m)

2.3 Bedrock, Solid Geology & linear features

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 249

2.3.1 Bedrock/Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary:

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	DCS-SDST	DOWNTON CASTLE SANDSTONE FORMATION - SANDSTONE	-
2	118.0	SW	ULLB-CAMDST	UPPER LLANBADOC BEDS AND LLANGIBBY BEDS (UNDIFFERENTIATED) - MUDSTONE, CALCAREOUS	LUDFORDIAN
3	253.0	SE	RG-MDSA	RAGLAN MUDSTONE FORMATION - MUDSTONE AND SANDSTONE, INTERBEDDED	-

2.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site boundary? Yes

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Moderate	Moderate

2.3.3 Linear features

Are there any records of linear features within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/Solid Geology and linear features such as faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nation wide coverage.

3 Radon Data

3.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is in a Radon Affected Area, as between 1 and 3% of properties are above the Action Level.

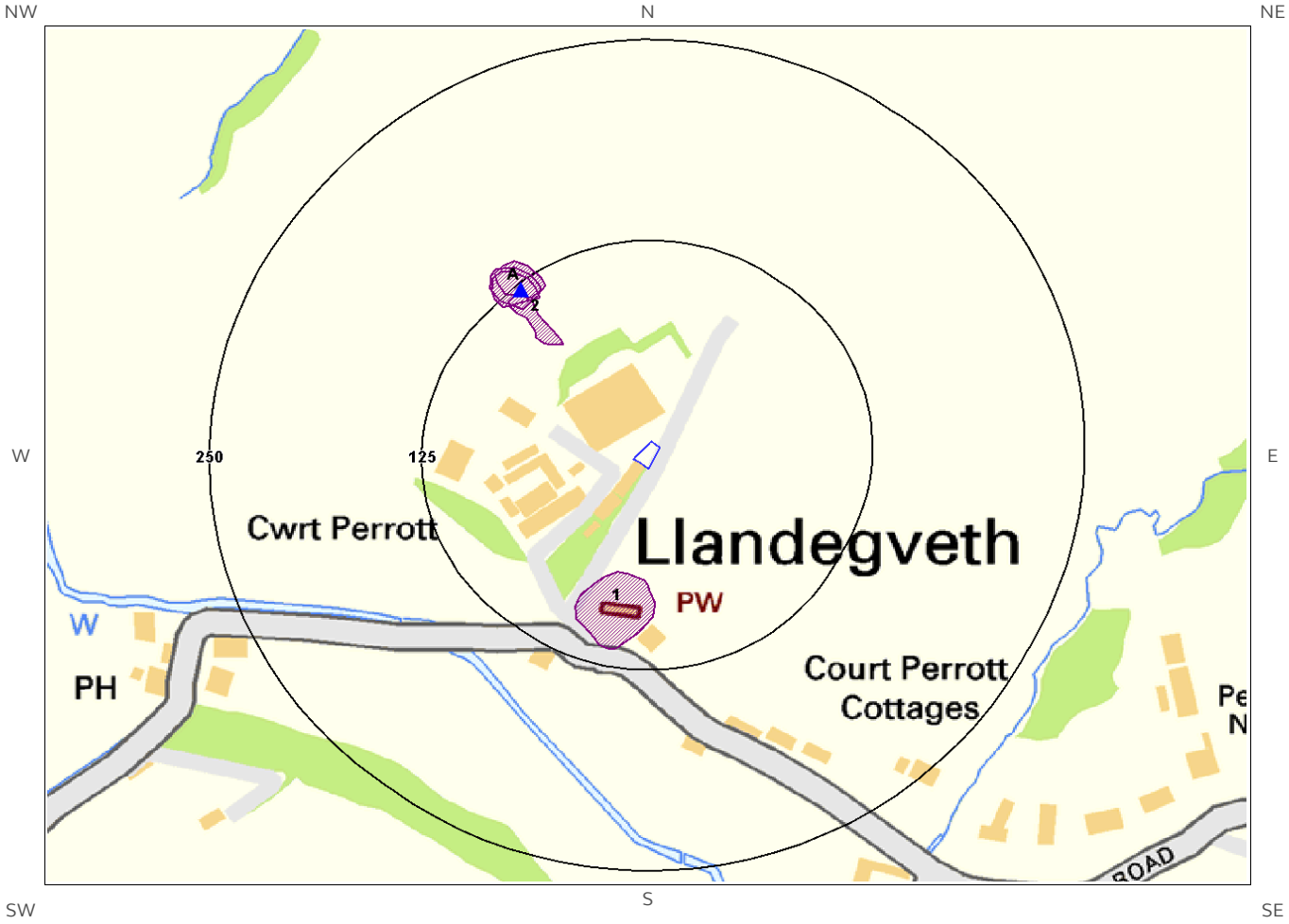
The radon data in this report is supplied by the BGS/Public Health England and is the definitive map of Radon Affected Areas in Great Britain and Northern Ireland. The dataset was created using long-term radon measurements in over 479,000 homes across Great Britain and 23,000 homes across Northern Ireland, combined with geological data. The dataset is considered accurate to 50m to allow for the margin of error in geological lines, and the findings of this report supercede any answer given in the less accurate Indicative Atlas of Radon in Great Britain, which simplifies the data to give the highest risk within any given 1km grid square. As such, the radon atlas is considered indicative, whereas the data given in this report is considered definitive.

3.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

---

4 Ground Workings map



Ground Workings Legend

Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Use	Date
1	67.0	S	333812 195714	Grave Yard	1881
2	79.0	NW	333765 195895	Unspecified Quarry	1881
3A	111.0	NW	333753 195913	Unspecified Pit	1922
4A	111.0	NW	333753 195913	Unspecified Old Quarry	1902
5A	112.0	NW	333753 195914	Unspecified Pit	1881
6A	114.0	NW	333756 195919	Unspecified Pit	1964

4.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? No

Database searched and no data found.

4.3 Current Ground Workings

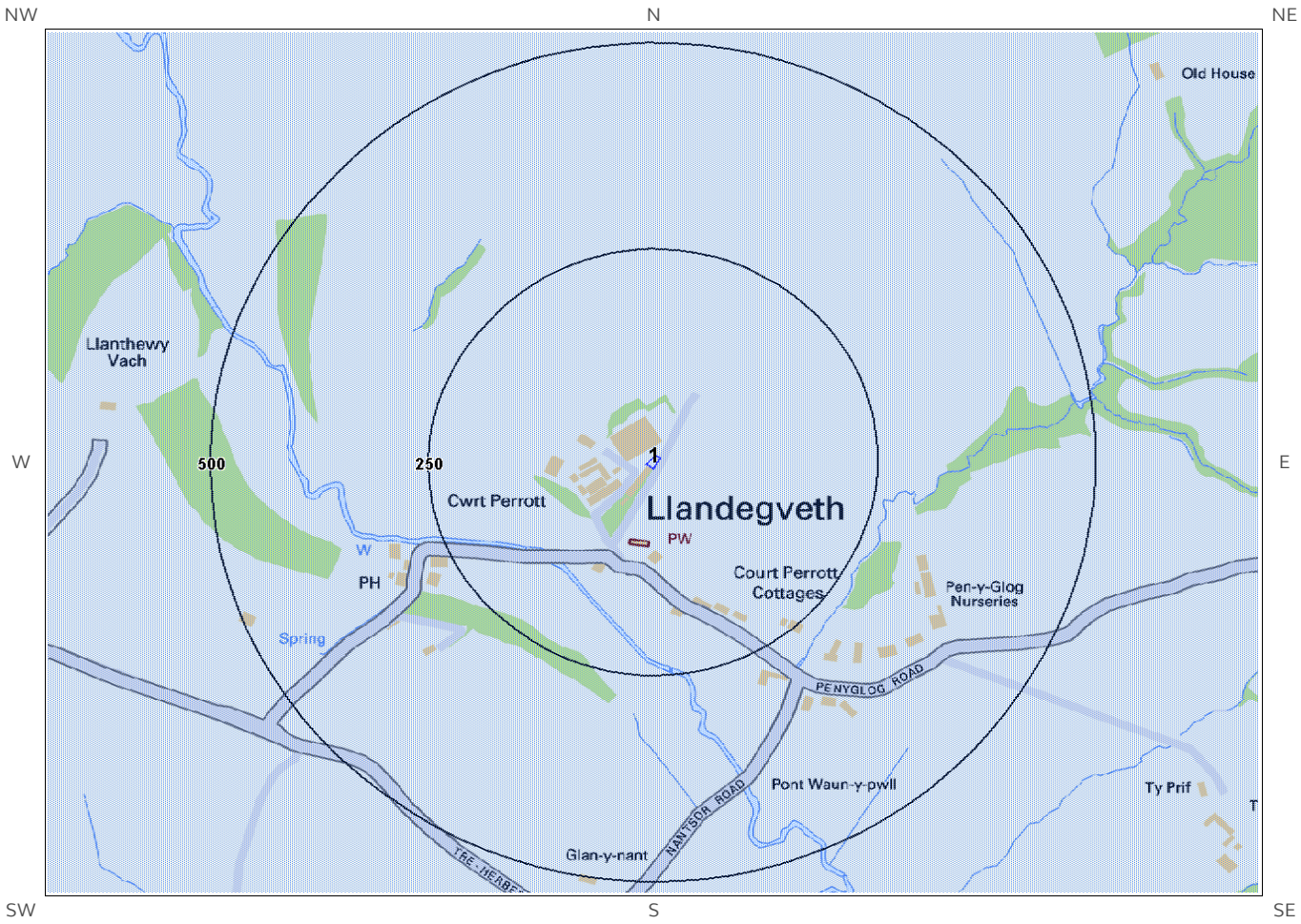
This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

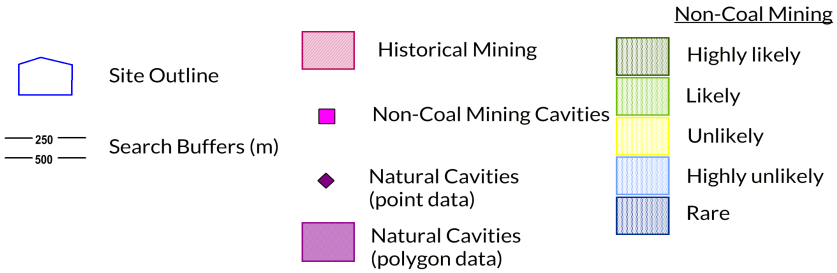
The following Current Ground Workings information is provided by British Geological Survey:

ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
7A	121.0	NW	333756 195913	Sandstone	Court Parrott	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	609.0	SW	333464 195316	Sandstone	Ty-Capten	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

5 Mining, Extraction & Natural Cavities map



Mining, Extraction and Natural Cavities Legend



5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? No

The following information provided by JPB is not represented on mapping: Database searched and no data found.

5.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? Yes

The following non-coal mining information is provided by the BGS:

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
1	0.0	On Site	Usk	Vein Mineral	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
Not shown	802.0	S	Usk	Vein Mineral	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

5.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.6 Natural Cavities

This dataset provides information based on the Peter Brett Associates natural cavities database. The dataset is made up of points and polygons. Where polygons are used these represent an area in which it is expected the cavities could be found. It does not indicate that cavities are present everywhere within the polygon, and caution should be used in the interpretation of this data.

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.7 Brine Extraction

This data provides information from the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.9 Cornwall and Devon Metalliferous Mining

This dataset provides information on metalliferous mining areas in Cornwall/Devon and is derived from records held by Mining Searches UK.

Are there any Cornwall and Devon Metalliferous Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

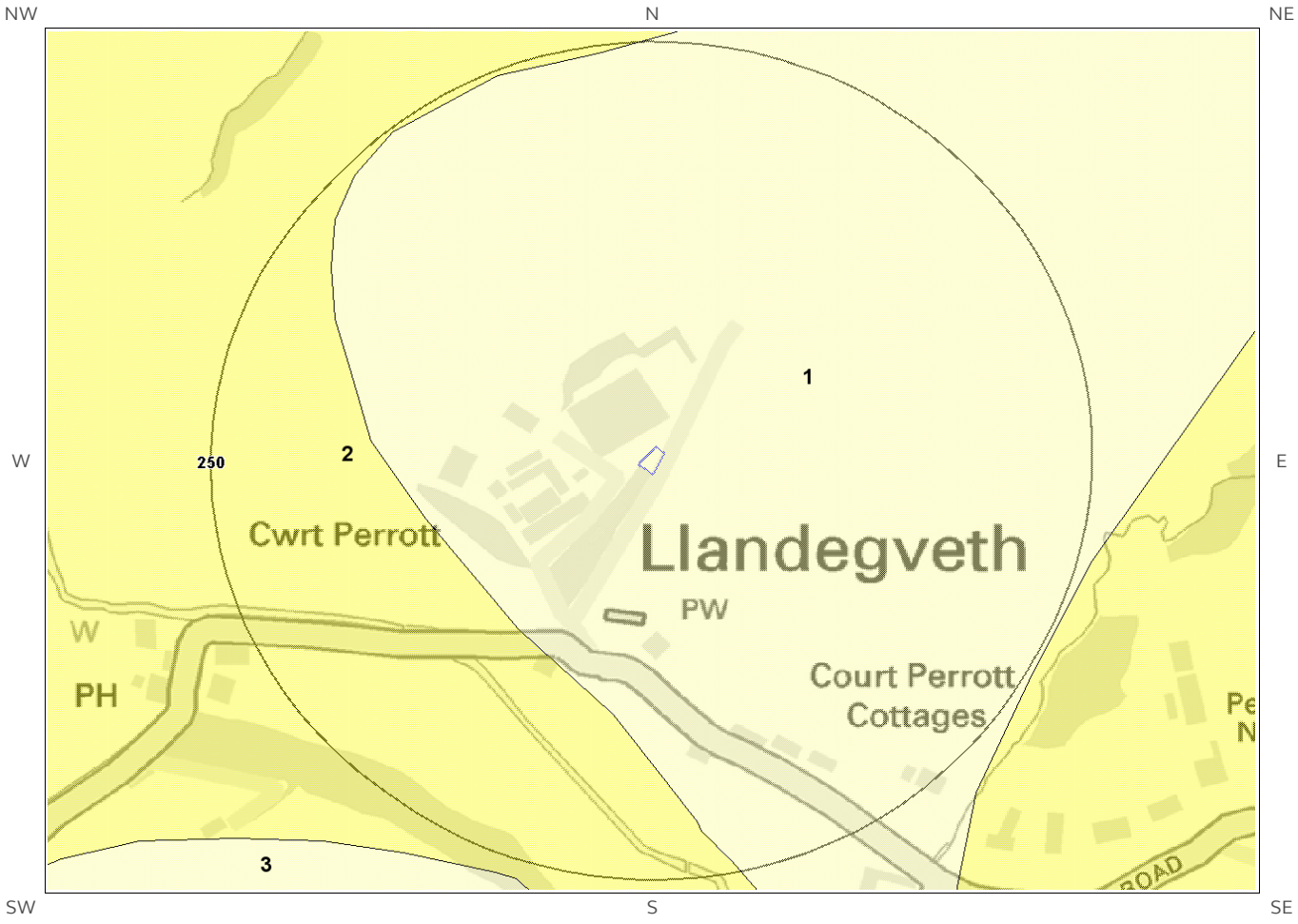
Are there any Clay Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

---

6 Natural Ground Subsidence

6.1 Shrink-Swell Clay map



Shrink Swell Clay Legend

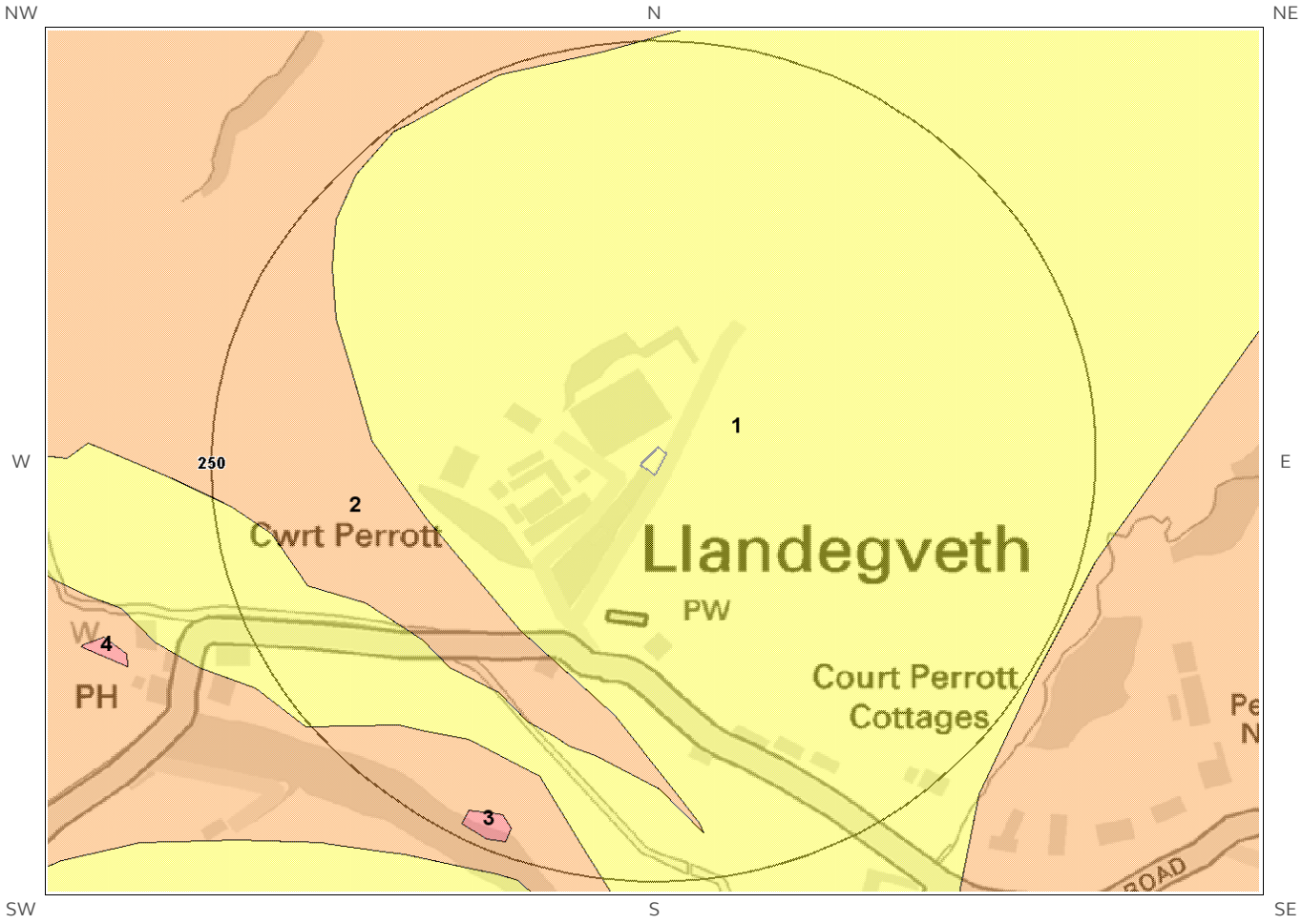
Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

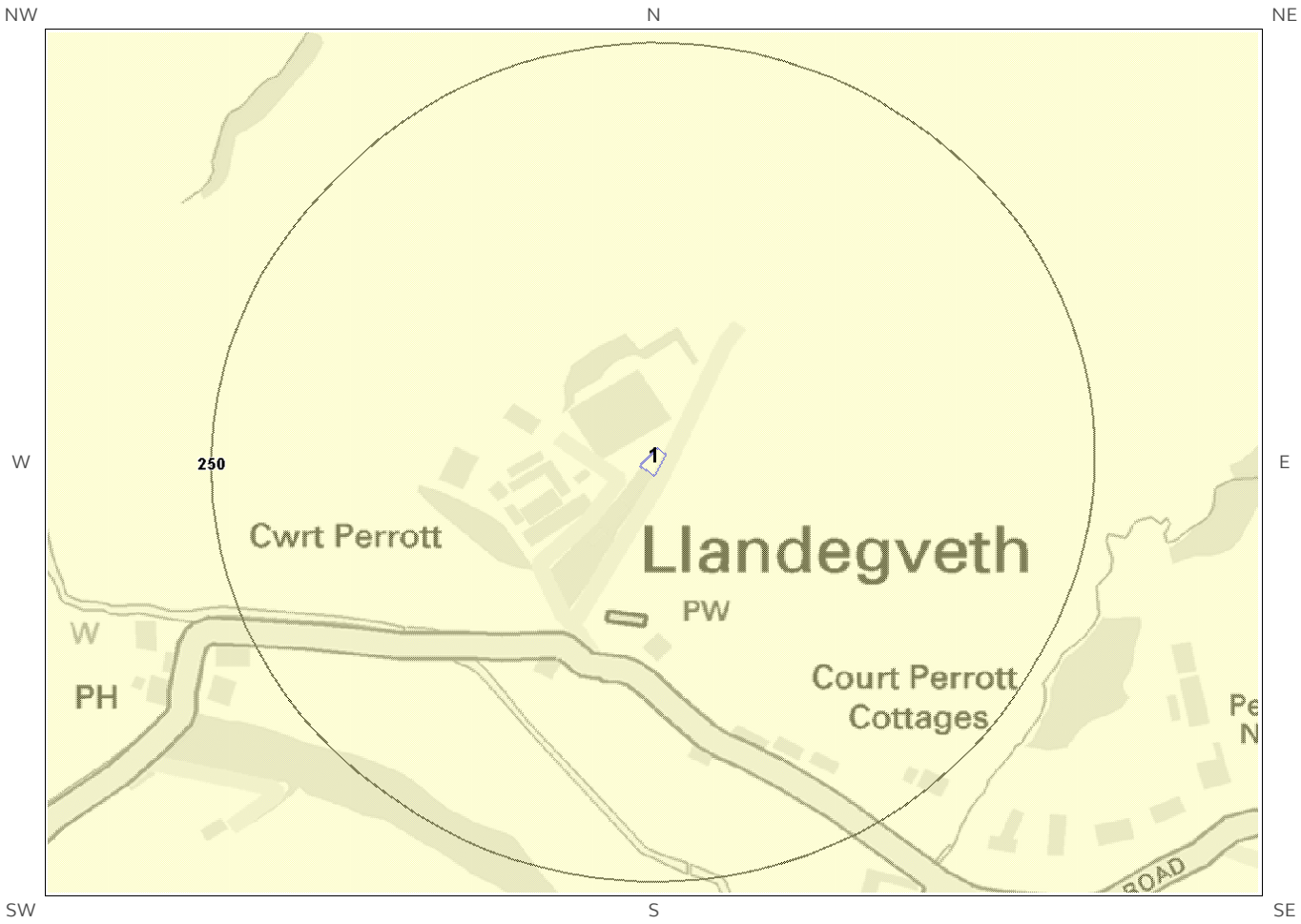
Low
Moderate
High

6.2 Landslides map



Landslides Legend

6.3 Ground Dissolution of Soluble Rocks map



Ground Dissolution Soluble Rocks Legend

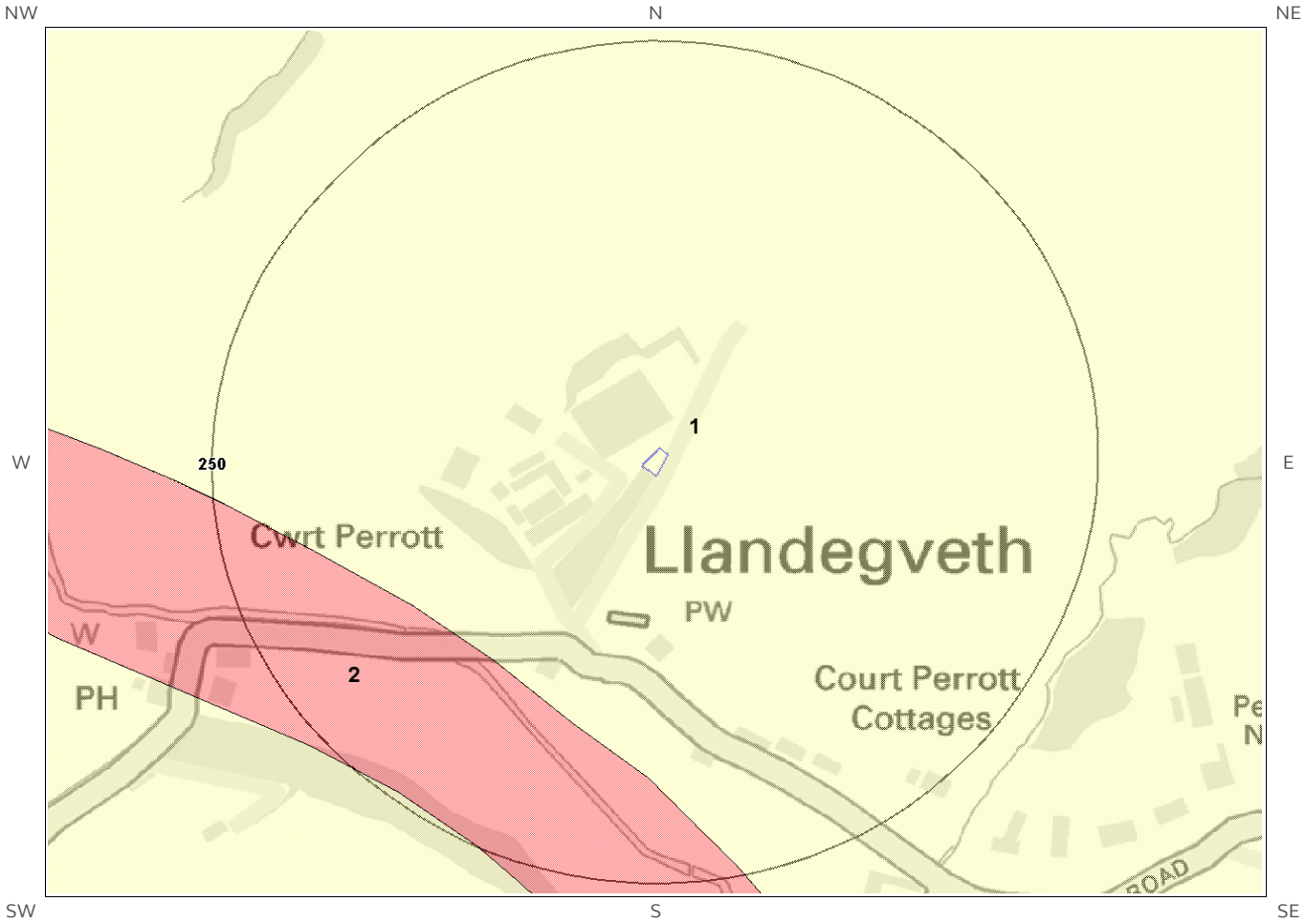
Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low

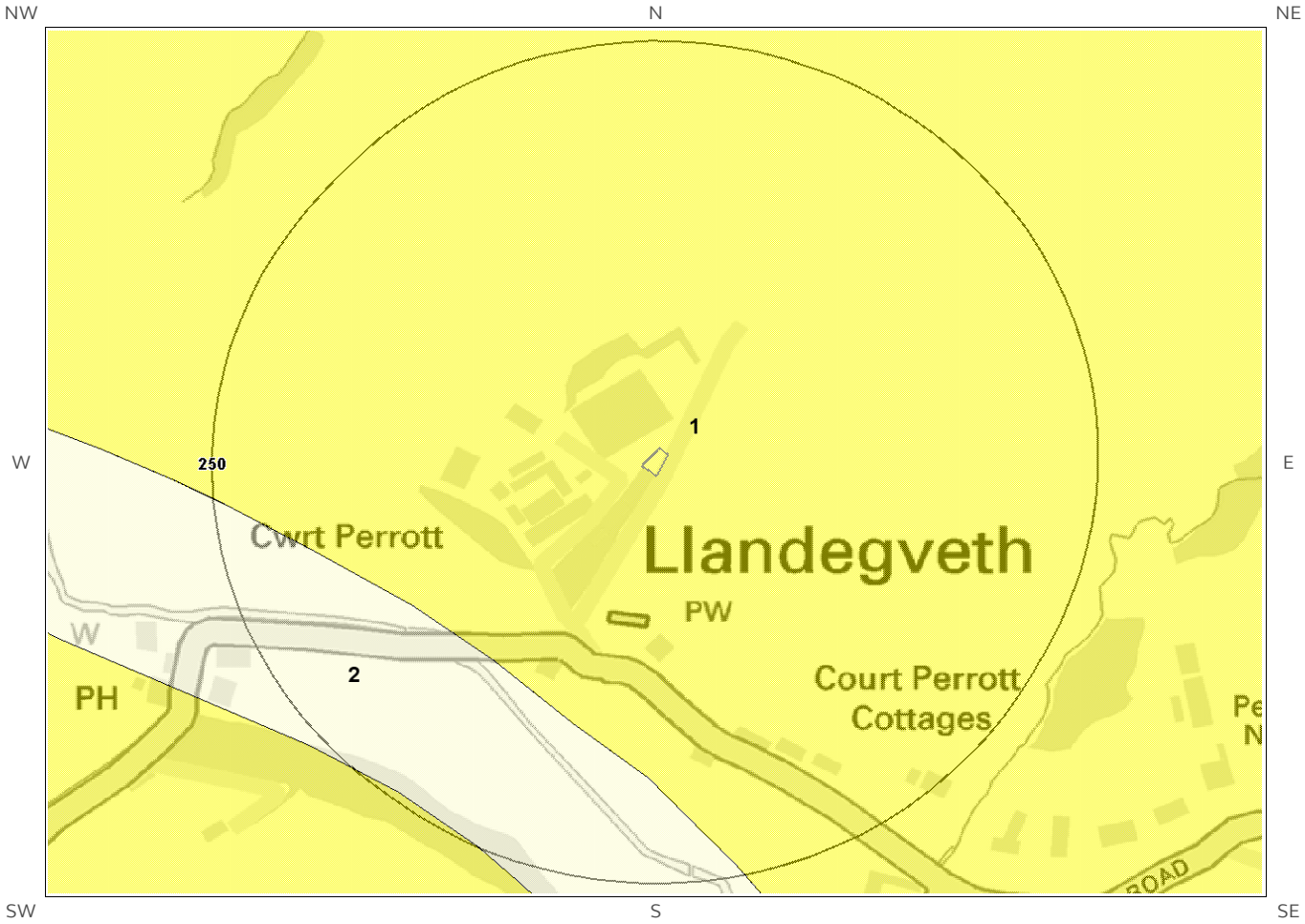
Low
Moderate
High

6.4 Compressible Deposits map



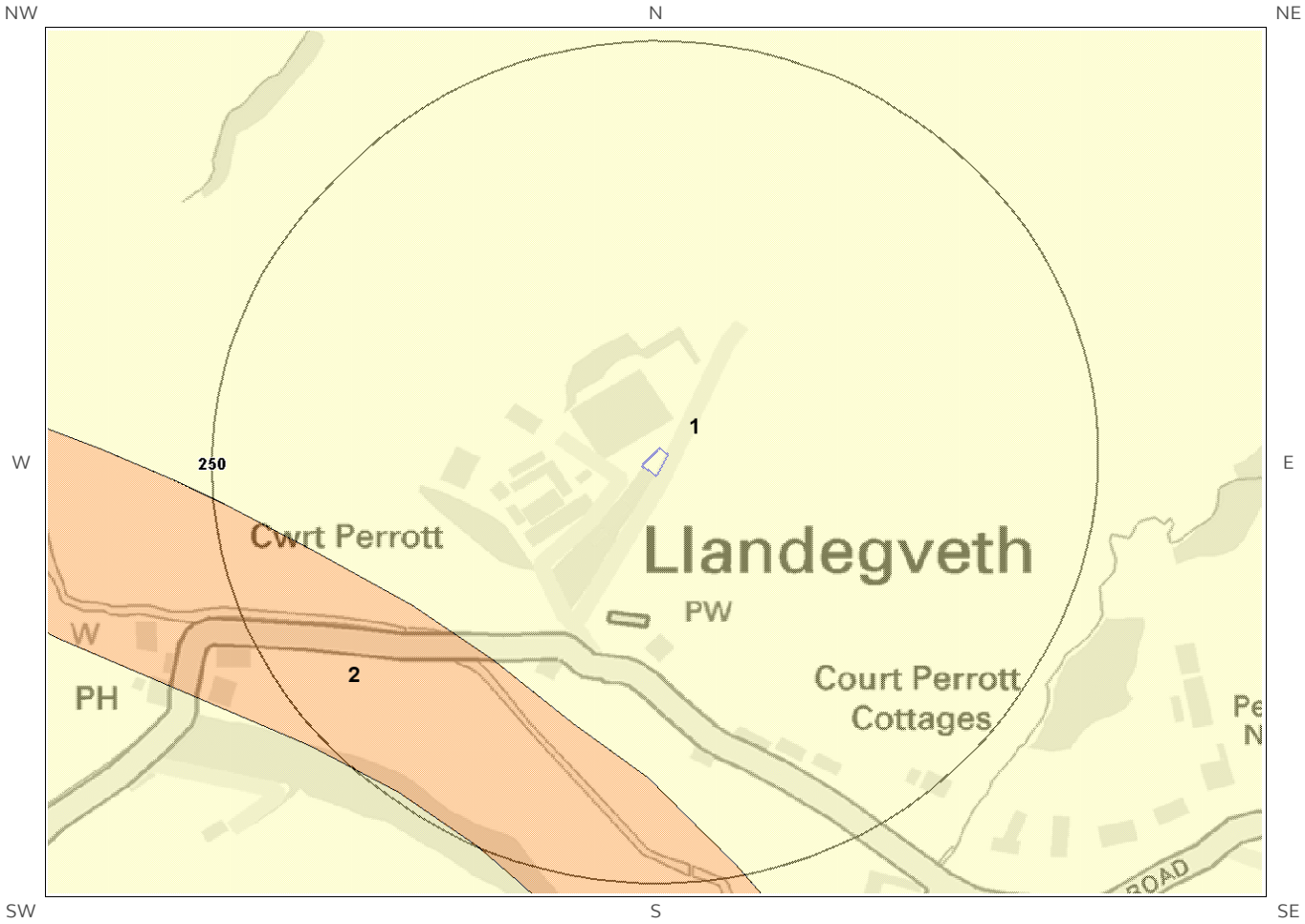
Compressible Deposits Legend

6.5 Collapsible Deposits map



Collapsible Deposits Legend

6.6 Running Sand map



Running Sand Legend

Site Outline

125
250
Search Buffers (m)

No Data / Null

Negligible

Very Low

Low

Moderate

High

6 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site*[*] boundary? Very Low

6.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

6.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This includes an automatically generated 50m buffer zone around the site

6.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

6.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

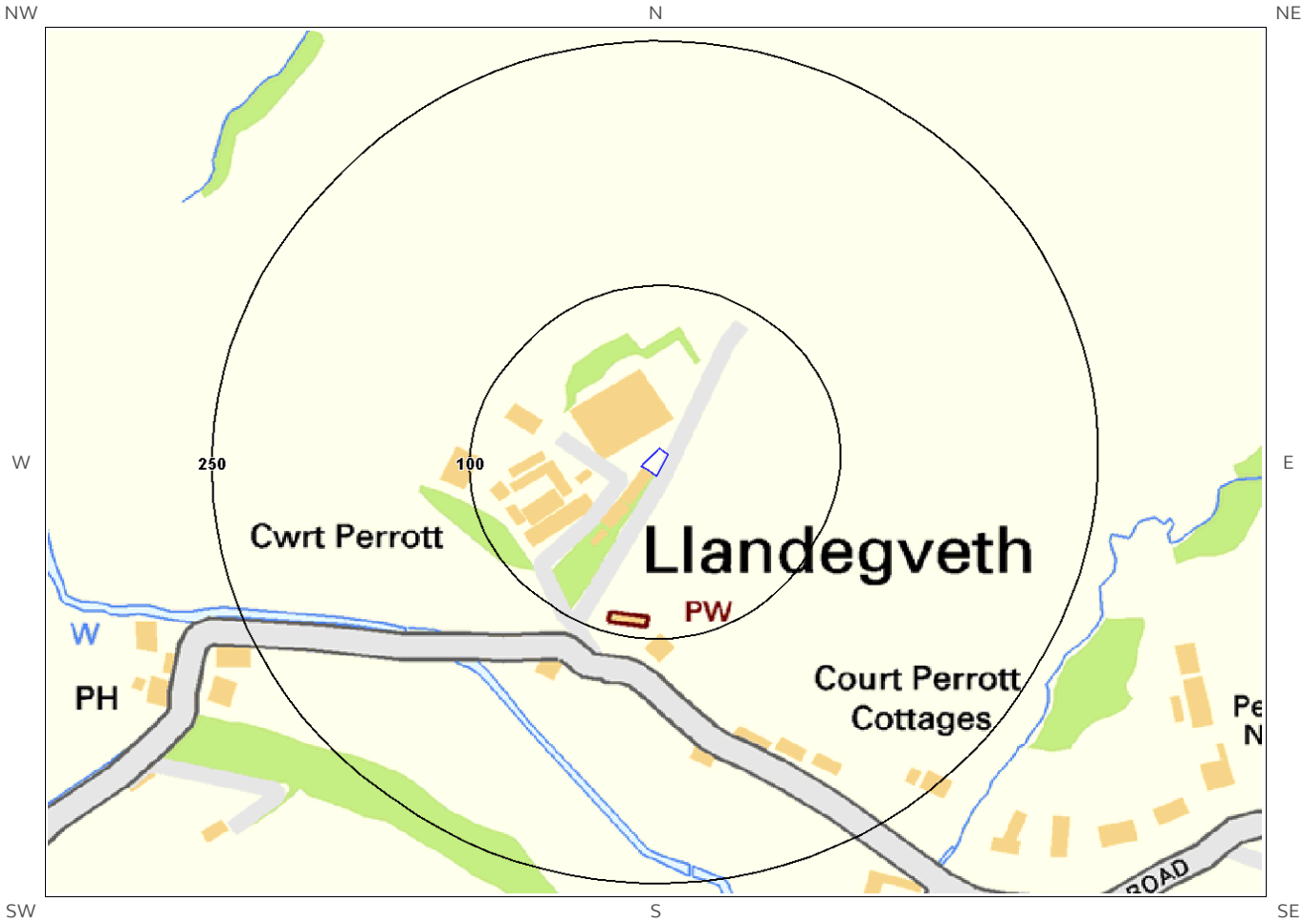
ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

6.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

7 Borehole Records map



Borehole Records Legend

Site Outline

Borehole Locations

125
250
Search Buffers (m)

7 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: 0

Database searched and no data found.

8 Estimated Background Soil Chemistry

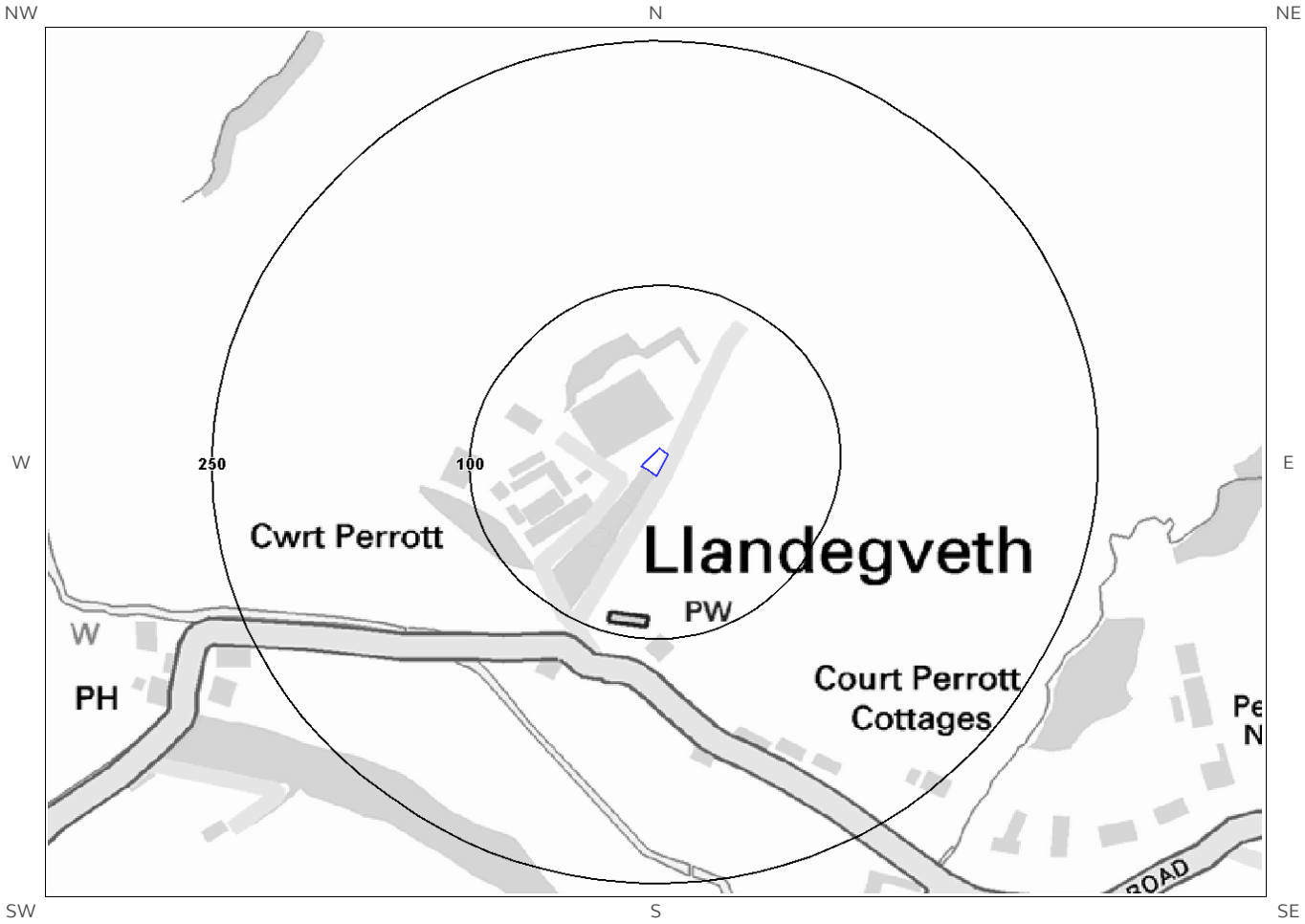
Records of background estimated soil chemistry within 250m of the study site boundary: 1

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg

*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

9 Railways and Tunnels map



Railways and Tunnels Legend

- Site Outline
- Search Buffers (m) — 250 — 500
- Underground or Partially Underground Railway / Subway System
- Railway Tunnel (OS Mapping)
- Abandoned or Dismantled Railway (OpenStreetMap)
- Railway Track (OS Mapping)
- Railway Track (OpenStreetMap)
- High Speed 2
- High Speed 2 Revised Proposed Route
- Crossrail 1
- Railway and/or Tunnel Feature from Historical Mapping

9 Railways and Tunnels

9.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary?	No
Have any underground railway lines been identified within 250m of the study site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary?	No
Have any other railway tunnels been identified within 250m of the site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels map.

9.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary?	No
Have any historical railway or tunnel features been identified within 250m of the study site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels map.

9.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary?	No
Have any historical railway lines been identified within 250m of the study site boundary?	No

Database searched and no data found.

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels map.

9.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary?	No
Have any active railway lines been identified within 250m of the study site boundary?	No

Database searched and no data found.

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels map.

9.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project?	No
Is the study site within 500m of the route of the Crossrail 1 rail project?	No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report.

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

Contact Details

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Fax: 0115 936 3276.
Email:**enquiries@bgs.ac.uk**
Web:**www.bgs.ac.uk**
BGS Geological Hazards Reports and general geological enquiries

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DX 716176 Mansfield 5
www.coal.gov.uk

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https://www.gov.uk/government/organisations/public-health-england
Email: **enquiries@phe.gov.uk**
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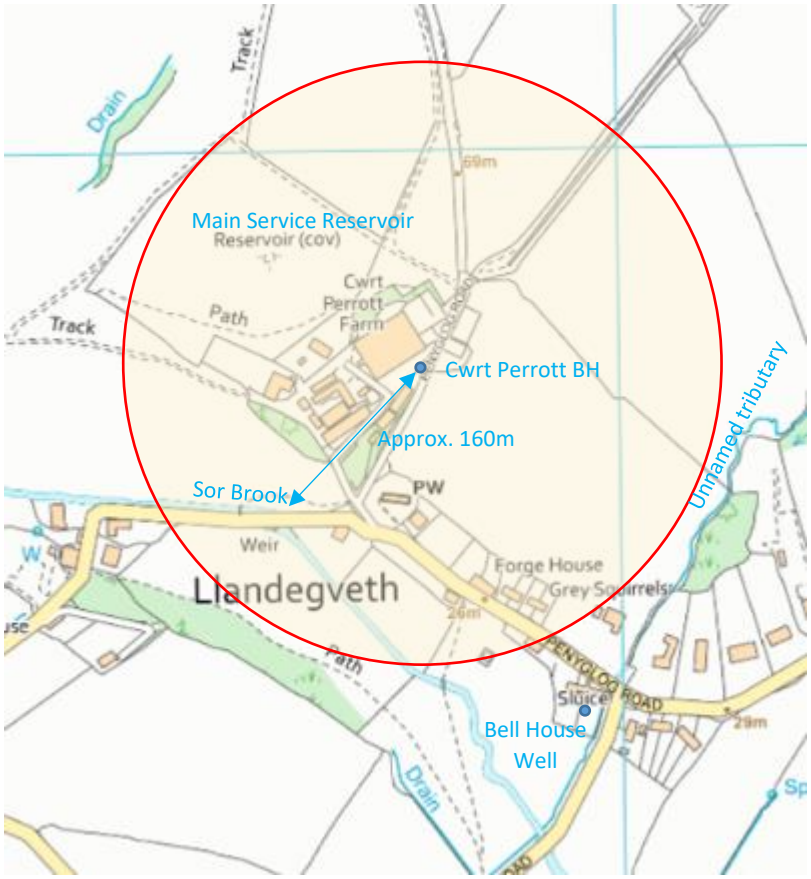
Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:
https://www.groundsure.com/terms-and-conditions-feb11-2019

Appendix 4 – Water Features Survey

Water Features Survey - Introduction

A water features survey (WFS) was completed on 12th August 2019 and all responses received up until 22nd August are recorded. The survey combined visits to all properties within the survey radius shown in the figure below.



Water Features Survey - Survey method

A household visit was completed and the survey and presence of water features discussed directly where possible. Where no resident was available a WFS letter was left at the property outlining the purpose of the survey. This was accompanied with a data request form and a map for return by email or post. The letter requested a response by 19th August 2019, stated as a week after the survey was undertaken.

Water Features Survey - Results

Individual properties

Water features at individual properties were identified using aerial photography and mapping are stated in the main body of this report. The results of the physical survey are outlined below.

No water features were identified at properties visited and no responses identifying additional water features were received by 22nd August from letters dropped to individual properties.

Outside of the search area, a well is shown on mapping located to the south of the Sor Brook and to the southwest of Cwrt Perrott abstraction borehole either in the boundary of the Farmers Arms pub or Beech Cottage. A discussion was held with the landlord of the Farmers Arms and a letter response from the occupant of Beech Cottage has confirmed no knowledge of this well. It must be assumed that this is therefore disused and/or backfilled.

A further well was identified as being unused and capped at Bell House with Brodawel. This is also outside the radius of search and the approximate location is marked on the above figure.

The following properties within the radius of search were visited and the responses received recorded below. For completeness a number of additional letters were also dropped at properties just outside of the radius of search.

Address	Survey method	Response
Grey Squirrels.	Letter drop	Reply received. No water features.
Forge House.	Letter drop	Reply received. No water features.
Forge Cottage.	Spoke to builder renovating property	House uninhabited and under renovation. No water features known.
1 Cwrt Perrott Cottages.	Letter drop	No Reply. Assumed no Water Features.
2 Cwrt Perrott Cottages.	Letter drop	No Reply. Assumed no Water Features.
3 Cwrt Perrott Cottages.	Letter drop	No Reply. Assumed no Water Features.
Mundy Cottage	Letter drop	Reply received. No water features.
Gobaith Newydd.	Letter drop	Reply received. No water features.
Ty-Isha Cottage.	Letter drop	No Reply. Assumed no Water Features.
Ty Bach.	Letter drop	No Reply. Assumed no Water Features.
St Tegfedd's Church.	Letter drop to keyholder at Ty Bach	No water features identified in walkover of churchyard.
Shop Cottage.	Spoken to householder	No abstraction water features identified. Letter response received to say Sor Brook runs through property.
Brook Cottage.	Letter drop	No Reply. Assumed no Water Features.

Surface Water Features

The only surface water feature identified within the radius of search is the Sor Brook. The width of the brook varies but is approximately 3-5m wide within the survey zone and water level was variable but broadly between 0.2 and 0.4m deep at the time of the survey.

Flow in the brook at the road bridge (at the point marked “weir” on the map above) was estimated using a field velocity area method. Assuming a channel width and depth of 3.7 and 0.3m respectively, considering flow over a distance of 5.5m, at 15:30 on 12th August, estimated discharge in the brook to be of the order of 300 litre/second.

A mapped drain was identified outside of the search radius to the northwest of the abstraction borehole and a small unnamed tributary of the Sor Brook to the southeast, again outside of the radius of search. These were both visited for completeness however.

The drain feature was inaccessible due to the steepness of the cutting but flow from a small spring at the head of the drain was noted from the top of the embankment. This runs as surface water south through the area of plantation noted on the map, eventually recharging to ground at the southern end of the plantation.

The small unnamed tributary to the east is a shallow feature with a low flow, running along the western boundary of the Cwrt Perrott land. This tributary flows south to meet with the Sor Brook.

Abstraction borehole at Cwrt Perrott Farm

The abstraction borehole was installed a number of years ago and there are limited records on construction. Construction details are outlined in the WRC application form as measured during the WFS.

The rest groundwater level was dipped at approximately 22.67mbd or 23.17mbgl. The datum is the top of the casing. This is in turn 0.5m below ground level. Due to an issue with the well dipper an accurate pumped water level could not be obtained although this was estimated to be between 27 and 28mbgl. More accurate data would be collected during the pumping test.

The photographs below show the borehole and flow meter arrangement. The flow meter provides flow reading of 1 litre resolution. The depth of the pump has not been established.

Appendix 5 Pumping Test Data and Calculations

CONSTANT RATE TEST

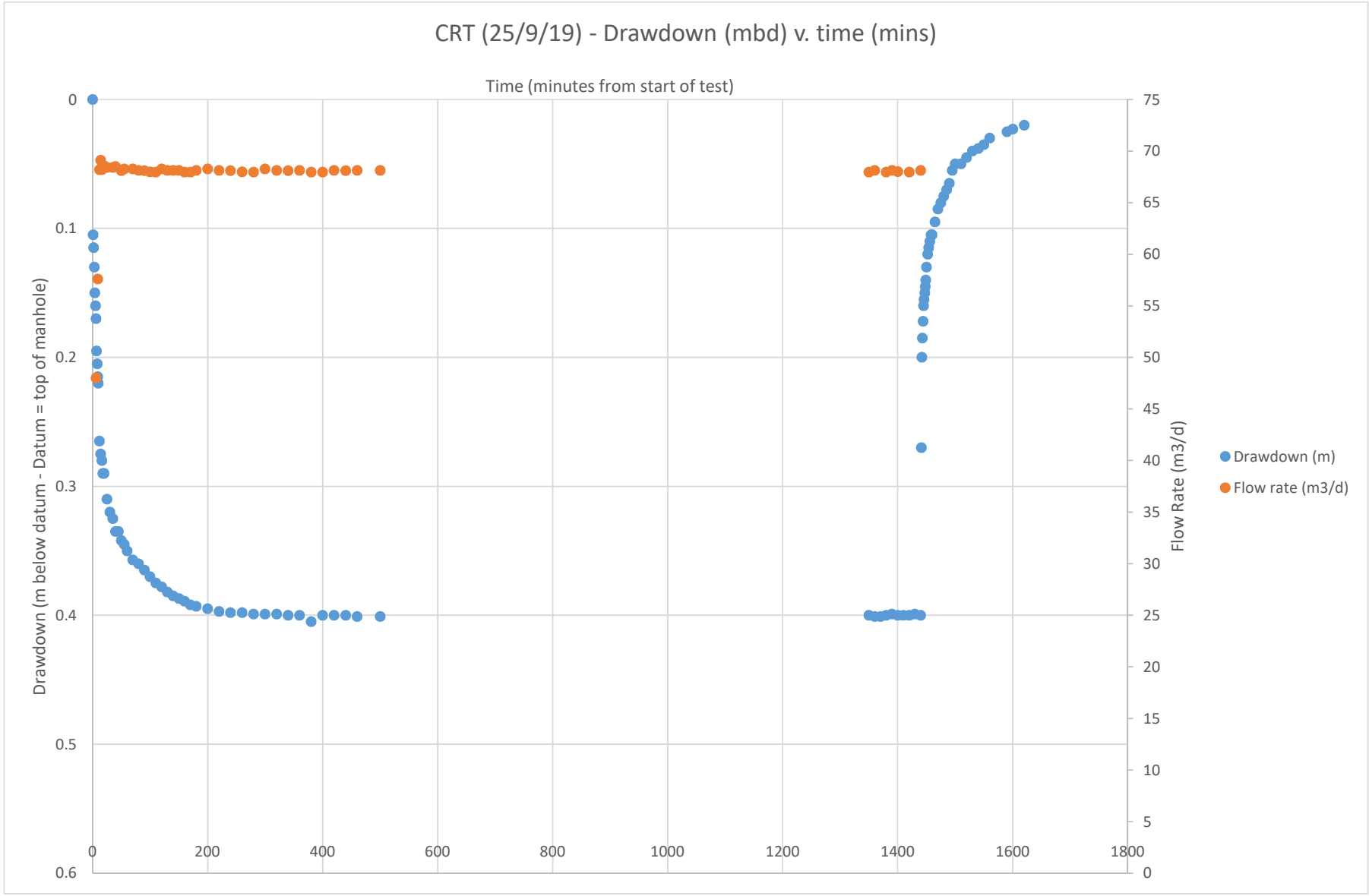
Rest water level (mbd) 23.28 Datum = top of manhole cover

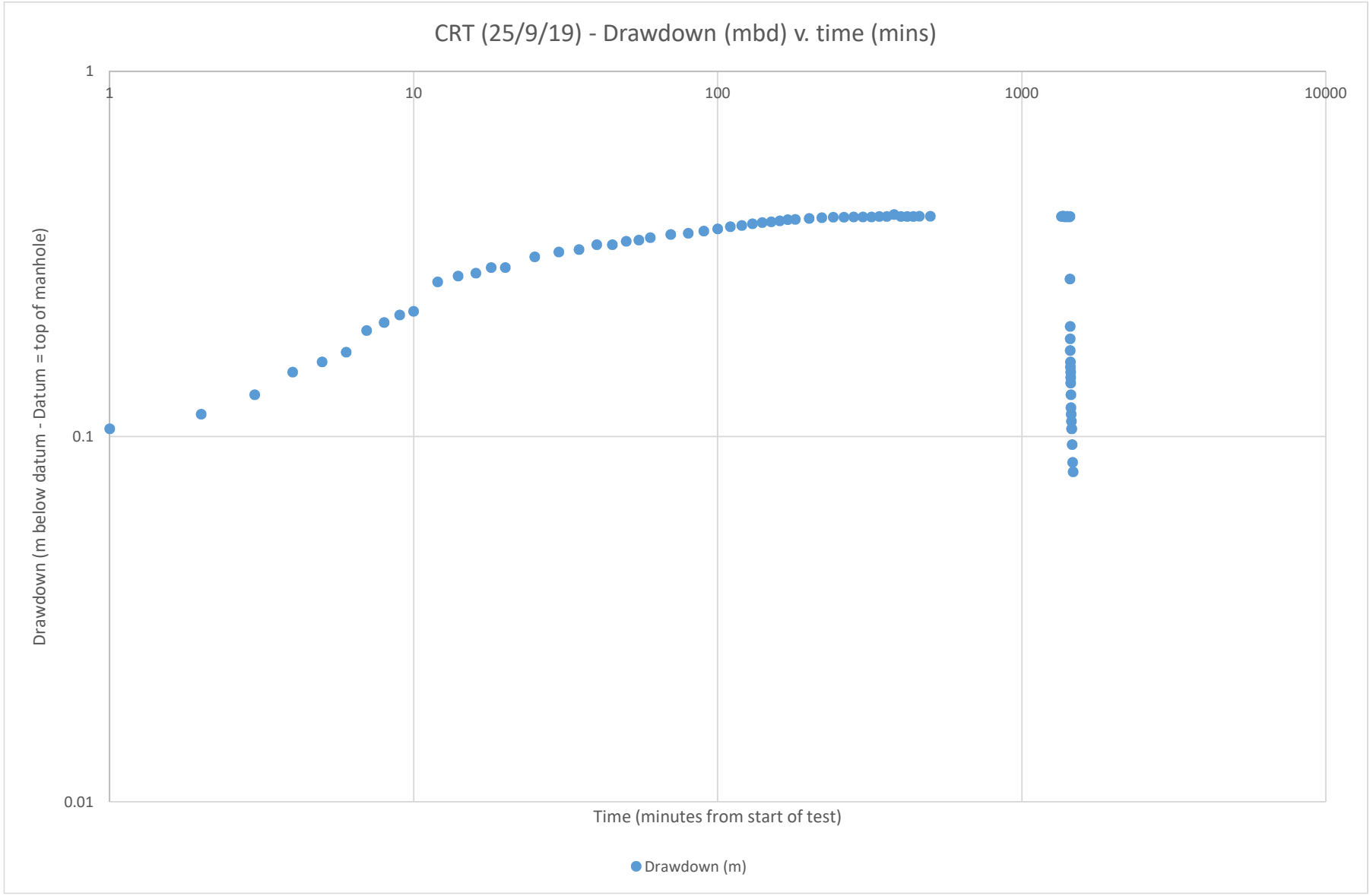
Time since start of test	Groundwater level (mbd)	Drawdown	Flow m3	Discharge reading (m3)
0	23.28	0		2748.1876
1	23.385	0.105		
2	23.395	0.115		
3	23.41	0.13		
4	23.43	0.15		
5	23.44	0.16		
6	23.45	0.17	48	
7	23.475	0.195		
8	23.485	0.205		
9	23.495	0.215	57.6	
10	23.5	0.22		
12	23.545	0.265	68.2	
14	23.555	0.275	69.12	
16	23.56	0.28	68.2	
18	23.57	0.29		
20	23.57	0.29	68.57	
25	23.59	0.31	68.4	2749.237
30	23.6	0.32		
35	23.605	0.325	68.4	2749.712
40	23.615	0.335	68.5	2749.95
45	23.615	0.335		
50	23.622	0.342	68.1	2750.423
55	23.625	0.345	68.26	2750.66
60	23.63	0.35		
70	23.637	0.357	68.26	2751.371
80	23.64	0.36	68.11	2751.844
90	23.645	0.365	68.1	2752.317
100	23.65	0.37	67.97	2752.789
110	23.655	0.375	67.96	2753.261
120	23.658	0.378	68.26	2753.735
130	23.662	0.382	68.11	2754.208
140	23.665	0.385	68.11	2754.681
150	23.667	0.387	68.11	2755.154
160	23.669	0.389	67.97	2755.626
170	23.672	0.392	67.97	2756.098
180	23.674	0.393	68.11	2756.571
200	23.675	0.395	68.26	2757.936
220	23.676	0.397	68.11	2759.298
240	23.677	0.398	68.1	2760.660
260	23.677	0.398	67.97	2762.020
280	23.678	0.399	67.96	2763.379
300	23.679	0.399	68.26	2764.744
320	23.678	0.399	68.11	2766.106
340	23.68	0.4	68.10	2767.468
360	23.68	0.4	68.11	2768.831
380	23.681	0.405	67.97	2770.190
400	23.683	0.4	67.97	2771.549
420	23.684	0.4	68.11	2772.912
440	23.682	0.4	68.10	2774.274
460	23.683	0.401	68.11	2775.636
500	23.681	0.401	68.11	2778.360
1350	23.68	0.4	67.97	
1360	23.681	0.401	68.11	
1370	23.681	0.401		
1380	23.68	0.4	67.97	
1390	23.679	0.399	68.11	
1400	23.68	0.4	68.00	2814.178
1410	23.682	0.4		
1420	23.682	0.4	67.97	2815.122
1430	23.679	0.399		

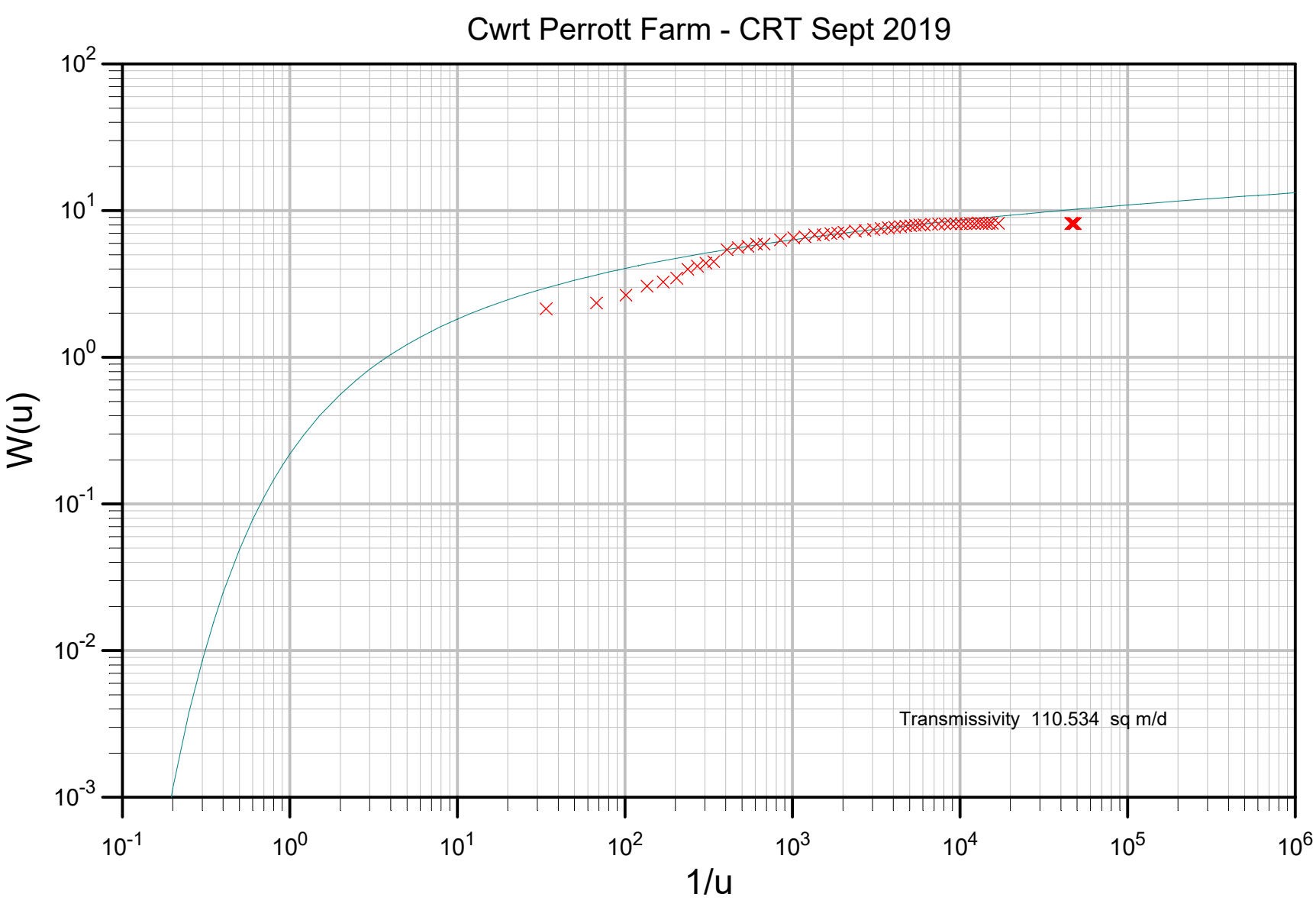
CONSTANT RATE TEST

Rest water level (mbd) 23.28 Datum = top of manhole cover

Time since start of test	Groundwater level (mbd)	Drawdown	Flow m3	Discharge reading (m3)	
1440	23.68	0.4	68.11	2816.068	Recovery remaining
1441	23.55	0.27			67.50%
1442	23.48	0.2			50.00%
1443	23.465	0.185			46.25%
1444	23.452	0.172			43.00%
1445	23.44	0.16			40.00%
1446	23.435	0.155			38.75%
1447	23.43	0.15			37.50%
1448	23.425	0.145			36.25%
1449	23.42	0.14			35.00%
1450	23.41	0.13			32.50%
1452	23.4	0.12			30.00%
1454	23.395	0.115			28.75%
1456	23.39	0.11			27.50%
1458	23.385	0.105			26.25%
1460	23.385	0.105			26.25%
1465	23.375	0.095			23.75%
1470	23.365	0.085			21.25%
1475	23.36	0.08			20.00%
1480	23.355	0.075			18.75%
1485	23.35	0.07			17.50%
1490	23.345	0.065			16.25%
1495	23.335	0.055			13.75%
1500	23.33	0.05			12.50%
1510	23.33	0.05			12.50%
1520	23.325	0.045			11.25%
1530	23.32	0.04			10.00%
1540	23.318	0.038			9.50%
1550	23.315	0.035			8.75%
1560	23.31	0.03			7.50%
1570					
1580					
1590	23.305	0.025			6.25%
1600	23.303	0.023			5.75%
1610					
1620	23.3	0.02			5.00%


CRT (25/9/19) - Drawdown (mbd) v. time (mins)
Time (minutes from start of test)
Drawdown (m below datum - Datum = top of manhole)
Flow Rate (m3/d)
0
0.1
0.2
0.3
0.4
0.5
0.6
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200
1400
1600
1800
Drawdown (m)
Flow rate (m3/d)


CRT (25/9/19) - Drawdown (mbd) v. time (mins)
1
0.1
0.01
1
10
100
1000
10000
Drawdown (m below datum - Datum = top of manhole)
Time (minutes from start of test)
Drawdown (m)


Cwrt Perrott Farm - CRT Sept 2019
W(u)
1/u
Transmissivity 110.534 sq m/d

JH Groundwater Ltd
Hydrogeological Solutions
www.jhgroundwater.co.uk

Project	Cwrt Perrott Farm	**Project No.**	1164
Calculation Title	Hydraulic Capture Zones	**Sheet No.**	1 of 1
Calc By	JPH	**Date**	27/09/2019
Checked By	JPH		

Parameter		**Value**	**Unit**	**Justification**
Qa	Abstraction rate	50	m3/d	Abstraction rate required for farm
Qr	Flow in Sor Brook	300	l/s	Flow in Sor Brook
TOTAL CATCHMENT	Recharge	310	mm/a	Effective precipitation minus SPR (30%) calculated from IH126 method for MORECS square 156 (1961-90).
Catchment radius	**(ZoC)**	**137**	**m**	Calculated to be circular but will be elongated up gradient
ABSTRACTION PERCENTAGE OF TOTAL CATCHMENT				
Catchment area to Sor Brook		18140000	m2	Catchment area for Sor Brook (FEH web service)
Catchment area of borehole abstraction		58852	m2	Calculated above
Fraction of abstraction total catchment		**1: 308**		Calculated from total and abstraction catchments
Fraction of abstraction total catchment		**0.32%**		

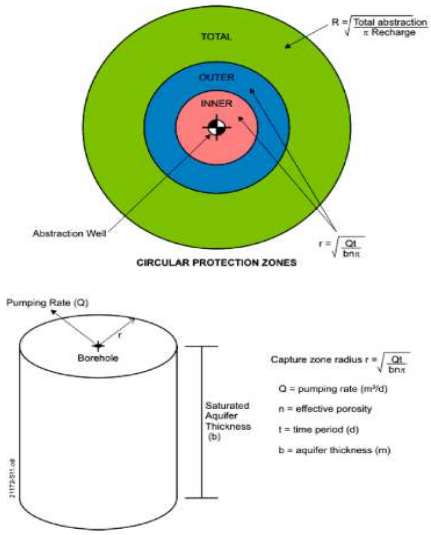


Figure 6.1 Protection zone delineation using volumetric flow method

From: Environment Agency, 2009. Groundwater Source Protection Zones – Review of Methods. Integrated catchment science programme. Science report: SC070004/SR1.

Without information on the direction of groundwater flow, hydraulic capture zones may be assumed to be circular with radii calculated as illustrated in Figure 6.1. But where the zones intersect boundaries (faults, edge of outcrop, etc.), these are used to define the limits of the SPZ and the radius of the circle is increased to give the correct area.

These manual calculations make a number of gross simplifying assumptions regarding the nature of the aquifers. However, they have been found to be useful in giving a rapid indication of the size of SPZs in situations where more complex calculations are inappropriate.

THEIS WELL FUNCTION

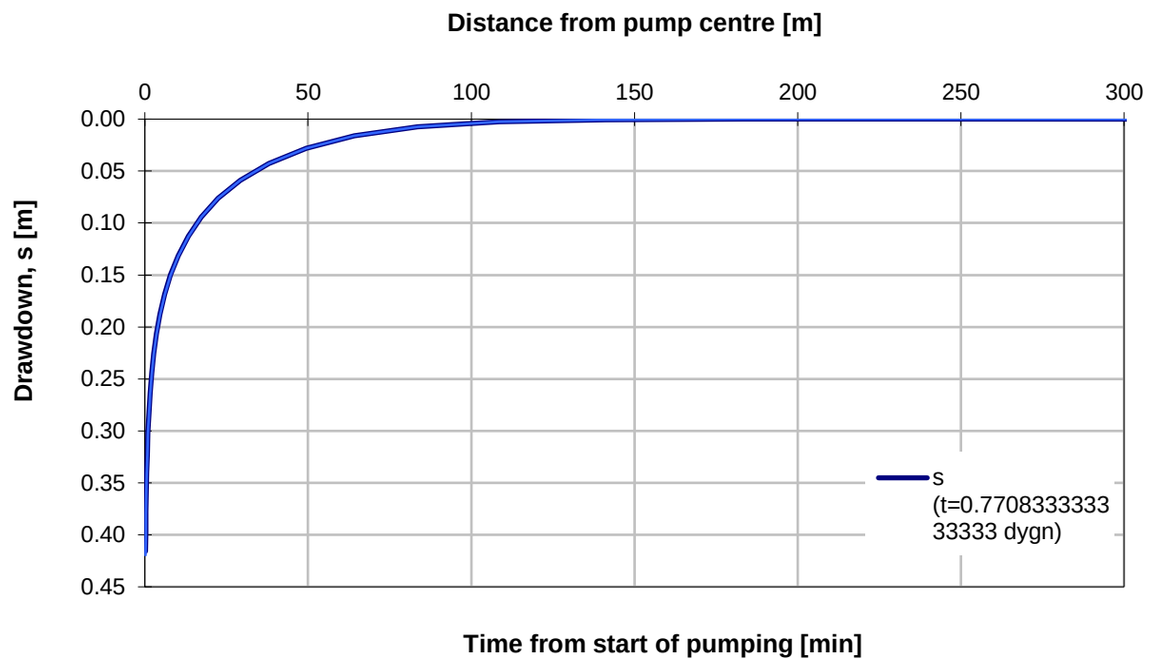
Inputs

Q	0.0005787	m^3/s	
Q	0.58	l/s	dygn
T	1.3E-03	m^2/s	m
S	5.0E-02	-	
ho	23.28	m	
t	0.7708333	days	
r	160	m	
Multiple, r:	1.3		
Multiple, t:	1.24		

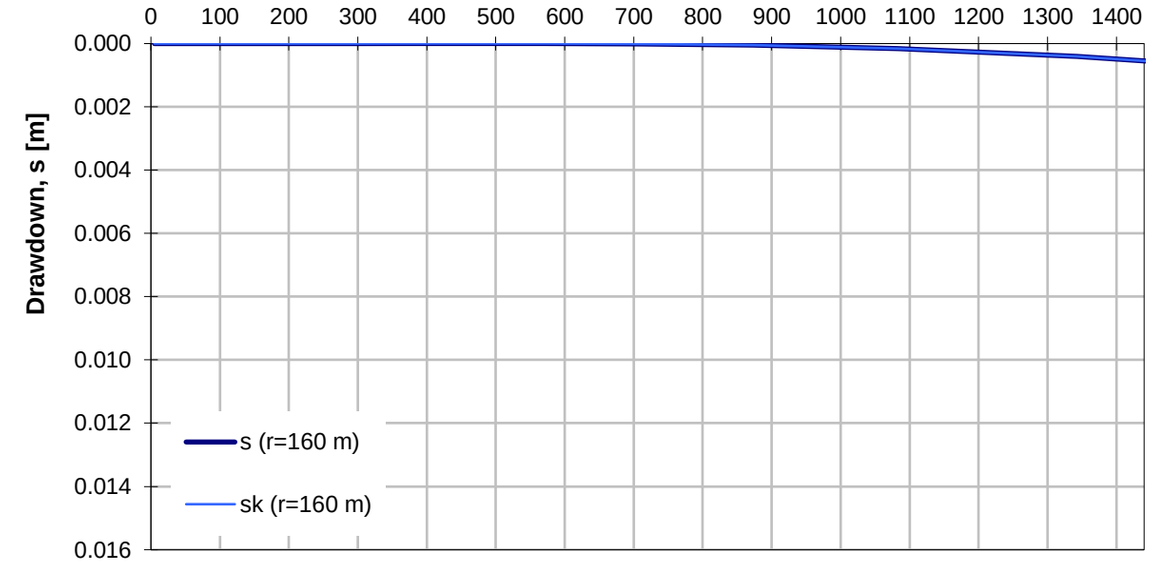
$$s = \frac{Q}{4\pi T} W(u)$$

$$W(u) = \int_u^{\infty} \frac{e^{-x}}{x} dx$$

$$u = \frac{r^2 S}{4Tt}$$



Corrected drawdown for unconfined aquifer



References: Moreau, M.; Cameron, S.; Daughney C.; Gusyev, M.; Tschritter, C. (2014). Envirolink Tools Project - Capture Zone Delineation – Technical Report, GNS Science Report 2013/57. 98p.

Please enter your data below

Arbitrary fixed radius AFR (m)	
Yield (m3/d)	50
Recharge rate (mm/d)	0.849
Effective porosity (unitless)	0.05
Time of travel - TOT (years)	365
Aquifer thickness (m)	15
Hydraulic conductivity (m/d)	7
Hydraulic gradient (m/m)	0.005

Capture / Protection zone dimension

Circular capture zone using the Recharge equation
Radius (m) 137

Area of Capture Zone
Area (m2) 58893

Circular protection zone using the Calculated Fixed Radius (CFR) equation
Radius (m) 1681

Uniform Flow Equation (UFE), the groundwater gradient is assumed to be along the y-axis, from right to left.
Stagnation point (m downgradient from the well) -15.2
Maximum half-width (m) 47.6
Capture zone max. width (m) 95.2